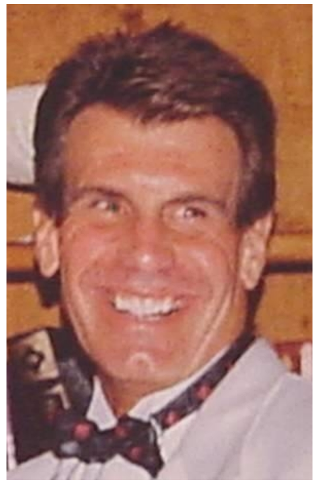
REGIONAL HAZE STATE IMPLEMENTATION PLAN FOR THE STATE OF ARIZONA

Air Quality Division
Arizona Department of Environmental Quality

December 23, 2003

Acknowledgement



Greg Witherspoon
(July 4, 1948 – December 24, 2001)

Greg Witherspoon committed his professional career to the advancement of balanced environmental policies and programs in Arizona. He worked at the Salt River Project for over 20 years as a Principal Environmental Scientist. In this capacity, he was engaged in numerous environmental matters affecting power utilities and Arizona's natural resources.

Among his many duties at SRP, Greg was actively involved in advancing air quality policies that would protect the public's enjoyment of the spectacular scenery in Arizona's national parks and wilderness areas. Greg participated in several technical committees to support the work of the Grand Canyon Visibility Commission in addressing regional haze visibility impairment in the Grand Canyon National Park and other Class I areas on the Colorado Plateau. He worked with other stakeholders throughout the west to advance technical and regulatory policies necessary to achieve long-term reductions of visibility impairing emissions. Greg was a champion of market based emission reductions as the vehicle for achieving air quality goals in the most cost effective manner. Greg was the consummate professional throughout the stakeholder process. He came to meetings thoroughly prepared. He readily shared his expertise and valued the input of others. He sought to build consensus among all the stakeholders throughout the process. Greg was instrumental in helping Arizona decide to base its Regional Haze State Implementation Plan on the program conceived by the Grand Canyon Visibility Commission and developed by its successor organization, the Western Regional Air Partnership.

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EXECUTIVE SUMMARY

This Arizona State Implementation Plan (SIP) addresses the requirements of Title 40 of the Code of Federal Regulations, Part 51, Subpart P – Protection of Visibility (40 CFR 51.300-307, and 309). The SIP describes the programs that the State will rely upon to make reasonable progress toward "preventing any future and … remedying any existing impairment of visibility" in the large parks and wilderness areas in Arizona and those in other states that may be affected by pollution generated in Arizona (Class I areas). The federal regional haze rules require states to develop and submit SIPs for improving visibility through the year 2018 that make reasonable progress toward achieving "natural visibility conditions" by the year 2064. This SIP is designed to adopt the basic visibility program that addresses impairment of visibility that can be traced to older major industrial sources and implements recommendations adopted by the Grand Canyon Visibility Transport Commission (GCVTC) in its 1996 report to EPA. The Western Regional Air Partnership (WRAP) is the successor organization to GCVTC, and, in addition to being chartered to implement the GCVTC's recommendations, provides the mechanism for states and tribes to coordinate efforts and pool resources to conduct the complex technical analyses necessary to develop the science that is part of the foundation of regional haze SIPs. Arizona State government officials and employees and a variety of Arizona stakeholders actively participate in WRAP committees and workgroups to direct the policy and technical products of the WRAP. As such, this SIP revision relies on much of the work conducted by WRAP staff and contractors.

Chapters 1 through 4 of this SIP include introductory and background information about visibility protection and regional haze. Chapter 5 is the plan for implementation of the rules and regulations addressing reasonably attributable visibility impairment, in addition to monitoring, planning, and new source review requirements under 40 CFR 51.300-307. Chapters 6 through 17 include Arizona's approach to meeting the requirements for developing long-term visibility improvement strategies for regional haze under 40 CFR 51.309. Chapter 18 summarizes the public participation process in developing this SIP as required under 40 CFR 51.102.

Table ES-1 summarizes the requirements in 40 CFR 51.302-307 for reasonably attributable visibility impairment, the approach taken by the State of Arizona to address the requirements, and the chapter in this SIP addressing the requirements.

Table ES-1. Requirements for Reasonably Attributable Visibility Impairment Under 40 CFR 51.302 through 307

Requirements of	Summary of Approach, Content, or Findings	Chapter in SIP
40 CFR 51.302 Implementation control strategies for reasonably attributable visibility impairment.	Arizona has promulgated regulations in 2003 to address the implementation of controls, as needed, for sources subject to the best available retrofit technology requirements of the 1977 Clean Air Act for reasonably attributable visibility impairment (RAVI).	5.1
40 CFR 51.303 Exemptions from control.	Arizona has incorporated into the Arizona RAVI rule the necessary provisions to address the petition of BART emissions limits to the EPA Administrator.	5.2
40 CFR 51.304 Identification of integral vistas.	No integral vistas were identified for the Class I areas on the Colorado Plateau addressed by this SIP or the other Additional Class I areas in Arizona.	5.3

Requirements of 40 CFR 51.3XX	Summary of Approach, Content, or Findings	Chapter in SIP
40 CFR 51.305 Monitoring for reasonably attributable visibility impairment.	Arizona established a comprehensive visibility monitoring program for the Class I areas and other transport sites in 1996. Arizona is an associate member of the IMPROVE Steering Committee and ensures information from the Arizona network is submitted as required, and participates in the technical leadership of the overall IMPROVE program.	5.4
40 CFR 51.306 Long-term strategy requirements for reasonably attributable visibility impairment.	Arizona has included in the SIP comprehensive long-term strategy components to address regional haze visibility impairment and RAVI from BART eligible sources.	5.5
40 CFR 51.307 New source review.	Arizona's R18-2-410 (Article 4, New Source Review, Arizona Administrative Code) address requirements of new sources to meet performance standards to assure emissions will not have an impact on visibility.	5.6

Table ES-2 summarizes the requirements in 40 CFR 51.309 for regional haze, the approach taken by the State of Arizona to address the requirements, and the chapter in this SIP addressing the requirements.

Table ES-2. Summary of Requirements for Regional Haze Visibility Impairment Under 40 CFR 51.309

Requirement of 40 CFR 51.309	Summary of Approach, Content, or Findings	Chapter in SIP
(d)(1) Time Period Covered	This SIP addresses reasonable progress at the Class I areas on the Colorado Plateau from December 31, 2003 through December 31, 2018.	1.1
(d)(2) Projection of Visibility Improvement	Projected emissions and estimated visibility changes for each of the Class I areas on the Colorado Plateau were performed by the Western Regional Air Partnership (WRAP).	Ch. 14
(d)(3) Treatment of Clean Air Corridors	The only Clean Air Corridor for the Class I areas on the Colorado Plateau does not include any area within Arizona. Arizona will include the results of future analyses in its periodic plan revisions.	Ch. 6
(d)(4), (f), and (h) Implementation of Stationary Source Reductions	General stationary source requirements are contained in Chapter 7. Chapter 8 contains a description of the SO_2 Milestone and Backstop Trading Program.	Ch. 7 (general) Ch. 8 (SO_2)
(d)(5) Mobile Sources	Federal programs (such as low sulfur diesel, engine standards, etc.) are identified and describe mobile source emissions throughout the planning period.	Ch. 9

Requirement of 40 CFR 51.309	Summary of Approach, Content, or Findings	Chapter in SIP
(d)(6) Programs Related to Fire	Arizona revised its open burning and smoke management regulations (A.A.C. R18-2-602 and A.A.C R18-2-1501 - 1515) to address the federal requirements.	Ch. 10
(d)(7) Area Sources of Dust Emissions From Paved and Unpaved Roads	WRAP's analysis concluded dust emissions from paved and unpaged roads are currently not a significant regional contributor to visibility impairment within the Colorado Plateau 16 Class I areas. Arizona will continue to support further research on this issue, as it develops its periodic plan revisions under 40 CFR 51.309(d)(10).	Ch. 11
(d)(8) Pollution Prevention	Programs and policies within Arizona related to renewable energy and energy efficiency are described.	Ch. 12
(d)(9) Additional Recommendations	The status of implementation of other strategies and options in the Grand Canyon Visibility Transport Commission Report are summarized. In addition, an overview of sources in and near each Arizona GCVTC Class I area is included.	Ch. 13
(d)(10) Periodic Revisions	Arizona will submit periodic plan revisions to this SIP in 2008, 2013 and 2018.	Ch. 16
(d)(11) State Planning and Interstate Coordination	Arizona has and will continue to participate in the WRAP. As periodic plan revisions are done, consultation will also be made with states and tribes not implementing 40 CFR 51.309.	Ch. 15
(f)(4) **Geographic Enhancement**	WRAP has developed a model MOA to be executed by Arizona and Federal Land managers to address geographic enhancement of the regional haze SO_2 Milestone and Backstop Trading Program (Ch. 8) for reasonably attributable visibility impairment.	Ch. 8 in 8.5
(g) Reasonable Progress for Additional Class I Areas	**A supplement to this plan revision to address regional haze at the Additional 8 Class I areas in Arizona will be developed in accordance with 40 CFR 51.309(g)(2-3) and submitted by December 31, 2008.**	Ch. 17

While the above tables are organized in the order of the provisions of the regional haze rule, the SIP itself is organized according to the logic of pollution control plans. Consequently, the chapters of the SIP do not correspond precisely to the order of the requirements in the regional haze rule.

Finally, the Technical Support Document (TSD) developed by the Western Regional Air Partnership (WRAP) is a reference for this SIP (herein referred to as the "WRAP TSD").

1. BACKGROUND

1.1. Introduction

Good visibility is important to fully enjoy the experience of visiting the State's and Country's national parks and wilderness areas. Visibility is how far and how well a person can see, and can be reduced or impaired by light scattering and absorption caused by particulate matter and gases in the atmosphere that occur from both natural and human-caused activities. Visibility impairing natural sources may include rain, wildland fires, volcanic activity, and wind blown dust. Visibility also can be impaired by human-caused sources of air pollution such as industrial processes, (utilities, smelters, refineries, etc.), mobile sources (cars, trucks, trains, etc.) and area sources (residential wood burning, prescribed burning, agricultural activities, wind blown dust from disturbed soils, etc.)

Congress established a program to protect visibility in the larger national parks and wilderness areas which referred to as the mandatory Class I Federal areas (herein referred to as "Class I areas"). The State of Arizona is submitting this SIP to address the requirements (40 CFR 51.300-307) for visibility protection in the Class I areas and remove the existing Federal Implementation Plan (FIP) (52 FR 45132, November 24, 1987). This SIP also fulfills the requirements under 40 CFR 51.309 for Arizona's 4 Colorado Plateau Class I areas in addition to the other 12 Class I areas studied by the Grand Canyon Visibility Transport Commission (GCVTC). It contains all necessary measures to address reasonably attributable visibility impairment and regional haze visibility impairment necessary to ensure the State of Arizona makes reasonable progress toward the national goal for visibility contained in 42 U.S.C. 7491 (Clean Air Act), specifically "...the prevention of any future, and remedying of any existing impairment of visibility in mandatory Class I Federal areas, which impairment results from man-made air pollution." The Regional Haze Rule (RHR) defines this goal as achieving natural visibility conditions by 2064. This SIP addresses reasonable progress toward the national goal for the planning period from December 31, 2003 thorough December 31, 2018.

1.2. Definitions

This SIP duplicates terms and phrases defined in 40 CFR 51.301, 40 CFR 51.309(b), and other terms specific to the programs set forth in this Plan. These definitions are contained in Appendix A-1a of this SIP.

1.3. 1977 Clean Air Act

In the 1977 Clean Air Act (CAA), Congress established requirements for the prevention of significant deterioration of air quality in areas within the United States and for the review of pollution controls on new sources.[1] Coupled with this, Congress established a visibility protection program and the national goal (Section 169A) for larger national parks and wilderness areas.[2] The visibility protection program also requires states to address any visibility impairment caused by emissions of air pollutants from certain large industrial sources if the source was less than 15 years old as of August 1977, through the establishment of emission limits based on best available retrofit technology (BART). Congress also

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[1] *Clean Air Act Amendments of 1977*, United States Congress. 42 U.S.C. 7470-7479. Government Printing Office: Washington, D.C. August 7, 1977.

[2] *Clean Air Act Amendments of 1977, Section 169A*, United States Congress. 42 U.S.C. 7491. Government Printing Office: Washington, D.C. August 7, 1977.

established mandatory criteria for states to use when establishing BART emission limits and developing long-term strategies for reasonable progress toward the national goal.

1.4. Reasonably Attributable Visibility Impairment

In 1980, the United States Environmental Protection Agency (EPA) issued final regulations to address the requirements of the 1977 Clean Air Act, requiring states with Class I areas to submit State Implementation Plan (SIP) revisions with new source review plans, monitoring plans, BART implementation plans, and long-term strategies to address reasonable progress toward the national visibility goal.[3] Arizona did not submit a SIP to address visibility, and in 1987 (52 FR 45132) EPA issued a Federal Implementation Plan.

1.5. 1990 Clean Air Act

Although the 1980 regulations addressed reasonably attributable visibility impairment from specific sources, also know as plume blight, it did not adequately address visibility impairment from large collections of sources whose emissions are mixed and transported over long distances, creating a uniform haze (regional haze). In the 1990 amendments to the Clean Air Act (CAA), Congress established the requirements to address regional haze visibility impairment, giving the EPA authority to establish visibility transport commissions and promulgate regulations to address regional haze, and requiring the establishment of a visibility transport commission to investigate and report on regional haze visibility impairment in the Grand Canyon National Park located in northern Arizona.[4]

The Regional Haze SIP meets the requirements of Section 110, Implementation Plans, of the CAA. Demonstration of the public review process can be found in Chapter 18 and its related Appendix. Information to satisfy Section 110(a)(2)(E), adequate personnel to carry out such an implementation plan, can be found in Appendix A-1b).

1.6. Grand Canyon Visibility Transport Commission

In response to the 1990 CAA, the Grand Canyon Visibility Transport Commission (GCVTC) was established in November 1991. Membership evolved over the approximately four and one-half years of its activities. When the GCVTC issued recommendations to EPA in June 1996, membership consisted of eight western governors (or their designees), four western tribal leaders, five ex-officio members representing federal land management agencies, an ex-officio tribal representative, and EPA. The transport region studied by the GCVTC consisted of nine western states: Arizona, California, Colorado, Idaho, New Mexico, Nevada, Oregon, Utah, and Wyoming. Arizona's Governor Symington chaired the GCVTC. The GCVTC members agreed to expand the scope of technical and policy studies to include all 16 of the Class I areas on the Colorado Plateau. The GCVTC elected to use a stakeholder-driven process to accomplish its objectives to review current science and policy information and determine what actions, if any, were needed to address regional haze visibility impairment at the Class I areas on the Colorado Plateau. Ultimately, the organization included over 200 political, policy and technical stakeholders, who staffed a variety of committees and subcommittees. The GCVTC was funded by EPA grants and contributions from stakeholders, including substantial in-kind labor. The GCVTC submitted its recommendations to EPA in June 1996.[5] The major recommendations of the GCVTC included:

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[3] *40 CFR Part 51 - Protection of Visibility,* United States Environmental Protection Agency, 45 FR 80089. Government Printing Office: Washington, D.C. December 2, 1980.

[4] *Clean Air Act Amendments of 1990, Section 169B,* United States Congress. 42 U.S.C. 7492. Government Printing Office: Washington, D.C. November 15, 1990.

[5] *Recommendations for Improving Western Vistas,* Grand Canyon Visibility Transport Commission; Western Governors' Association: Denver, CO, June 10, 1996.

- The need to promote energy conservation, energy efficiency and renewable energy production;
- The need to track emissions growth that may affect air quality in clean air corridors;
- The need to manage emissions of stationary sources of sulfur dioxide with a voluntary program using emission reduction milestones coupled with a backstop cap-and-trade program that would be implemented if emissions reductions milestones were exceeded.
- The need to cooperate and work with federal land managers to do further studies of sources in and adjacent to Class I areas;
- The need to manage emissions of mobile sources through the implementation of more stringent national engine and fuel standards;
- The need to manage emissions of mobile sources from large urban areas that contribute significantly to visibility impairment in any of the 16 GCVTC Class I areas;
- The need to analyze the contribution of road dust emissions on visibility in the Class I areas;
- The need to promote programs to encourage emissions reductions in Mexico;
- The need to manage the visibility impacts resulting from the growth of emissions from prescribed fires needed to restore the ecosystem; and,
- The need to establish a successor organization to the GCVTC to oversee, promote, and support the GCVTC's recommendations.

1.7. Western Regional Air Partnership

The GCVTC's successor, the Western Regional Air Partnership (WRAP) was formed in September 1997. Though the WRAP's charter allows it to address any air quality issue of interest to WRAP members, its current work is focused on developing the policy and technical work products needed by states and tribes for regional haze SIPs or Tribal Implementation Plans (TIPs). Figure 1-1 shows the WRAP region.

The WRAP Board is composed of representatives from 13 states, 13 tribes, the US Department of Agriculture, the US Department of the Interior, and EPA. The WRAP operates on a consensus basis and conducts business through stakeholder-based technical and policy groups charged with assisting the development of regional haze work products. Additional information about the WRAP can be found at http://www.wrapair.org.

1.8. 1999 Regional Haze Rule

EPA proposed regional haze regulations in 1997.[6] The proposed regulations described a national program but did not include provisions to address the recommendations of the GCVTC. The Western Governors' Association (WGA) subsequently developed a recommendation related to the Colorado Plateau area and submitted it to EPA in June 1998.[7] Based on this and other comments, EPA issued the final regional haze rule in July 1999. In addition to the national program that could apply to any state or tribe and the final rule contained requirements for an optional program relying on the work of the GCVTC.[8]

1.9. 2002 Annex Rule for Stationary Sources of Sulfur Dioxide

One of the requirements of the RHR was the development and submission to EPA of a

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[6] *40 CFR Part 51 - Regional Haze Regulations; Proposed Rule - 62 FR 41138*. United States Environmental Protection Agency, Government Printing Office: Washington, D.C. July 31, 1997.

[7] Leavitt, M. O, Governor of Utah, Letter to EPA Administrator Browner on behalf of the Western Governors' Association, June 29, 1998.

[8] *40 CFR Part 51 - Regional Haze Rule; Final Rule, 64 FR 35714*. United States Environmental Protection Agency, Government Printing Office: Washington, D.C. July 1, 1999.

supplement or Annex to the GCVTC recommendations to define the program for stationary sources of sulfur dioxide by October 1, 2000. The WRAP established the Market Trading Forum (MTF) consisting of key stakeholders in the region to develop the Annex. The MTF analyzed the technical and policy issues surrounding the establishment of the voluntary emission reduction milestones with a backstop program to assure emission reductions were achieved and deliberated the content of the Annex.

Figure 1-1. Western Regional Air Partnership Region

The WRAP approved and submitted the Annex to the GCVTC recommendations to define a voluntary program of sulfur dioxide emission reduction milestones coupled with a backstop market-trading program to assure emission reductions on September 30, 2000. EPA proposed changes to the regional haze rule to incorporate the GCVTC Annex,[9] and the final rule was published in the Federal Register on June 5, 2003 (68 FR 33764).

1.10. <u>2003 Rule Change to Mobile Source Requirements for National Strategies</u>

The GCVTC developed long-term projections of emissions in the GCVTC transport region based on information available in the early 1990's. Those emission projections showed that emissions from mobile sources were expected to decline through approximately 2005 and then begin to increase through 2040. As a result, the GCVTC recommendations included recommended actions for national strategies, that were out of the control of the GCVTC, and local strategies. The local strategies included the concept of capping emissions from mobile sources in large urban areas that contribute significantly to visibility impairment in any of the 16 GCVTC Class I areas in the year 2005, or some other year that emissions reached its minimum levels. This strategy was adopted in the RHR in 40 CFR 51.309(d)(5)(ii) and (iii).

After the RHR was adopted, EPA promulgated several new emission and fuel standards for mobile sources. Emission projections developed by the WRAP demonstrated emissions from mobile sources would decline significantly through the entire planning period from 2003 through 2018, and possibly beyond. Each pollutant was expected to decline except for sulfur dioxide from off-road mobile sources unless pending rule making for fuel standards were promulgated by EPA. Given the significant reduction in emissions, the WRAP determined that the current requirement under 40 CFR 51.309(d)(5)(ii) and (iii) were no longer an effective management tool for mobile sources, and developed proposed changes to the RHR to address emissions from mobile sources.

In 2003, the WRAP formally requested that EPA make revisions to the mobile sources section of the Regional Haze Rule (40 CFR 51.309(d)(5)) to reflect changes in emissions due to federal programs developed since the rule was promulgated in 1999. The basis for the WRAP request was EPA's adoption of more stringent national vehicle emission and fuel standard that result in mobile source emissions declining throughout the region during the 2003-2018 planning period covered by plans being submitted in December 2003. EPA proposed changes to 40 CFR 51.309(d)(5) on July 3, 2003 (68 FR 39842 and 68 FR 39888). EPA held a hearing on October 7, 2003, on the proposed change and promulgated the final rule on December 22, 2003 (68 FR 71009).

9 *40 CFR Part 51 - Regional Haze Regulations; Proposed Rule, 67 FR 30418,* United States Environmental Protection Agency. Government Printing Office: Washington, D.C. May 6, 2002.

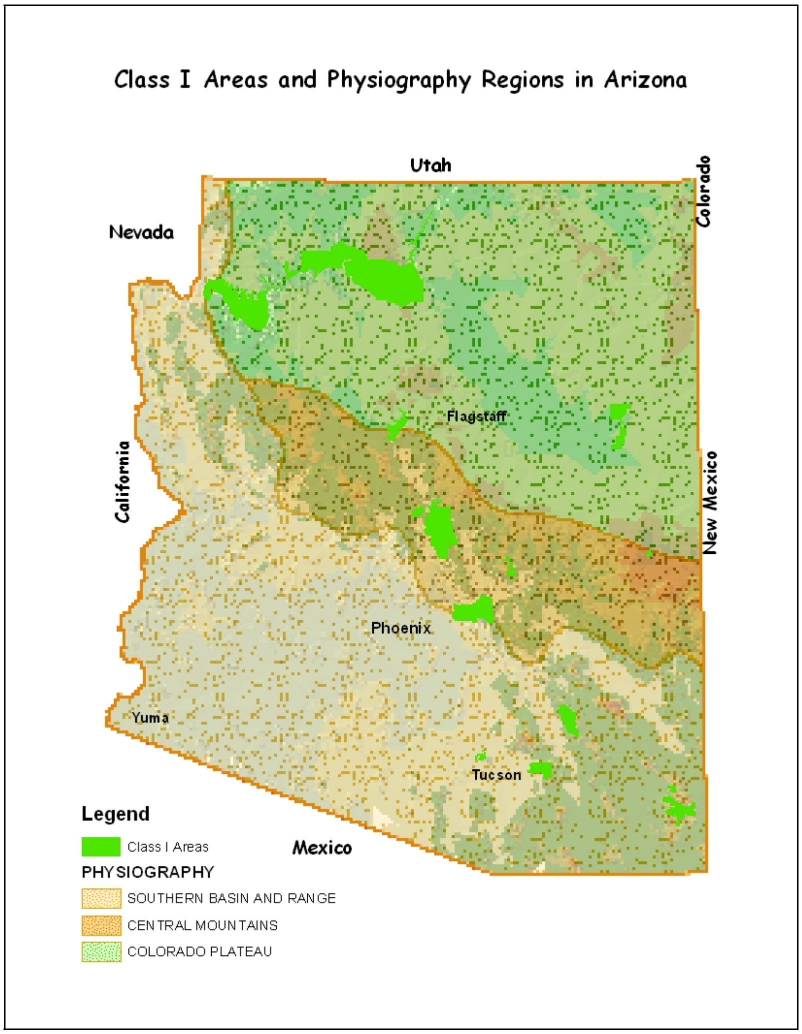
2. PHYSICAL, DEMOGRAPHIC, AND ECONOMIC DESCRIPTIONS OF ARIZONA

This section of the SIP provides an overview of the physical, demographic and economic characteristics, along with some history of the formation of the state. Appendix A-2a contains a bibliography of sources for the information presented in this chapter.

2.1. Climate and Physiography

Arizona encompasses nearly 114,000 square miles, ranging in elevation from 70 feet above sea level on the Colorado River at the Arizona-Mexico border, to 12,643 feet in the north at Humphreys Peak just north of Flagstaff. It contains four desert regions and hundreds of mountains, remnants of state's past volcanic activity. Arizona borders states of California and Nevada on the West, Utah on the North, Colorado to the Northeast, New Mexico on the East, and the country of Mexico to the South.

Figure 2-1. Class I Areas and Physiography Regions in Arizona



Arizona has three main topographical areas: 1) a high plateau in the northeast; 2) a mountainous region oriented southeast to northwest; and 3) low mountain ranges and desert valleys in the southwestern portion of the state. These regions bring a wide range of climate to the state with lows well below zero in the high plateau and mountainous regions of central and northern Arizona, while temperatures can exceed 125°F within the desert areas.

Precipitation throughout Arizona is governed by elevation and time of year, with the highest elevations averaging between 25 to 30 inches of precipitation annually. The desert southwest averages as low as three to four inches per year. The average number of days per year with measurable precipitation varies from near 70 days in the north (Flagstaff area) to 15 in the southwest (Yuma area). From November through March, storm systems from the Pacific Ocean cross the state, some bringing blizzard conditions to the high elevations. Summer rainfall begins early in July and usually lasts until mid-September. The moisture-bearing winds come from either the southwest (Gulf of California) or southeast (Gulf of Mexico), and during a wind shift called, "the North American Monsoon," large thunderstorms can occur in the mountainous regions on down through the central and southeastern portion of the state. Blowing dust prior to onset of rain can occur during these storms. Flash floods can also occur.

Approximately 70% of Arizona's land is owned and managed by the federal government and the 21 federally recognized Indian tribes. The state owns nearly 13%, leaving about 18% of the state land is under private ownership.

Arizona is host to some of the country's most spectacular and beloved national parks and wilderness areas. Of the 158 national parks and wilderness areas classified as mandatory Class I Federal areas, 12 are located in Arizona (40 CFR 81.403). Four of the 12 Arizona Class I areas are on the Colorado Plateau, the area of study by the GCVTC. A list of all 16 Class I areas that were part of the GCVTC study of Colorado Plateau Class I areas can be found in Chapter 3 of this SIP. Detailed information on Arizona's four Colorado Plateau Class I areas also can also be found in Chapter 3. Figure 2-2 shows Arizona Class I areas.

2.2. <u>Population</u>

The Arizona Territory was formed in 1863 from the western part of the New Mexico Territory.[10] As part of the New Mexico Territory in 1860, "Arizona County" had an 1860 population of 6,482. By 1870, Arizona Territory's population grew to 9,658 with most of the inhabitants living in Pima County. Arizona's population during the 2000 Census had grown to 5,130,632.

Arizona has six urbanized areas (i.e., 50,000 people or more), two of which are major urban areas (i.e., 250,000 people or more), and three represent newly qualified areas based on the results of the 2000 Census (see Table 2-1). Two of these urbanized areas, Flagstaff and Prescott, are located in northern Arizona. Flagstaff is in Coconino County near two of the four Class I areas: Grand Canyon National Park and Sycamore Canyon Wilderness.

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[10] Arizona was the name given to the territory. The town of Arizona actually was located south of the new border in Sonora, Mexico. The old name of the region was 'Pimería Alta.' The Treaty of Guadalupe Hidalgo in 1848 ended the war between the U.S. and Mexico. The treaty required Mexico to cede hundreds of thousands of square miles of land to the U.S. The geographical areas included western New Mexico, Arizona north of the Gila River, California, Nevada, Utah, as well as parts of Colorado, Wyoming, Kansas, and Oklahoma. Then, in 1853 with the Gadsden Purchase, which added the land south of the Gila River, Arizona formed its present borders.

Figure 2-2. Counties and Class I Areas in Arizona

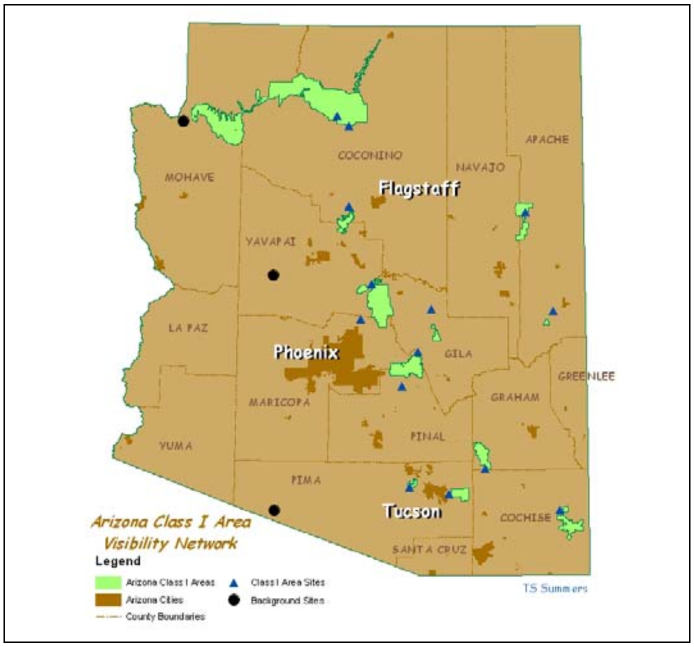

Table 2-1
Arizona's Urbanized Areas: Census 2000

Urbanized Areas	Arizona County	Population
Avondale	Maricopa	67,875
Flagstaff	Coconino	57,050
Phoenix-Mesa	Maricopa	2,907,049
Prescott	Yavapai	61,909
Tucson	Pima	720,425
Yuma (AZ-CA)	Yuma	94,950

Source: U.S. Bureau of the Census

Table 2-2 shows Census 2000 county populations as well as 2002 mid-year county population estimates for Arizona. According to these data, the state grew 6.7 percent between 2000 and 2002. The two largest Metropolitan Statistical Areas (MSAs), Phoenix-Mesa and Tucson, grew at 7.3 percent and 5.5 percent, respectively, during these two years. The Phoenix-Mesa MSA includes Maricopa and Pinal Counties. Pinal County was added to the Phoenix-Mesa MSA in 1993.

Table 2-2
Growth of Arizona's Counties: 2000-2002

County	Census 2000 (April)	2002 Estimate (July)
Apache	69,423	70,105
Cochise	117,755	124,040
Coconino	116,320	125,420
Gila	51,335	53,015
Graham	33,489	34,070
Greenlee	8,547	8,605
La Paz	19,715	20,365
Maricopa*	3,072,149	3,296,250
Mohave	155,032	166,465
Navajo	97,470	101615
Pima (Tucson MSA)	843,746	890,545
Pinal*	179,727	192,395
Santa Cruz	38,381	39,840
Yavapai	167,517	180,260
Yuma	160,026	169,760
State Total	5,130,632	5,472,750

* Part of Phoenix-Mesa Metropolitan Statistical Area
Source: U.S. Bureau of the Census; Population Statistics Unit, Research Administration, Department of Economic Security, December 6, 2002.

The Phoenix-Mesa MSA ranks 14th among all metropolitan areas by total population for 2000. However, the Phoenix-Mesa MSA is one of the fastest-growing metropolitan areas in the nation. As a county, however, Maricopa County gained the most number of people numerically, ranking it as the fourth largest county in the nation.

Table 2-3 portrays population projections for selected areas in Arizona including the Phoenix-Mesa MSA and Tucson MSA in five-year increments from 2000 to 2020. The county population projections for the four counties where the Arizona Colorado Plateau Class I areas are located and the projected state totals also are included for reference.

Table 2-3
Population Projections for Selected Arizona MSAs and Counties: 2000-2020

Area	2000	2005	2010	2015	2020
Phoenix-Mesa-Scottsdale MSA	3,115,787	3,511,048	3,909,281	4,317,999	4,747,319
Tucson MSA	854,329	943,795	1,031,623	1,119,342	1,206,244
Apache County	67,925	72,236	76,645	81,173	85,766
Coconino County	123,329	135,595	147,352	158,753	169,343
Mohave County	147,529	171,504	194,403	215,988	236,396
Navajo County	88,898	94,395	99,979	105,843	111,946
Yavapai County	152,966	175,693	198,052	219,614	240,849
State Total	4,961,953	5,553,849	6,145,108	6,744,754	7,363,604

Source: Population Statistics Unit, Research Administration, Department of Economic Security (DES), Approved by Director August 1, 1997.

According to these projections, the state's population is projected to grow by 48 percent in 20 years. While these are the official population projections for the State, they are under estimates. The 2000 projection is 4.2% below the 2000 official U.S. Census count and the decennial growth rates for 2000 through 2010 and 2010 through 2020 are 20% and 10%, respectively.

If the average decennial growth rate of 40 percent from 1960 through 2000 is maintained, Arizona's population in 2010 would almost be equivalent to the 2020 DES population projection. Carrying the 40 percent decennial growth rate forward to 2020 would mean a state population of about 10 million compared to the 7.3 million projected in 2020 by DES.

2.3. Economy

Arizona's growth in gross state product ranked first in the nation during 1992 through 1999, increasing from $85 billion in 1992 to $140 billion in 1999. Contributing to this growth were high-tech manufacturing industries, wholesale and retail trade, services, and construction industries.[11] Manufacturing output averaged 13.2 percent annually during this eight-year time period. The other sectors grew predominantly as the population of the state grew.

Table 2-4 shows a time series of civilian non-farm labor force data. The last column shows the annual average growth rate in employment between 1990 and 2001. Total non-farm and private employment grew at rates over 50%. By contrast the minimum decennial growth rate for 1960 through 2000 was 35%. Figure 2-3 shows the change in employment from 1990 through 2001. It should be noted that reliable data for agricultural employment are not available due to large seasonal fluctuations in employment.

[11] Based on construction data through the 1990s, it is evident that the single family housing sector was a major force, coupled with the commercial sector, behind the state's construction and real estate industries.

Table 2-4
Average Number of Non-Farm Employees in Arizona 1990-2001 (10,000s)

Year	1990	1992	1994	1996	1998	2000	2001	Annual Avg. Growth
Goods	27.33	26.22	30.35	34.69	37.30	38.78	38.48	4.1%
Services	120.98	125.49	138.86	154.54	170.18	185.49	188.01	4.0%
Total Non-Farm	148.31	151.71	169.20	189.23	207.47	224.27	226.50	3.9%
Private	122.41	124.03	139.77	157.44	173.32	187.61	188.72	3.2%

Source: Arizona Department of Economic Security in cooperation with U.S. Department of Labor, Bureau of Labor Statistics.
* Percent change between 1990 and 2001.

Figure 2-3. Non-Farm Employment in Arizona: 1990-2001

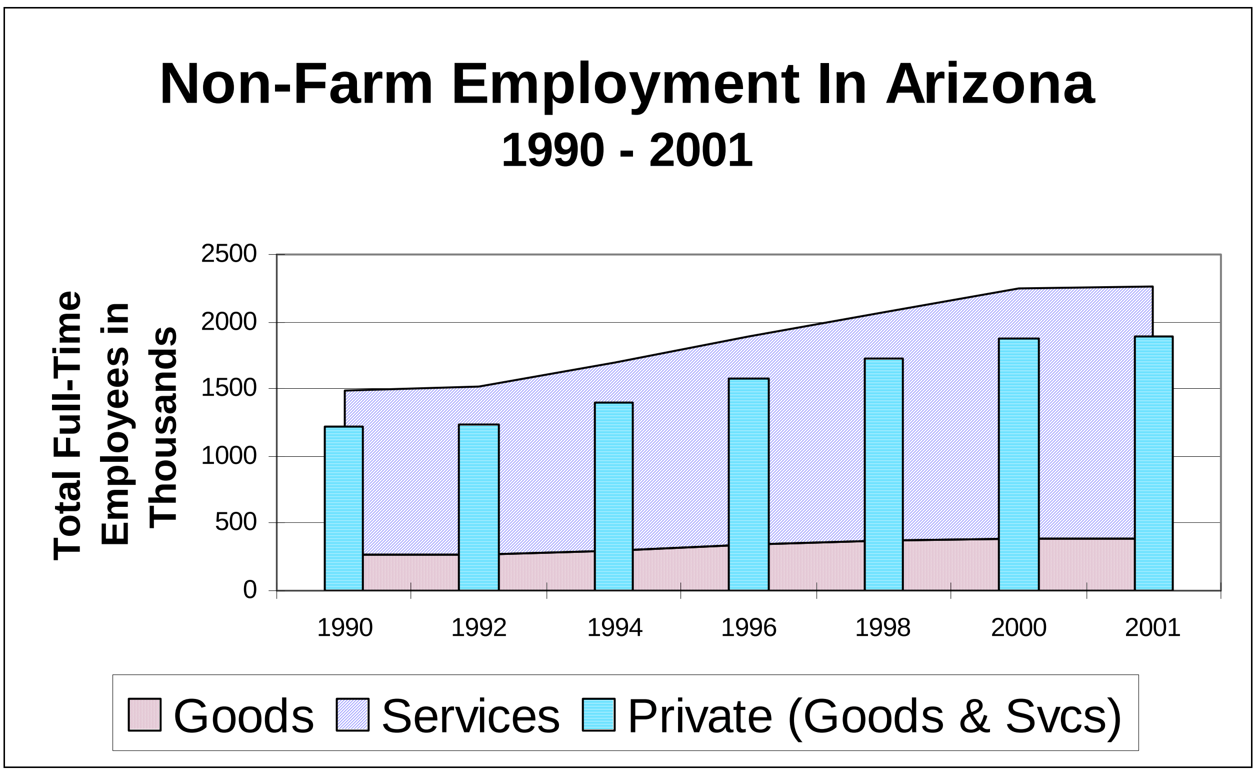

Table 2-5 contains selected economic indicators forecast for Arizona for 2001 through 2005. All indicators are forecast to increase except for mining, manufacturing, and TCPU. The forecast largest gains are for personal income (27.9%), restaurant and bar sales (26.0%), retail sales (19.8%), food sales (17.9%), and services (16.7%).

Table 2-5
Projected Economic Indicators for Arizona: 2001-2005

Economic Indicator	2001	2002	2003	2004	2005
Personal Income ($millions)	137,313.5	143,291.1	150,549.4	161,338.3	175,570.2
Retail Sales ($millions)	55,421.2	55,928.2	58,288.5	61,477.6	66,369.8
Food Sales ($millions)	7,262.7	7,491.3	7,678.3	8,050.4	8,565.3
Restaurant & Bar Sales ($millions)	6,360.6	6,490.3	6,851.4	7,367.4	8,014.0
Gasoline Sales ($millions)	3,492.3	3,476.4	3,693.4	3,717.5	3,845.0
Total Employment (10,000s)	226.63	224.74	229.23	238.10	248.87
Mining (1,000s)	9.6	8.8	8.7	8.5	8.3
Construction (1,000s)	164.9	159.4	161.6	160.8	166.6
Manufacturing (1,000s)	210.1	194.0	188.8	193.0	204.4
TCPU (1,000s)**	110.7	105.6	105.1	107.5	110.4
Trade (1,000s)	533.2	537.2	547.8	570.8	594.9
FIRE (1,000s)***	150.7	149.9	155.1	164.4	173.2
Services (1,000s)	711.1	707.3	736.8	783.5	829.7
Government (1,000s)	376.4	385.3	388.6	392.7	401.2
Unemployment Rate	4.7%	5.7%	5.2%	4.4%	4.1%

Source: *Economic Outlook 03/04*. The University of Arizona. Eller College of Business and Public Administration, Table 3.

* Includes bar sales as well
** Transportation, Communication, and Public Utilities
*** Finance, Insurance, and Real Estate

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3. MANDATORY CLASS I FEDERAL AREAS ON THE COLORADO PLATEAU

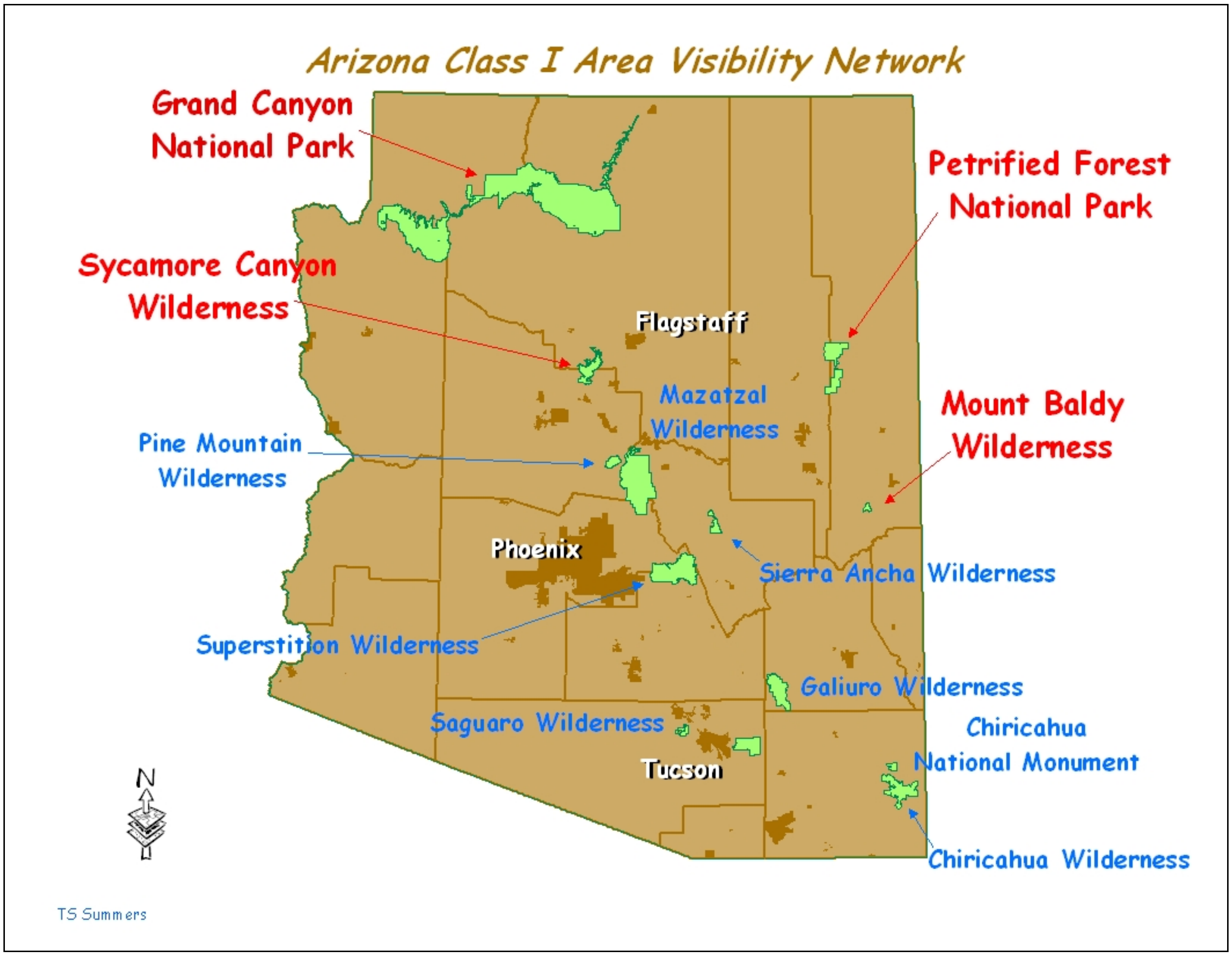
This chapter describes the 16 Class I areas on the Colorado Plateau studied by the Grand Canyon Visibility Transport Commission and addressed in this SIP in response to 40 CFR 51.309. Figure 3-1 shows the location of the national parks and wilderness areas addressed by this SIP.

Figure 3-1. Colorado Plateau Class I areas

3.1. Arizona Class I Areas

There are a total of 12 mandatory Class I Federal areas in Arizona. Of the four Arizona Class I areas addressed by this SIP, two, Grand Canyon National Park and Sycamore Canyon Wilderness are located in the northwestern portion of the state. Grand Canyon National Park extends over toward the state's western border with Nevada, and Sycamore Canyon Wilderness Area is located south of Flagstaff. The third Class I area, Petrified Forest National Park, occupies land adjacent to and directly south of the Navajo Reservation. The fourth, Mt. Baldy Wilderness Area, occupies a comparatively small portion of land on the eastern side of the state and is one of the many extinct volcanoes found throughout the state. All four of these Arizona Class I areas are part of a larger formation known as the Colorado Plateau. This high, semi-arid tableland includes, along with northern Arizona, southeast Utah, northwest New Mexico, and western Colorado.

Figure 3-2. Arizona Class I Areas.



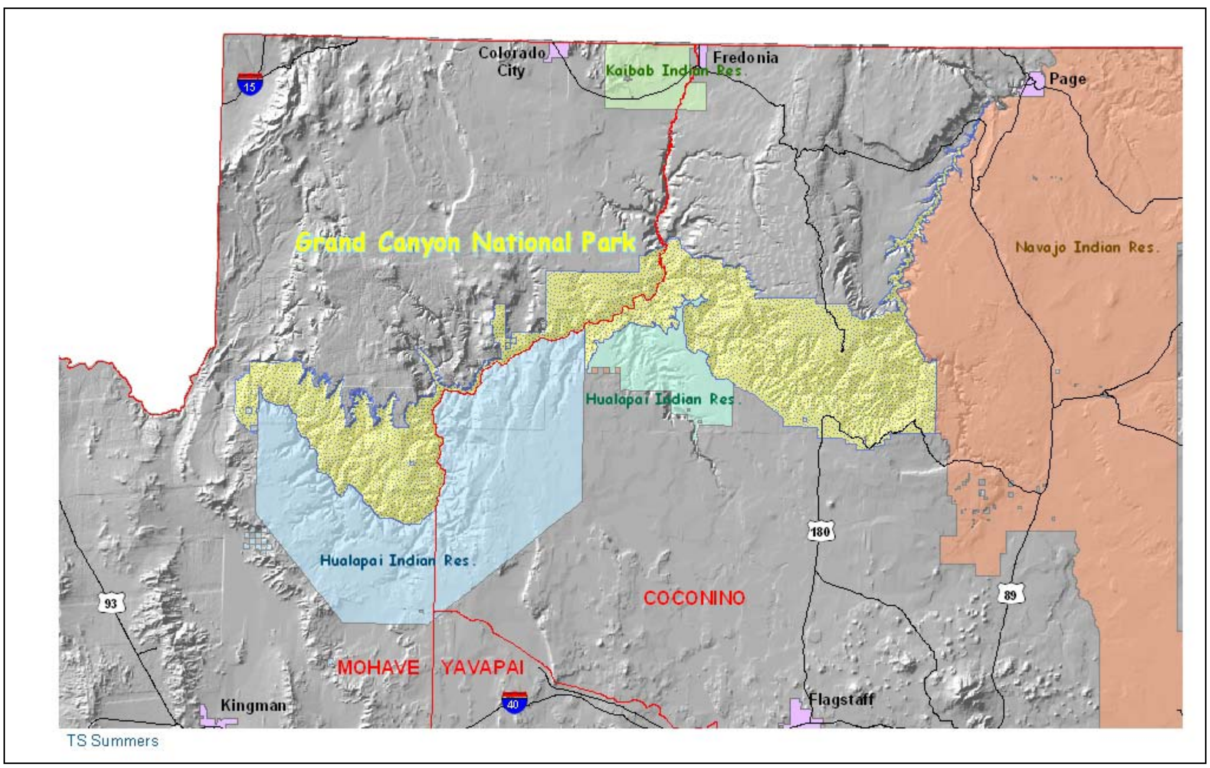
3.1.1. <u>Grand Canyon National Park</u>

The Grand Canyon National Park is on the southwestern Colorado Plateau. Over time, the Colorado River and its tributaries cut through the many layers of rock that make up the southwestern Colorado Plateau, forming a gorge one-mile deep and several miles wide. This cut into the earth begins at Lees Ferry, below Glen Canyon Dam, and extends 277 miles with a variation in width from 10-18 miles wide to just hundreds of yards in Marble Canyon to the northeast. The western part of the canyon extends into the Mohave Desert, while the eastern part reaches into the Great Basin Desert.

The Park, after being designated a national monument in 1908, became a national park on February 26, 1919. The Park is contained within Mohave and Coconino Counties. The Grand Canyon was designated a World Heritage Site in 1979. The Grand Canyon is a spectacular example of weathering and erosion, featuring unmatched vistas and intriguing landforms comprised of irregular-shaped cliffs and valleys caused by differential erosion, buttes, mesas, and rock depositions forming talus cones and aprons. Because of these geological spectacles, the Grand Canyon ranks among the world's greatest attractions with on-going erosion revealing much about the earth's geological history. Every year millons of visitors from all over the world visit the Park.

Figure 3-3. View From South Rim of The Grand Canyon National Park

Figure 3-4. Map of Grand Canyon National Park Area

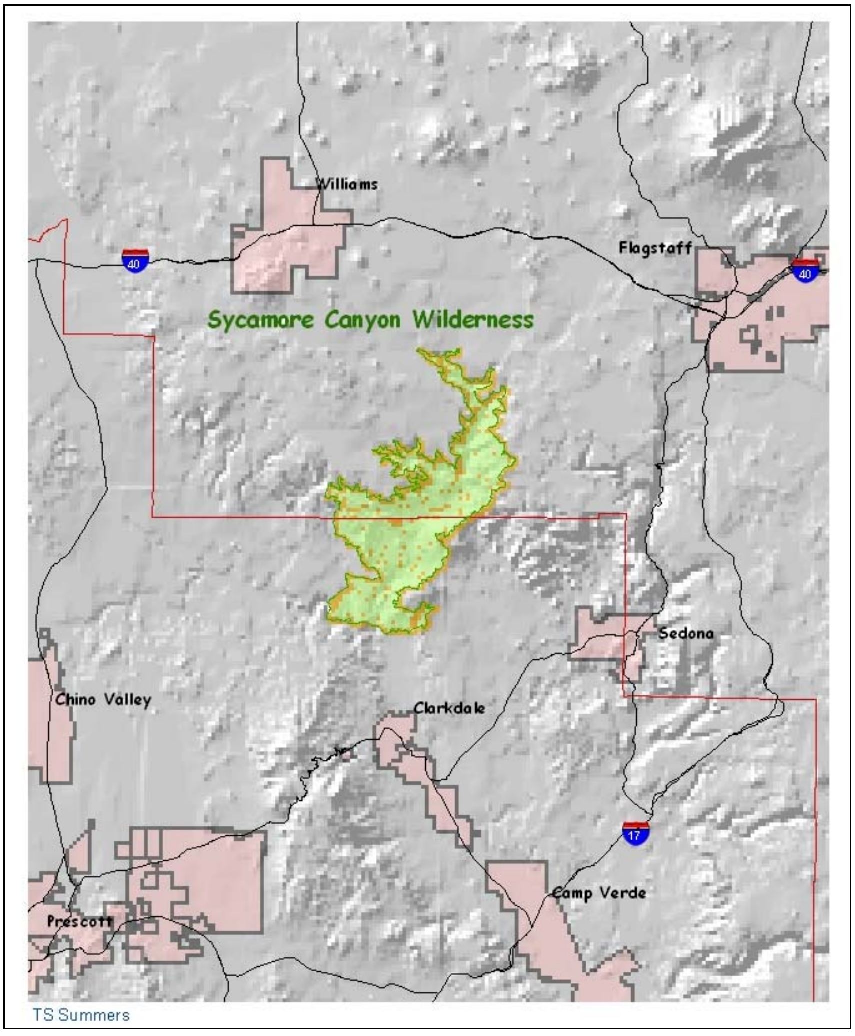


3.1.2. Sycamore Canyon Wilderness

Approximately 40 miles southwest of Flagstaff is the Class I Area known as Sycamore Canyon Wilderness. Designated in 1935 as a Primitive Area, Congress formally established the area as a federally protected area in 1972. It became a Wilderness Area through the 1977 Arizona Wilderness Act.

The area, split between Coconino and Yavapai Counties, contains 55,937 acres, beginning with pine and fir forests on the Colorado Plateau through part of the Mogollon Rim, ending at the desert mouth of the Verde Valley. Sycamore Canyon Wilderness, containing beautiful red rock, buttes, and sheer cliffs, is only 15 miles west of Oak Creek Canyon and Sedona area, one of Arizona's most popular tourist destinations. Motorized or mechanized vehicles are not allowed in the area.

Figure 3-5. Map of Sycamore Canyon Wilderness Area

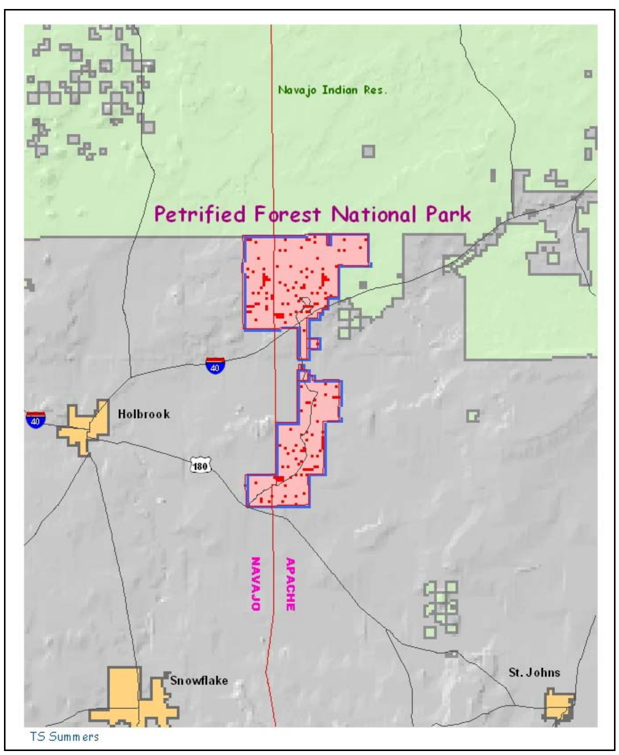


3.1.3. Petrified Forest National Park

Petrified Forest National Park is located in northeastern Arizona. The Park lies within both Navajo and Apache Counties, covering a total of 93,533 acres. It was designated a national monument in 1906 and a national park in 1962. The southern portion of Petrified Forest National Park contains one of the world's largest concentrations of petrified wood. The northern portion of the Park encompasses the badlands of the Chinle Formation that extends along the Little Colorado River valley to the west for about 125 miles. Known more commonly as "the Painted Desert" with its colored soils ranging from blues and reds to yellows and grays, this area includes at its southern tip, the Rainbow Forest

Figure 3-6. Petrified Forest National Park

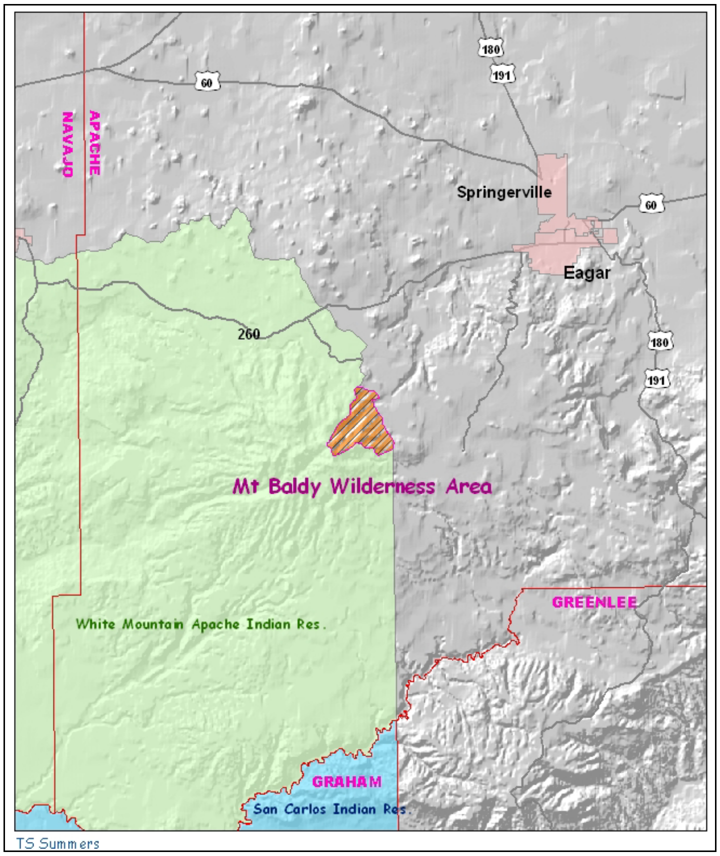
Figure 3-7. Map of Petrified Forest National Park Area



3.1.4. Mt. Baldy Wilderness

Not to be confused with California's Mt. Baldy, located in the San Gabriel Mountains, Mt. Baldy Wilderness, located in Apache County about 90 miles south of the Petrified Forest National Park. Mt. Baldy Wilderness, 7,079 acres, is an ancient volcano and the second highest peak in Arizona. It is located in the White Mountains along the southern edge of the Colorado Plateau. The summit of Mt. Baldy is on the White Mountain Apache Indian Reservation and is closed to all non-tribal members. This SIP is only for the portion of Mt. Baldy under the jurisdiction of the State.

Figure 3-8. Map of Mount Baldy Wilderness Area



Four rivers have headwaters on the slopes of Mt. Baldy: the Black, Blue, White, and Little Colorado rivers. Fishing and camping are major recreational activities where 25 lakes are scattered among the mountains. Livestock grazing is common on the meadows and pine forests of the White Mountains. The area has a wide range of weather, with snow at the higher elevations.

The same conditions and restrictions that pertain to the Sycamore Canyon Wilderness Area also pertain to Mt. Baldy Wilderness area – no motorized or mechanized vehicles, no bicycles, and no power equipment is allowed.

3.2. Class I Areas Outside Arizona

The four Class I areas on the Colorado Plateau are joined by 12 other Class I areas to make up the total of 16 Class I areas originally examined by the GCVTC. A brief description of each of these 12 areas follows.[12]

Capitol Reef National Park, Utah – Capitol Reef received its name from the barrier created by a 100 mile long ridge of rock that was thrust up from the earth millions of years ago. The rock is said to resemble the dome-like structures seen on capitol buildings in Washington, D.C. The park is fairly isolated in the south central part of Utah, 60 miles south of I-70.

Bryce Canyon National Park, Utah – Also in southern Utah, Bryce Canyon represents the effect of centuries of erosion that has shaped the colorful Claron limestones, sandstones, and mudstones of this park into thousands of spires, pinnacles and mazes. The local name for these shapes is "hoodoos," one of which forms a natural amphitheatre along the eastern edge.

Zion National Park, Utah – On the southern edge of the Colorado Plateau, Zion is known for its highly variable weather due to its elevation changes of 3,666 feet at its lowest point in Coalpits Wash to 8,726 feet at its highest, Horse Range Mountain in the Kolob Canyon section. The variable weather an elevations have led to numerous "microenvironments" that range from hanging gardens to isolated mesas.

Arches National Park, Utah - Arches National Park contains over two thousand natural sandstone arches, including the famous Delicate Arch. The park, also known for its balanced rocks and pinnacles, is located near Moab, Utah. Protected since 1929, it became a national park in 1971.

Canyonlands National Park, Utah – Canyonlands preserves one of the last, relatively undisturbed areas of the Colorado Plateau. It contains a large portion of the Colorado River and its tributaries, which carve out numerous canyons and gorges. The unique desert ecosystem has been visited by different groups of settlers for over 10,000 years, in concert with available resources. Its national park designation in 1964 is an attempt to maintain its natural beauty while still allowing for continued visitors.

Mesa Verde National Park, Colorado – Spanish for "green table," Mesa Verde allows visitors to experience both cultural and physical influences on the land. From approximately 600 A.D. through 1300 A.D., settlements flourished in stone villages throughout the alcoves of the canyon walls. Twenty-four tribes in the southwest have ancestral affiliation with the sites at Mesa Verde. The park is 35 miles west of Durango in southwestern Colorado, just off US Highway 160.

Flattops Wilderness Area, Colorado – Flattops has a less friendly history than Mesa Verde, witnessing the "Meeker Massacre" of 1879 when federal troops forcibly removed the Ute Indians, who had resided in the area for perhaps thousands of years. Originally destined to become a summer home area, it was instead recommended for wilderness area designation in 1919. In fact, Flattops became the keystone in the establishment of the National Wilderness Preservation System.

Maroon Bells Wilderness Area, Colorado – Maroon Bells, and its neighboring area, Snowmass, see a large amount of visitors every year. There are over 100 miles of trail, and despite peaks that rise above 14,000 feet, people literally swarm throughout the park's over 181,000 acres to enjoy some of the most beautiful views, some say of wildflowers alone, in the country. The park is named not for a flower, but

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[12] The State of Arizona thanks the USDA and US Park Service for providing information on the national parks and wilderness areas that comprise the Colorado Plateau through its various web sites and literature.

for Maroon Bells peak, one of the most photographed mountains, especially when it is reflected in Maroon Lake.

West Elk Wilderness Area, Colorado – As busy as Maroon Bells Wilderness Area is with visitors, West Elk is fairly devoid of people. Only hunters populate the area in the fall, when elk and deer number in the thousands. Long lava flows are found throughout the area, where trails can lead to areas containing ridges that the wind and water have carved into formations that resemble the turrets of castles.

Black Canyon of the Gunnison Wilderness Area, Colorado – The Black Canyon of the Gunnison's unique and spectacular landscape was formed slowly by the action of water and rock scouring down through hard Proterozoic crystalline rock. No other canyon in North America combines the narrow opening, sheer walls, and startling depths offered by the Black Canyon of the Gunnison.

Weminuche Wilderness Area, Colorado – Weminuche is Colorado's largest wilderness area. It contains 63 high altitude lakes, known for their deep blue color. The area encompasses a total of 488,210 acres that include the headwaters of both the Rio Grande and San Juan Rivers. The area also contains the Continental Divide Trail and is said to exemplify the mission of the Wilderness Act of 1964 by securing the benefits of an enduring resource of wilderness for generations to come.

San Pedro Parks Wilderness Area, New Mexico – This area, at the same latitude as the Grand Canyon National Park where the Colorado Plateau dips into New Mexico and Arizona, has an elevation of 10,000 feet above sea level. But unlike its counterpart in Arizona, the area has rolling mountaintops and meadows with large grassy areas. The area sees frequent rain in late summer and snow by November. Its mountain streams are a favorite of local trout anglers.

4. TECHNICAL BASIS FOR REGULATION OF REGIONAL HAZE

This chapter provides a brief introduction to the science of visibility and the technical basis for the regulation of regional haze. A more detailed presentation of the concepts contained in this chapter can be found in the 1999 document entitled *Introduction to Visibility* by William C. Malm, Ph.D., available from CIRA (Cooperative Institute for Research in the Atmosphere) at Colorado State University.

4.1. How Do We See?

Light waves, like radio waves, are a form of electromagnetic radiation. All electromagnetic radiation travels in the form of waves at the speed of light which is approximately 186,000 miles per second. Light waves, like radio waves, also have distinct frequencies (the number of times per second the wave goes from crest to crest) and a corresponding wave length (the distance between the crest of each wave). As an example, when you tune your radio to 550 on the AM dial, your radio receives a signal that has a frequency of 550 thousand cycles per second with a corresponding wave length of approximately 1,800 feet (six football fields). In contrast, blue light has a frequency of about 3.5 trillion cycles per second corresponding wave length of 1.5 millionths of an foot. Unlike radio waves that require humans to use a radio receiver to capture information, the human eye directly captures information contained in light waves.

Light waves are made up of small energy packets, or photons, that travel through the air. Light photons each have a defined energy level that give them a distinct color corresponding to its frequency or wave length. Red light waves are at the lowest energy level and the longest wavelength. Blue light waves are at the higher energy level and shorter wavelength. White light, like sunlight, is made up of a mixture of all of the different wave lengths of light. When white sunlight goes through a prism, or through rain drops, the photons can be separated by energy level and generate a rainbow of colors. The human eye is a sophisticated receiver of electromagnetic radiation in the form of light. Unlike a radio receiver that can only detect and interpret one frequency at a time, the human eye can detect all frequencies, or wavelengths, of visible light simultaneously.

The human eye can distinguish a wide variety of colors and light intensities of objects. In order to distinguish an object from its background, there must be a contrast between the object and its background. The contrast necessary to distinguish an object from its background varies depending on color and texture, but generally, a 2% contrast is necessary in order to be detected by the human eye.

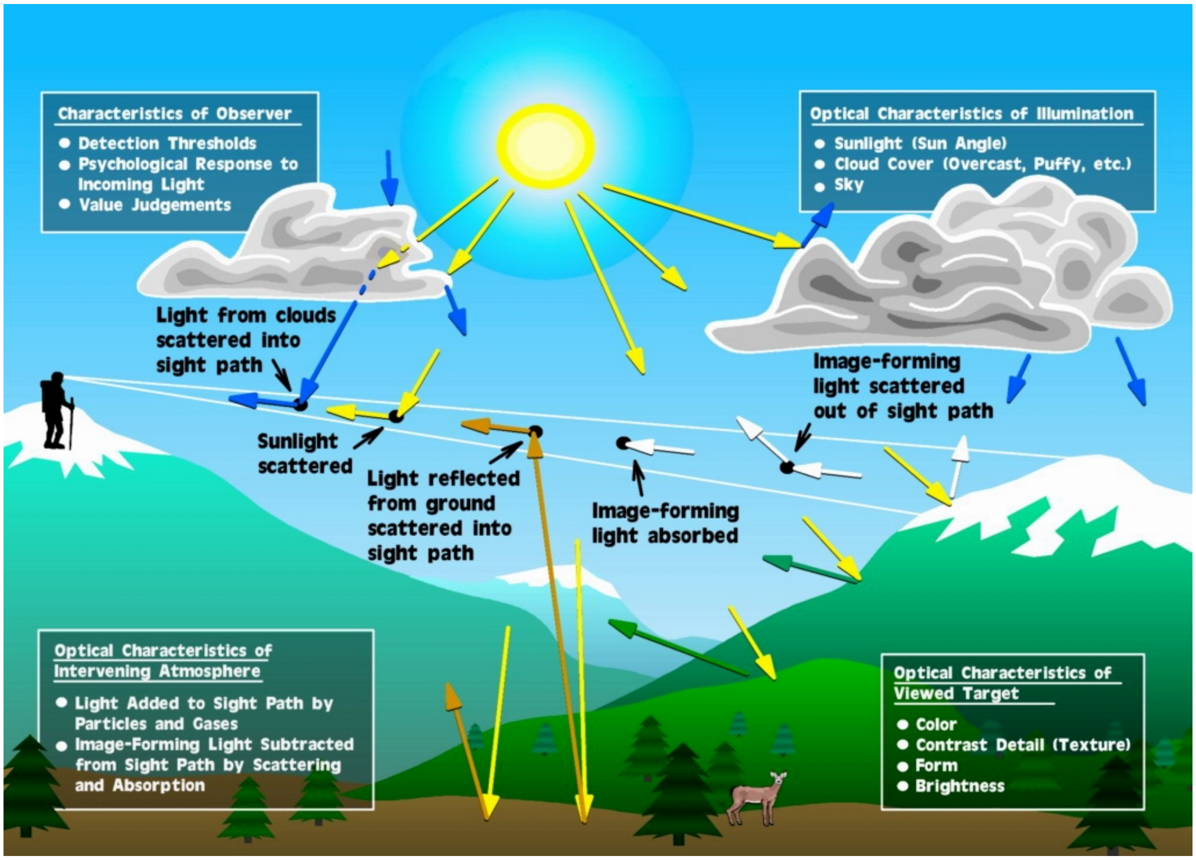
When sunlight hits a solid object, the surface absorbs some photons and reflect others. The wavelength of the light reflected defines the color that the human eye perceives. For example, the reason an apple looks red is that red photons are mostly reflected, and photons in the other color wavelengths are mostly absorbed. An egg looks white because the surface absorbs and reflects all of the color components of light at about the same level.

Sunlight reflected from surfaces on the earth, or scattered by particles and gases in the air, interfere with the view that would be experienced under ideal conditions. Gases and very small particles preferentially scatter blue light in all directions. Large particles tend to scatter all colors of light (white light) in the forward direction. This causes a very strong white haze to appear to the eye when looking toward the sun, and much lighter haze when looking away from the sun.

4.2. How Particulates and Gases Impair Visibility

As light photons travel through the air, they collide with molecules of gases and particles. This collision results in the light photons either being scattered or absorbed. When sunlight travels through clear air (i.e., with no particles), light photons corresponding with the higher energy level blue wavelengths of light are preferentially scattered, resulting in the human eye perceiving the sky as being blue, even though air is a colorless gas. Figure 4-1 shows how particles and gases interact with light.

Figure 4-1. Interaction of Particles and Gases with Light.



There is a limit to how far the eye can see. That limit is defined by the rate at which light is extinguished (scattered or absorbed) as it travels through the air. The light extinction coefficient defines the rate at which light is removed as it travels through the air. In clear air (i.e., with no particles in the air), that limit is approximately 350 kilometers and results from Rayleigh scattering caused by light encountering molecules of oxygen and nitrogen in clear air. This corresponds to a light extinction coefficient of approximately 10 inverse mega-meters (10 Mm^{-1}).

Particles in the air, which are also referred to as aerosols, also interfere with light as it travels, especially particles that are approximately the same size as the wavelength of light. As light travels, light photons will be scattered and absorbed by particles in the air. A higher concentration of particles in the air will result in a higher light extinction coefficient and more visibility impairment.

Different types of particles have different effects on visibility. For visibility studies, concentrations of particles in the air are expressed in millionths of grams (micrograms) per cubic meter of air. Filters are used to collect the particles for laboratory analysis. The equipment used to collect the filters separate the particles by size. Some filters only collect fine particles that are smaller than 2.5 microns in diameter, while others collect both fine particles and courser particles smaller than 10 microns in diameter. Light extinction efficiencies are used to convert the concentration of particles in the air into the impact on the light extinction coefficient. As was noted above, smaller particles are more efficient at scattering light than larger particles.

4.3. Types of Particles and Gases Contributing to Visibility Impairment

There are two distinct categories of particles in the air: primary particulates that are directly emitted into the air, and secondary particulates that are formed by the chemical reaction of gases emitted into the air. Primary particulates include course soils, fine soils, elemental carbon (soot), and organic carbon. Secondary particulates include ammonium sulfate formed from gaseous sulfur dioxide, ammonium nitrate formed from gaseous oxides of nitrogen, and also organic carbon particles formed from volatile organic carbon gases. An additional factor that effects visibility is that ammonium sulfate and ammonium nitrate particles also can absorb moisture in the air causing the particles to grow, which increases light extinction.

For regional haze visibility assessment studies, Table 4-1 summarizes the particles of interest, light extinction efficiencies, and the effect of relative humidity on the extinction efficiencies for ammonium sulfate and ammonium nitrate particles.

Table 4-1. Light Extinction Efficiencies of Particles

Type of Particle	**Light Extinction Efficiency & Effect of Relative Humidity (RH)**		
Relative Humidity	**30% RH**	**60% RH**	**90% RH**
Humidity Dependent			
Ammonium Sulfate	3.0	4.8	11.4
Ammonium Nitrate	3.0	4.8	11.4
Humidity Independent			
Organic Carbon	4.0	4.0	4.0
Elemental Carbon	10.0	10.0	10.0
Fine Soil	1.0	1.0	1.0
Coarse Soil	0.6	0.6	0.6

Source: EPA Visibility Monitoring Guidance EPA-454/R-99-003. Humidity effects derived from Figure 2-3. Light Extinction Efficiencies are expressed in units of square-meters per gram.

The key concepts to understand from Table 4-1 are:

- The extinction efficiency varies widely depending on the type of particle. For instance, elemental carbon, which not only scatters light but also absorbs light has 16.7 times the influence on visibility than coarse soil.
- Relative humidity is important if ammonium sulfates or ammonium nitrates are present. At high relative humidity the extinction efficiency can be a factor of 4 higher than under low relative humidity.
- Understanding of the composition of the particles present in the atmosphere is necessary to accurately characterize the impact on visibility.

4.4. Sources of Particulates and Gases Contributing to Visibility Impairment on the Colorado Plateau

Sources of emissions that contribute to the particles in the atmosphere that cause visibility impairment fall into two broad classes: natural sources of emissions, and human-caused (or anthropogenic) sources of emissions. The GCVTC developed comprehensive emission inventories for areas contributing to visibility impairment at the 16 GCVTC Class I areas on the Colorado Plateau.

Natural sources of emissions include a wide variety of pollutants that are emitted to the atmosphere. Wildfire emissions include primarily fine particulates (organic carbon, elemental carbon, and fine soils), course soils, oxides of nitrogen, and volatile organic compounds. Volcanic activity produces fine and course soils, and in many instances, sulfur dioxide. High winds can create emissions from natural undisturbed lands that contain primarily coarse and some fine soils. Achieving visibility conditions comparable to those that would be experienced with only natural sources is the long-term goal of the regional haze program.

Human-caused sources of emissions also contribute to visibility impairment. Point sources (such as utility boilers, smelters, industrial boilers, and refineries) produce the majority of the sulfur dioxide in the GCVTC region, and about 25% of the oxides of nitrogen. Mobile sources (such as cars, trucks, off-road equipment, trains, and planes), produce the majority of the oxides of nitrogen in the GCVTC region and half of the human-caused volatile organic carbon emissions. In addition to direct emissions from mobile sources, road dust can be an important source of course and fine soil emissions. Prescribed fire on wildlands produce emissions similar to natural occurring wildfires. Finally, area sources (which make up all the other source types not discussed above) generate a broad range of emissions of all pollutants of interest for visibility and can be important especially in large population centers. States are required to develop long-term strategies to manage human-caused sources of visibility impairment to make reasonable progress toward the national goal of eliminating human-caused visibility impairment.

4.5. Visibility Conditions on the Colorado Plateau

The Colorado Plateau generally has the best visibility conditions in the country. Unlike the eastern United States where ammonium sulfates are the most significant contributor to visibility impairment, there is no one type of particle that is the most significant contributor on the Colorado Plateau. The GCVTC found that particle based visibility impairment results equally from ammonium sulfates, the combination of organic carbon and elemental carbon, and the combination of coarse and fine soils. The GCVTC found that ammonium nitrate is a relatively small contributor to visibility impairment on the Colorado Plateau. On a day-to-day basis there can be one type of particle that has a more pronounced impact on visibility than others. However, all sources of these types of particles must be reviewed to develop an effective long-term strategy to make reasonable progress toward the national goal.

4.6. State of Arizona Visibility Monitoring Plan and Network

The Arizona Department of Environmental Quality (ADEQ), local agencies, and federal land managers at Arizona's 12 Class I areas are cooperatively operating a visibility monitoring network to track impairment of visual air quality. The Arizona Class I visibility network consists of visibility monitoring equipment provided by the Interagency Monitoring of PROtected Visual Environments (IMPROVE) monitoring program and additional equipment provided by ADEQ. The IMPROVE aerosol samplers collect particulate matter on filters (both $PM_{2.5}$ and PM_{10} fractions) which are routinely analyzed for chemical constituents. ADEQ and the National Park Service (NPS) have added optical monitoring equipment to measure visibility impairment, and meteorological monitoring equipment at most sites.

Arizona maintains a visibility monitoring operation plan. This visibility monitoring plan is updated when necessary to reflect updated IMPROVE and EPA guidance, and specific needs identified by ADEQ. ADEQ is an Associate Member of the IMPROVE Steering Committee and participates in the technical oversight of the IMPROVE network.

The chemical constituent data from the IMPROVE samplers are used to identify the chemical species and emission sources responsible for existing human-caused visibility impairment. The optical data show the visual air quality at a point as a person might experience the view. Nephelometers measure light scattering by particles at points collocated with the IMPROVE samplers, and at four areas, transmissometers also provide optical data on total light extinction along a path. Meteorological data are collected to provide a more complete understanding of the behavior of the atmosphere in general, as well as clarifying local air movement. These data are collectively used to track short-term and long-term trends, assess source contributions to visibility impairment that are reasonably attributable to a single source or group of sources, and determine the causes of regional visibility impairment at a given location.

The intent of this visibility monitoring operational plan is to characterize long-term trends in all Arizona Class I areas as completely as possible using ambient visibility measurements, within constraints of an area's size, terrain, or logistics, for each of the 12 federally-protected Class I areas in Arizona. In practical terms, one monitoring site or a group of sites may represent several Class I areas, or multiple locations of the same or different types of sites may represent an individual Class I area. This monitoring plan is designed to meet the following requirements of 40 CFR 51.305 and 40 CFR 51.308(d)(4): 1) to have a long-term monitoring strategy; 2) to track visibility trends at Arizona Class I areas; 3) to assist in identifying any attributable visibility impairment; and 4) to provide monitoring data, if necessary, for evaluating the impact of new or major modifications of categorical major sources. Arizona's monitoring program began in the spring of 1996, and the monitoring plan was updated in 2002. In addition to the state-sponsored IMPROVE monitoring, the National Park Service has maintained IMPROVE monitors (transmissometer and particle samplers) in Petrified Forest and Grand Canyon national parks since 1987, providing a long baseline of visibility measurements.

Pursuant to 40 CFR 51.305 and 40 CFR 51.308(d)(4), the State of Arizona maintains a monitoring plan to address visibility impairment. The State of Arizona relies on the IMPROVE program for data collection and processing and commits to the reporting of all visibility monitoring data to the Administrator at least annually for each Class I area in the State.

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5. STRATEGY TO ADDRESS REASONABLY ATTRIBUTABLE VISIBILITY IMPAIRMENT (RAVI)

Section 169A of the CAA contains the national goal that requires states to remedy existing visibility impairment and prevent future visibility impairment in the Class I areas. Initially, states containing mandatory Class I Federal areas were required to address the specific type of air pollution coming from existing stationary sources that could be anticipated to cause or contribute to visibility impairment. This type of pollution was commonly referred to as "plume blight," or more formally, reasonably attributable visibility impairment (RAVI). On December 2, 1980, the EPA determined that there were two types of air pollution that reduced or impaired visibility (45 FR 80084). One type was described as "smoke, dust, colored gas plumes, or layered haze emitted from stacks," and the second type was "widespread, regionally homogeneous haze from a multitude of sources" (Ibid, p. 80085).

The existing stationary sources subject to this regulation include any reconstructed source that was not in operation prior to August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit 250 tons per year of any regulated pollutant. "In existence" is interpreted by the EPA to be consistent with the term, "commence construction" found in Prevention of Serious Deterioration (PSD) regulations (40 CFR 51.165(a)(1)(xvi) and 40 CFR 52.21(b)(9)). If construction commenced after August 7, 1977, the source would be subject to the PSD/NSR (new source review) program.

The SIPs developed to address visibility impairment from sources that could be reasonably anticipated to cause or contribute to visibility impairment in Class I areas had to include four specific things: (1) a monitoring plan to assist in the determination of what type of emissions were actually occurring in and near the Class I Area; (2) a way to determine what type of technological controls (best available retrofit technology or BART) could be used at a source should that source be found to cause or contribute – be found attributable – for the air pollution; (3) a process for addressing possible visibility impairment from new sources through existing New Source Review regulations, including review of that process by the FLMs; and (4) long-term strategies for dealing with existing and any future visibility impairment from stationary sources.

SIPs for 36 states were due to EPA by December 2, 1980. Unable to comply by the deadline, Arizona along with several other states, was cited on July 12, 1985, as failing to meet the requirements of 40 CFR 51.305, monitoring, and 51.307, new source review (50 FR 28545). On November 24, 1987, Arizona was cited as failing to meet the requirements of 40 CFR 51.306, long-term strategies, and 51.302, control strategies (i.e., BART).[13] Failure to meet the requirements in 40 CFR 51.302, 305, 306, and 307 through a SIP meant EPA imposed a Federal Implementation Plan or FIP (52 FR 45134, November 24, 1987). Included in the 1987 FIP was FLM certification of three Class I areas in Arizona for visibility impairment: Grand Canyon National Park, Petrified Forest National Park, and Saguaro Wilderness.

On September 15, 1988, EPA published its assessment of the Class I areas certified by the FLMs that included an assessment of the three Arizona areas named in 1987 (53 FR 35956). By 1991, EPA published a final rule that revised Arizona's FIP to reflect an analysis of the visibility impairment at Grand Canyon National Park for an attributable stationary source, Navajo Generating Station (56 FR 50172).

For the purpose of addressing the process the State of Arizona could use in the event of future certifications, a State rule has been promulgated for reasonably attributable visibility impairment. That

[13] Arizona was not cited for failure to meeting 51.304, integral vistas, as no integral vistas have been listed in Arizona. Integral vistas are areas outside the boundary of a Class I Area, but visible from within it.

rule, effective December 2, 2003, can be found in Appendix A-5a. The following sections discuss how Arizona is now meeting the requirements of 40 CFR 51.302 through 307, which should allow EPA to remove the existing FIP.

5.1. Implementation of Control Strategies

Pursuant to 40 CFR 51.302, states must have a procedure in place to analyze and, if necessary, implement control strategies for RAVI, and imposition of best available retrofit technology (BART) for any eligible source whose emissions are found to cause or contribute to visibility impairment. Arizona's RAVI rule can be found in Appendix A-5a; a list of the BART-eligible sources is listed in Section 1601 of the rule. Arizona's RAVI rule also serves as the authority for the possible implementation of controls under "geographical enhancement" for any stationary source found to impair visibility via the WEB Trading Program as outlined in Chapter 8 of this SIP.

40 CFR 51.302 also requires the state to communicate with the FLMs and provide for consultation on any matters pertaining to visibility impairment. A letter notifying the FLMS of the State of Arizona's visibility contact person, as well as the opportunity to review this SIP prior to any public hearings, can be found in Appendix A-5b. A subsequent letter notifying the FLMs of the public comment period, and locations and dates of public hearings for this SIP can also be found in Appendix A-5b. All supporting documents related to the promulgation of Arizona's RAVI rule can also be found in Appendix A-5c.

5.2. Exemptions from Controls

Pursuant to 40 CFR 51.303, any source found attributable for visibility impairment and required to install and operate BART, may request a federal exemption from BART. This federal exemption process is incorporated by reference in R18-2-1606 of Arizona's RAVI rule. At this time, no source in the State of Arizona has requested a federal exemption from BART.

5.3. Identification of Integral Vistas

Pursuant to 40 CFR 51.304, any identified integral vista must be addressed on an equivalent basis as for any Class I Area. An integral vista is a specific landmark or panorama located outside the boundary of a mandatory Federal Class I Area, but visible from that Class I Area. Therefore, any impairment within the Class I Area could possibly impact the integral vista as well. No integral vistas have been identified to date for the State of Arizona's 12 mandatory Class I Federal areas (52 FR 45132, November 24, 1987).

5.4. Monitoring

Pursuant to 40 CFR 51.305, the State of Arizona has developed a monitoring plan for the 12 Class I areas. The plan, *Arizona Class I Area Visibility Monitoring Operational Plan (Monitoring Plan)*, published in 1996 and updated in 2002, includes a commitment to, "characterize long-term trends in all Arizona Class I areas as completely as possible using ambient visibility measurements, within constraints of an area's size, terrain, or logistics, for each of the 12 Class I areas in Arizona" (p. 3 *Monitoring Plan*).

Arizona's *Monitoring Plan* was developed with the full cooperation of the FLMs, other related agencies and counties as well as air quality specialists in the field of monitoring, data gathering and assessment, and meteorology. The *Monitoring Plan* is reviewed annually and contains four objectives that also serve to meeting the needs of any visibility regulations promulgated by the State of Arizona to meet RAVI. The objectives are: (1) long-term monitoring strategy, (2) track visibility trends at Arizona

Class I areas, (3) assist in identifying any reasonably attributable visibility impairment impacts, and (4) provide monitoring data if necessary for new or major modifications of categorical major sources.

Along with providing a network of visibility monitors, the *Monitoring Plan* also accounts for the long-standing IMPROVE monitoring program and integration with EPA's PM 2.5 monitoring guidance. IMPROVE was established in 1985 to coordinate the monitoring of national parks and wilderness areas and to ensure sound and consistent scientific methods were being employed. The IMPROVE Steering Committee established monitoring protocols for visibility measurement, particulate matter measurement, and scientific photography of the Class I areas. IMPROVE monitoring is designed to established reference information on visibility conditions and trends to aid in the development of visibility protection programs.

5.5. Long-term Strategy Requirements

Pursuant to 40 CFR 51.306, a long-term strategy for RAVI must be established in the SIP. This strategy must cover a 10-15 year period. Arizona's submittal under 40 CFR 51.309 fulfills the long-term strategy requirements for RAVI for stationary sources. Should any source be found attributable for visibility impairment and subsequently required to install and operate BART, the State of Arizona commits to submitting a SIP revision (as required by R18-2-1605(B)), meeting the review requirements for the long-term strategies as outlined in 51.306(e), including any impact resulting from the imposition of controls or exemption from controls for BART.

5.6. New Source Review for Visibility Protection

Pursuant to 51.307, the State of Arizona's R18-2-410 (Article 4, New Source Review, *Arizona Administrative Code*) addresses the requirements of new sources to meet performance standards to assure emissions will not have an impact on visibility in Arizona's 12 Class I areas. The rule can be found in Appendix A-5d.

On September 1, 1994, EPA deemed the State of Arizona SIP revision for New Source Review (NSR) / Prevention of Significant Deterioration (PSD) and minor NSR source programs complete and is awaiting further EPA action.

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6. LONG-TERM STRATEGY FOR THE CLEAN AIR CORRIDOR

6.1. Regulatory History and Requirements

One of the requirements of the Regional Haze Rule (40 CFR 51.309(d)(3)) is to finalize earlier work initiated by the GCVTC to address clean-air corridors. One of the tasks of the GCVTC required by CAA 169B was to determine whether any clean-air corridors exist for any of the 16 GCVTC Class I areas. A clean-air corridor is a geographic region that contributes clean air to a Class I area on the days with best visibility. If clean-air corridor(s) were found to exist, the GCVTC was required to recommend whether additional control strategies were needed to manage emissions growth to protect visibility on the least impaired days in the Class I areas. For the purpose of its assessment, the GCVTC considered the average of the days representing the 20% best visibility conditions to be the least impaired days. EPA also used this definition in defining the term in the 1999 Regional Haze Rule (40 CFR 51.308 and 40 CFR 51.309).

In 1995, the GCVTC Meteorology Subcommittee completed an analysis of the geographical source areas contributing to least impaired days in the 16 GCVTC Class I areas. The analysis, in a report entitled, *Clean-Air Corridors: A Framework for Identifying Regions that Influence Clean Air on the Colorado Plateau,*[14] showed that the area north and west of the Grand Canyon National Park does provide clean air to the Grand Canyon area primarily due to a combination of favorable meteorological conditions and low emissions of pollutants from the sparsely populated area. The GCVTC Public Advisory Committee (PAC) reviewed the clean-air corridor analysis and emission projections and determined expected emissions growth was less than the amount that would degrade visibility on the least impaired days in the 16 Class I areas. Based on this finding, the PAC recommended emissions growth be monitored in the future but that no additional control strategies were needed in the identified clean-air corridor at that time. The GCVTC adopted this recommendation and included it in its final report to EPA, which was integrated into the regional haze rule (40 CFR 51.309(d)(3)).

The Regional Haze Rule requires states submitting SIPs under 40 CFR 51.309 to determine if there were additional areas(s) to be considered as clean-air corridors for emission tracking purposes in the GCVTC areas. The successor to the GCVTC, the Western Regional Air Partnership (WRAP), completed an economic/technical analysis to validate the growth projections in the clean air corridors. This analysis was included as part of a consensus policy adopted by the WRAP Board in November, 2002. A copy of this policy, *WRAP Policy on Clean Air Corridors*, is contained in Appendix A-6a. The WRAP policy defined a clean air corridor consistent with the range of optional clean air corridor definitions identified by the GCVTC Meteorology Subcommittee. The final clean air corridor included a recognition of county-level emissions inventory practices, and an emissions tracking requirement in the clean air corridor. The technical studies and findings used as the basis for the WRAP Clean-Air Corridor Policy are located in Chapter 3 of the WRAP Technical Support Document.

The most recent projections of visibility conditions at the 16 GCVTC Class I areas performed by WRAP is discussed in Chapter 14.

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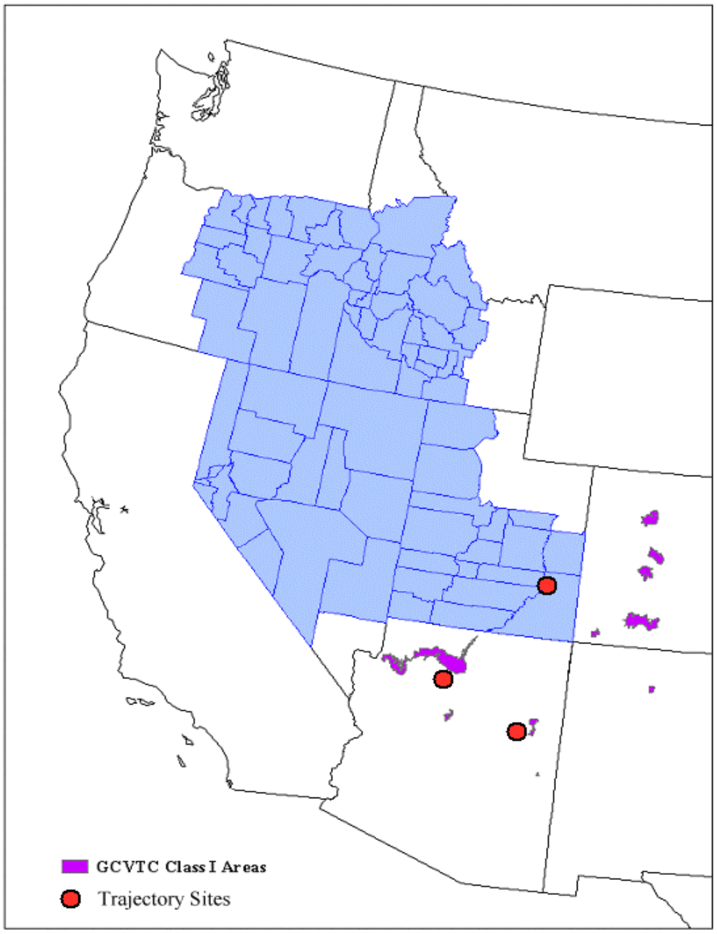
14 *Clean Air Corridors: Framework for Identifying Regions that Influence Clean Air on the Colorado Plateau*, Meteorology Subcommittee of the Grand Canyon Visibility Transport Commission; Western Governors' Association: Denver, CO, July 1995.

6.2. Identification of Clean Air Corridor; Other Clean Air Corridors

Pursuant to 40 CFR 51.309(d)(3)(i), the State of Arizona concurs that there is an existing clean-air corridor as defined in the *WRAP Policy on Clean-Air Corridors*. The boundary of the clean-air corridor is indicated on the map in Figure 6-1 provided below. No portion of Arizona is inside the clean-air corridor.

Figure 6-1. Map of the Clean Air Corridor in the Transport Region



This Clean Air Corridor was identified using studies conducted by the Meteorological Subcommittee of the Grand Canyon Visibility Transport Commission, and then updated by the WRAP based on an assessment described in the *WRAP Policy on Clean-Air Corridors*, and related technical analysis conducted by the WRAP.

The State of Arizona, pursuant to 40 CFR 51.309(d)(3)(v), has determined, based on the *WRAP Policy on Clean-Air Corridors* and technical analysis, that no other clean-air corridors are identified at this time. The State of Arizona commits to participating in a regional effort to review this determination as part of periodic plan revisions required under 40 CFR 51.309(d)(10).

6.3. Strategy for Clean Air Corridors

(a) Comprehensive emissions tracking program. Pursuant to 40 CFR 51.309(d)(3), a comprehensive emissions tracking system has been established to track emissions inside and outside the clean-air corridor, as specified in (b) below, to ensure that visibility is not degraded on the least-impaired days in any of the 16 Class I areas of the Colorado Plateau. This comprehensive emissions tracking system was developed by the WRAP to assist the above states in meeting this requirement. Appendix A-6b of this SIP describes the WRAP comprehensive emissions tracking system, and the process by which the WRAP will summarize annual emission trends in order to identify any significant emissions growth that could lead to visibility degradation in the 16 Class I areas. Included in this summary will be an assessment of whether any significant emissions growth has occurred within the Clean Air Corridor, in accordance with *(c)* below. The State of Arizona will work cooperatively with states not submitting a plan revision under 40 CFR 51.309 that have emissions within or outside the clean-air corridor that could affect air quality in the clean-air corridor, to assure the emissions are incorporated into the tracking program through inter-state consultation.

(b) Patterns of growth within the clean-air corridor. Pursuant to 40 CFR 51.309(d)(3)(ii), the State of Arizona has determined, based on the *WRAP Policy on Clean-Air Corridors* and WRAP technical analysis, that current projections of emissions changes inside the identified clean-air corridor will not contribute to degradation of visibility on the least impaired days in the 16 Class I areas during the planning period through 2018. Future emissions growth will be tracked in accordance with the comprehensive emissions tracking system noted in (*a)* above. The WRAP will summarize annual emission trends within the clean-air corridor and assess whether any significant emission growth has occurred within the corridor as an analysis tool for states.

(c) Patterns of growth outside the Clean Air Corridor. Pursuant to 40 CFR 51.309(d)(3)(iii), the State of Arizona has determined, based on the *WRAP Policy on Clean-Air Corridors* and technical analysis conducted by the WRAP, that outside the Clean Air Corridor identified in Section 6.2, above, there is no emissions growth occurring at this time that is contributing to visibility impairment within the Clean Air Corridor in any of the 16 Class I areas of the Colorado Plateau As part of the WRAP's annual summary of emission trends within the corridor, an assessment will be made of emission and monitoring data trends outside the Clean Air Corridor, in order to determine if significant emissions growth is occurring outside the corridor that could be impairing air quality within the corridor, and resulting in visibility impairment in the 16 Class I areas.

(d) Actions if impairment inside or outside the Clean Air Corridor occurs. The State of Arizona, in coordination with other transport region states and tribes, will review the WRAP's annual summary of emission trends within the Clear Air Corridor and whether any significant emissions growth was identified within the corridor in accordance with *(b)* above, or was identified outside the corridor, in accordance with *(c)* above. If significant emissions growth is identified, the State of Arizona in coordination with other transport region states and tribes, will conduct or seek WRAP assistance in conducting an analysis of the effects of this emissions growth in terms of possible impact on air quality within the corridor and possible degradation of the least-impaired days in any of the 16 Class I areas of the Colorado Plateau. Pursuant to 40 CFR 51.309(d)(3)(iv), if this analysis finds that this growth is causing visibility impairment in the 16 Class I areas, the State of Arizona in coordination with other transport states and tribes will evaluate the need for additional emission reduction measures, and identify an implementation schedule for such measures, if needed. The implementation of any additional emission measures shall be coordinated with all appropriate transport region states and tribes, on a mutually agreed upon timetable, and reported to EPA in accordance with the periodic progress reports required under 40 CFR 51.309(d)(10)(i). If the WRAP regional planning process is unable to perform such an analysis for

the GCVTC Class I areas in Arizona, or come to a consensus on the interpretation of such an analysis, the State of Arizona will perform such studies and engage in independent interstate consultation provided for under 40 CFR 51.309(d)(11).

7. LONG-TERM STRATEGY FOR STATIONARY SOURCES

7.1. Regulatory History and Requirements

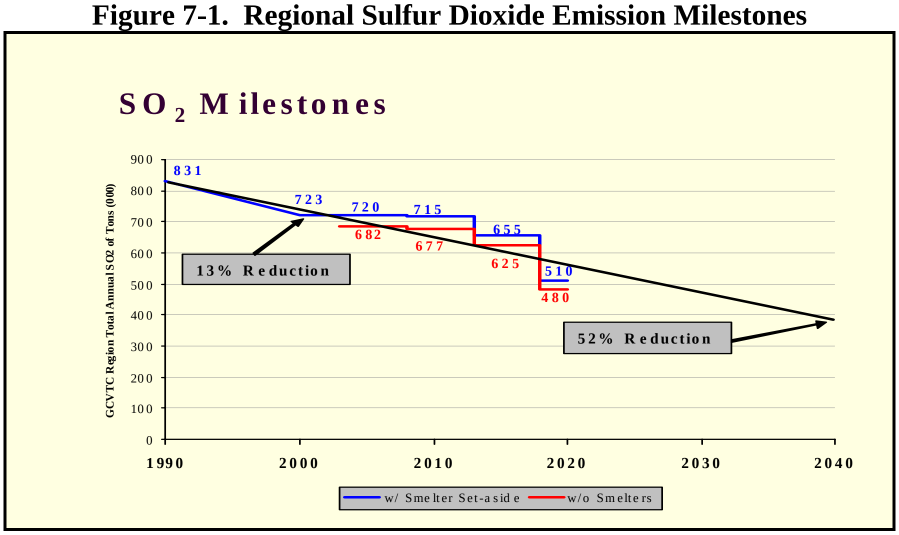
The Grand Canyon Visibility Transport Commission (GCVTC) studied the long-term projected changes of emissions from stationary sources. It was found that emissions of sulfur dioxide from stationary sources would decline by at least 13% between 1990 and 2000. Also, emissions of sulfur dioxide would continue to decline through 2040 when only 30% to 50% of the 1990 emission levels would remain. This decline was due to the normal turnover of source technology as older sources retire and are replaced by newer and cleaner technologies.

The GCVTC decided that the most effective way to address emissions of sulfur dioxide from stationary sources was to establish regional emission milestones and provide for a backstop program to achieve necessary emission reductions. If the emission reduction milestones are not achieved, then a backstop market trading program will be implemented.

In Section 309(d)(4)(ii-iv) of the Regional Haze Rule, EPA required the states to complete the development of a backstop market trading program for sulfur dioxide. The WRAP submitted the Annex to EPA in October 2000.[15] On June 5, 2003, EPA approved the program (68 FR 33764). Chapter 8 of this SIP contains the regional Sulfur Dioxide Milestones and Backstop Trading Program as required under Section 309(h) of the June 5, 2003, revised Regional Haze Rule. To keep the actual program as detailed in Chapter 8 intact, what follows here is a summary of the major elements of the program.

- Regional milestones, SO_2 emissions tracking requirements, and methodology the State of Arizona would use to determine allocations and manage the allowance tracking system should the program be "triggered" by the violation of any of the milestones as shown in Figure 7-1.

Figure 7-1. Regional Sulfur Dioxide Emission Milestones



[15] Western Regional Air Partnership. Voluntary Emissions Reduction Program for Major Industrial Sources of Sulfur Dioxide in Nine Western States and a Backstop Market Trading Program, An Annex to the Report of the Grand Canyon Visibility Transport Commission. Denver, CO. September 29, 2000.

- Description of the regulatory authority for the SO_2 Milestones and Backstop Trading Program. The Western Backstop SO_2 Trading Program Rule establishes the procedures and compliance requirements for the participating states, tribes, and affected sources. Appendix A-7a contains the State of Arizona's draft rule based on the Western Backstop SO_2 Trading Program Model Rule. This draft rule also contains requirements for participating sources under the pre-trigger portion of the program found in Section 8.2.1 of the SO_2 Milestones and Backstop Trading Program. The State of Arizona commits to the promulgation of a State rule for the Western Backstop SO_2 Trading Program as expeditiously as practicable.

- Authority to require major industrial sources of SO_2 to submit an annual emissions inventory in the pre-trigger phase of the program to measure compliance with the regional SO_2 milestones. The authority for Arizona to require sources to meet this requirement of Section 8.2.1 of the SO_2 Milestones and Backstop Trading Program is contained in the draft rule in Appendix A-7a. Again, the State of Arizona commits to the promulgation of a State rule for the Western Backstop SO_2 Trading Program as expeditiously as practicable.

- Establishment of a WRAP standing committee to develop the coordination procedures for the program. This "309 Coordinating Committee" will be formally proposed at the WRAP Board Meeting to be held in October 2003. Appendix A-7b contains the proposal approved by the WRAP Board on October 15, 2003 for the establishment of the WRAP 309 Coordinating Committee.

7.2. Monitoring and Reporting of Stationary Source Sulfur Dioxide Emissions.

Achievement of Greater Than a 13% Reduction in Sulfur Dioxide by 2000. One item that must be included in the first SIP under Section 309(d)(4)(i) is monitoring and reporting of stationary source sulfur dioxide (SO_2) emissions. This monitoring and reporting data must be sufficient to determine whether a 13 % reduction in actual stationary source SO_2 emissions has occurred between the years 1990 and 2000, and whether milestones required by Section 51.309(d)(4)(ii) have been achieved for the transport region. As shown in Table 7-1, regional SO_2 emission totals show that there has been a 25 percent reduction in these emissions from 1990 to 2000.[16] Details of the source of emission inventories used for this calculation are in the Chapter 4 of the WRAP TSD.

Table 7-1. State-by-State Comparison of 1990 and 2000 Stationary Source Sulfur Dioxide Emissions in the 9 GCVTC Transport Region States (tons per year)

States	**1990**	**2000**
Arizona	185,398	99,133
California	52,832	38,501
Colorado	95,534	99,161
Idaho	24,652	27,763
Nevada	52,775	53,943
New Mexico	177,994	117,344
Oregon	17,705	23,362
Utah	85,567	38,521
Wyoming	136,318	124,110
Totals	**828,775**	**621,838**

7.3.

16 *Year 2000 Point Source SO_2 Emissions Analysis - 9 State Western Region Report,* E.H. Pechan & Associates, Inc. for the Western Governors' Association; Denver, CO, May 2002.

Report on Assessment of NOx/PM Strategies

Provisions for Stationary Source NO_X and PM. Pursuant to 40 CFR 51.309(d)(4)(v), the State of Arizona has included in this SIP a report which assesses emissions control strategies for stationary sources of NOx and PM, and the degree of visibility improvement that would result from implementation of the identified strategies. The report, *Stationary Source NOx and PM Emissions in the WRAP Region: An Initial Assessment of Emissions, Controls, and Air Quality Impacts*, was prepared by the WRAP and is included in Appendix A-7c. The report represents the State of Arizona's initial assessment of stationary source NOx and PM strategies for regional haze. The State of Arizona has determined that NOx and PM strategies are not needed at this time. The State of Arizona commits to adopting long-term strategies and Best Available Retrofit Technology (BART) requirements for stationary sources of NOx and PM as a SIP revision in 2008 if Arizona determines such emission control strategies are needed to demonstrate reasonable progress.

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8. SO_2 MILESTONES AND BACKSTOP TRADING PROGRAM

8.1. Milestones and Determination of Program Trigger

8.1.1. Regional SO_2 Milestones

(1) Base Milestone Values. The regional sulfur dioxide base milestones for the years 2003 through 2018 are provided in Table 8-1. The base milestones will be adjusted annually as described in paragraphs 8.1.1(2), (3) and (4) of this plan.

Table 8-1. Base Sulfur Dioxide Emissions Milestones (excludes Smelter Set-aside)

Column 1	Column 2	Column 3
For the year	the base regional sulfur dioxide milestone is	and the annual SO_2 emissions for these years will determine whether emissions are greater than or less than the milestone
2003	682,000 tons SO_2	2003
2004	682,000 tons SO_2	Average of 2003 and 2004
2005	682,000 tons SO_2	Average of 2003, 2004 and 2005
2006	682,000 tons SO_2	Average of 2004, 2005 and 2006
2007	682,000 tons SO_2	Average of 2005, 2006 and 2007
2008	680,333 tons SO_2	Average of 2006, 2007 and 2008
2009	678,667 tons SO_2	Average of 2007, 2008 and 2009
2010	677,000 tons SO_2	Average of 2008, 2009 and 2010
2011	677,000 tons SO_2	Average of 2009, 2010 and 2011
2012	677,000 tons SO_2	Average of 2010, 2011 and 2012
2013	659,667 tons SO_2	Average of 2011, 2012 and 2013
2014	642,333 tons SO_2	Average of 2012, 2013 and 2014
2015	625,000 tons SO_2	Average of 2013, 2014 and 2015
2016	625,000 tons SO_2	Average of 2014, 2015 and 2016
2017	625,000 tons SO_2	Average of 2015, 2016 and 2017
2018	480,000 tons SO_2	Year 2018 only
2019 forward, until replaced by an approved SIP	480,000 tons SO_2	Annual; no multiyear averaging

(2) Adjustments for participation by eligible States and Tribes. The amount provided in Table 8-2 below will be subtracted from the milestone in Table 3 for each state and tribe that does not have an Implementation Plan approved by the EPA Administrator as meeting the requirements of 40 CFR 51.309 as of December 31 of the year following the milestone year. The first adjustment to the 2003 milestone will be made no later than March 31, 2005, and will be based on all states and tribes that do not have a federally-approved Implementation Plan as of December 31, 2004.

Table 8-2a. (Years 2003-2010) Amounts of SO_2 Tons To Be Subtracted from the Base Milestones for States and Tribes That Do Not Have an Approved Implementation Plan under 40 CFR 51.309*

State or Tribe	2003	2004	2005	2006	2007	2008	2009	2010
1. Arizona	117,372	117,372	117,372	117,372	117,372	117,941	118,511	119,080
2. California	37,343	37,343	37,343	37,343	37,343	36,363	35,382	34,402
3. Colorado	98,897	98,897	98,897	98,897	98,897	98,443	97,991	97,537
4. Idaho	18,016	18,016	18,016	18,016	18,016	17,482	16,948	16,414
5. Nevada	20,187	20,187	20,187	20,187	20,187	20,282	20,379	20,474
6. New Mexico	84,624	84,624	84,624	84,624	84,624	84,143	83,663	83,182
7. Oregon	26,268	26,268	26,268	26,268	26,268	26,284	26,300	26,316
8. Arizona	42,782	42,782	42,782	42,782	42,782	42,795	42,806	42,819
9. Wyoming	155,858	155,858	155,858	155,858	155,858	155,851	155,843	155,836
10. Navajo Nation	53,147	53,147	53,147	53,147	53,147	53,240	53,334	53,427
11. Shoshone-Bannock Tribe of the Fort Hall Reservation	4,994	4,994	4,994	4,994	4,994	4,994	4,994	4,994
12. Ute Indian Tribe of the Uintah and Ouray Reservation	1,129	1,129	1,129	1,129	1,129	1,129	1,129	1,129
13. Wind River Reservation	1,384	1,384	1,384	1,384	1,384	1,384	1,384	1,384

*These numbers differ from Annex opt-in/-out tables in that the smelter set-aside is excluded and the new source set-aside is included.

Table 8-2b. (Years 2011-2018) Amounts of SO_2 tons to be Subtracted from the Base Milestones for States and Tribes that do not have an Approved Implementation Plan under 40 CFR 51.309*

State or Tribe	2011	2012	2013	2014	2015	2016	2017	2018
1. Arizona	119,080	119,080	116,053	113,025	109,998	109,998	109,998	82,302
2. California	34,402	34,402	33,265	32,128	30,991	30,991	30,991	27,491
3. Colorado	97,537	97,537	94,456	91,375	88,294	88,294	88,294	57,675
4. Idaho	16,414	16,414	15,805	15,197	14,588	14,588	14,588	13,227
5. Nevada	20,474	20,474	20,466	20,457	20,449	20,449	20,449	20,232
6. New Mexico	83,182	83,182	81,682	80,182	78,682	78,682	78,682	70,000
7. Oregon	26,316	26,316	24,796	23,277	21,757	21,757	21,757	8,281
8. Utah	42,819	42,819	41,692	40,563	39,436	39,436	39,436	30,746
9. Wyoming	155,836	155,836	151,232	146,629	142,025	142,025	142,025	97,758
10. Navajo Nation	53,427	53,427	52,707	51,986	51,266	51,266	51,266	44,772
11. Shoshone-Bannock Tribe of the Fort Hall Reservation	4,994	4,994	4,994	4,994	4,994	4,994	4,994	4,994
12. Ute Indian Tribe of the Uintah and Ouray Reservation	1,135	1,135	1,135	1,135	1,135	1,135	1,135	1,135
13. Wind River Reservation	1,384	1,384	1,384	1,384	1,384	1,384	1,384	1,384

*These numbers differ from Annex opt-in/-out tables in that the smelter set-aside is excluded and the new source set-aside is included.

(3) Adjustment for Future Operation of Copper Smelters in Arizona and New Mexico. If either the BHP San Manuel smelter in Arizona or the Phelps Dodge Hidalgo smelter in New Mexico resumes

operation, the milestones will be increased as described below. The adjustment will occur only if the respective state has a State Implementation Plan approved by the EPA Administrator under 40 CFR 51.309. Once the adjustments have been made, the milestones will not be changed due to future suspensions or changes in plant operations, except as provided below. If Arizona or New Mexico elect not to submit a SIP under 40 CFR 51.309, the emissions for the smelters in the state opting out will be subtracted from the smelter set-aside.

(a) If one or both smelters resume operations under their existing permits, the milestone will be adjusted upward for each smelter respectively by the following amounts:

1. Phelps Dodge Corporation, Hidalgo Smelter: 22,000 tons SO_2
2. BHP, San Manuel Smelter: 16,000 tons SO_2
3. For the 2013 through 2018 milestones, the maximum increase will be 30,000 tons SO_2.

(b) If Arizona or New Mexico determines that either smelter will resume operation by operating only a portion of the plant, the milestone adjustment in (a) will be reduced by a percentage to reflect current conditions. If the smelter resumes normal operations at a later date, the full adjustment described in (a) will be applied.

(c) If one or both smelters resume operations after going through new source review, the milestone adjustment will be based on the new permitted level for the source, but in no instance may the adjustment to the milestones exceed 22,000 tons SO_2 per year for the Hidalgo Smelter or 16,000 tons SO_2 per year for the San Manuel Smelter.

(d) If one or both smelters do not resume operation, the State of Arizona will determine, based on the calculation procedures in section 8.1.3(4) of this plan, the amount of source-specific set aside that will be added to the milestone to account for capacity expansion at the remaining smelters. This set-aside will only be available for use if sulfur input and emissions from the copper smelters are above the baseline level listed in Table 8-3 in any particular year as a result of increased capacity. The increase to the milestone will be based on a smelter's proportional increase above its baseline sulfur input. The set-aside will be recalculated every year to reflect actual operations of the remaining copper smelters. The set-aside may not be traded under the backstop trading program.

Table 8-3. Preliminary Smelter-Specific Set Aside

Company/Smelter	Baseline Sulfur Input	Baseline Allocation	Smelter-specific Set-aside
BHP San Manuel	417,200 tons	16,000 tons SO_2	1,500 tons SO_2
Asarco Hayden	235,000 tons	23,000 tons SO_2	3,000 tons SO_2
Phelps Dodge Chino	212,800 tons	16,000 tons SO_2	3,000 tons SO_2
Phelps Dodge Hidalgo	256,800 tons	22,000 tons SO_2	4,000 tons SO_2
Phelps Dodge Miami	208,700 tons	8,000 tons SO_2	2.000 tons SO_2
Kennecott Copper Corporation, Smelter and Refinery	340,269 tons	1,000 tons SO_2	100 tons SO_2
TOTAL	**1,670,769 tons**	**86,000 tons SO_2**	**13,600 tons SO_2**

(4) Other Milestone Adjustments.

(a) All other milestone adjustments will require a SIP revision. Section 8.1.3(3) of this plan outlines adjustments to be made to the emissions inventory to ensure a consistent comparison to the milestones. These adjustments will be incorporated into the milestones every five years as part of the periodic SIP revisions required by 40 CFR 51.309(d)(10). Adjustments to the milestones shall be tracked in the annual emissions report in section 8.1.3(3) of this plan.

(b) Within ninety days of the periodic SIP revision incorporating adjustments based on section 8.1.3(3) of this plan, the State of Arizona shall provide notice to sources whose records were used to calculate the adjustments, including the date of the SIP revision reflecting the milestone adjustment to sources whose records were used as the basis for the milestone adjustment and a statement that the source needs to retain the record for at least five years from the date of the SIP revision, or ten years from the date of establishing the record, whichever is longer.

8.1.2. <u>Regional Program Administration</u>

(1) Pre-trigger tracking of regional SO_2 emissions. The State of Arizona will work cooperatively with the states and tribes that are participating in the SO_2 Milestones and Backstop Trading Program to ensure that an emission tracking system for the regional SO_2 inventory is developed and maintained. The State of Arizona is responsible for all regional program administration functions as described in this plan. The State of Arizona will perform these functions using the Western Regional Air Partnership (WRAP) as the State of Arizona's agent. The WRAP compiled the SO_2 emission inventories that were used during the development of the Annex, and the WRAP continues to refine and improve the overall tracking system for the regional haze. The WRAP will maintain the outlined pre-trigger emissions tracking functions in the foreseeable future. If the WRAP is no longer able to fulfill this function, then the State of Arizona will ensure that other arrangements are made, either through a different regional organization or through a contractor, to maintain the SO_2 tracking system that is described in this plan. The WRAP has no authority to make regulatory determinations. The WRAP has limited authority under this plan to perform tracking and accounting functions, prepare reports, and perform other administrative functions as directed by the State of Arizona. The State of Arizona will work expeditiously to correct any problems if the WRAP fails to perform any of the functions described in this plan in a timely manner.

(2) Designation of the Tracking System Administrator. If the backstop trading program is triggered due to an exceedance of the SO_2 milestones as outlined in section 8.1.3 of this plan, the State of Arizona will work cooperatively with the other participating states and tribes to designate one Tracking System Administrator (TSA). The TSA will be designated as expeditiously as possible, but no later than six months after the program trigger date. In addition, before the TSA is designated, the State of Arizona will enter into a binding contract with the TSA that will require the TSA to perform all TSA functions described in this plan. The State of Arizona has sufficient authority under State contract law to ensure that the functions in this plan are carried out by the TSA.

(3) Information Provided by other States and Tribes. The State of Arizona will accept the emission inventory and permitting information provided by the other participating states and tribes in order to determine the milestone value and program trigger if such other states and tribes have provided proper documentation and followed the public notification process in their federally approved implementation plans.

8.1.3. <u>Determination of Program Trigger</u>

(1) Until the program has been triggered and source compliance is required, the State of Arizona will submit an annual emissions report to the WRAP and all participating states and tribes by September 30 of each year. The report will document actual sulfur dioxide emissions during the previous calendar year for all sources subject to the Sulfur Dioxide Milestone Inventory requirements. The first report for calendar year 2003 will be submitted by September 30, 2004. The State of Arizona will prepare the supporting documentation that is included with the annual emissions report as noted in (2) and (3) below.

(2) The annual emissions report for Arizona will include a source emissions change report that contains the following information:

(a) identification of any new sources that were not contained in the previous calendar year's emissions report, and an explanation of why the source is now included in the program;

(b) identification of any sources that were included in the previous year's report and are no longer included in the program, and an explanation of why this change has occurred; and

(c) an explanation for increases or decreases of emissions at any applicable source or more than twenty percent from the previous year.

(3) The annual emissions report for Arizona will include the proposed emission adjustment as described in (a) through (c) to ensure a consistent comparison to the milestones.

(a) Changes in flow rate measurement methods. Actual emission inventories for utilities that use EPA's Reference Method 2F, 2G, or 2H to measure stack flow rate will be adjusted to be comparable with the flow rate assumptions that were used in 1999, the base year inventory for the Annex. The adjustment may be calculated using any of the following three methods, and emissions for the year 2018 will not be adjusted.

(i) Directly determine the difference in flow rate through a side-by-side comparison of data collected with the new and old flow reference methods during a relative accuracy test audit (RATA) test.

(ii) Compare the annual average heat rate using Acid Rain heat input data (MMBtu) and total generation (MWHrs) as reported to the Federal Energy Information Administration. Under this approach, the flow adjustment factor will be calculated using the following ratio:

<u>Heat input/MW for first full year of data using new flow rate method /</u>
Heat input/MW for last full year of data using old flow rate method.

(iii) Compare the standard CFM per MW before and after the new flow reference method based on CEMs data submitted in the Acid Rain Program, as follows:

<u>SCF/Unit of Generation for first full year of data using new flow rate method</u>
SCF/Unit of Generation for last full year of data using old flow rate method.

(b) Changes in emission monitoring or calculation methods. Actual emission inventories for sources that change the method of monitoring or calculating their emissions will be adjusted to be comparable to the emission monitoring or calculation method that was used in the base year inventory for the Annex (1999 for utilities and 1998 for all other sources).

(c) Changes due to enforcement actions.

(i) Adjustments due to enforcement actions arising from settlements. Adjustments to the milestones shall be made, as specified in section 8.1.3(3) and (4), if:

(A) an agreement to settle an action, arising from allegations of a failure of an owner or operator of an emissions unit at a source in the program to comply with applicable regulations which were in effect during the base year, is reached between the parties to the action;

(B) the alleged failure to comply with applicable regulations affects the assumptions that were used in calculating the source's base year and forecasted sulfur dioxide emissions; and

(C) the settlement includes or recommends an adjustment to the milestones.

(ii) Adjustments due to enforcement actions arising from administrative or judicial orders. Adjustments to the milestones shall be made as directed by any final administrative or judicial order, as specified in section 8.1.3(3) and (4). Where the final administrative or judicial order does not include a reforecast of the source's baseline, the State of Arizona shall evaluate whether a reforecast of the source's baseline emissions is appropriate.

(iii) Adjustments method and effective dates. Based on section 8.1.3(3) and (4), the milestone must be decreased by an appropriate amount based on a reforecast of the source's decreased sulfur dioxide emissions. The adjustments do not become effective until after the source has reduced its sulfur dioxide emissions as required in the settlement agreement, or administrative or judicial order. All adjustments based upon enforcement actions must be made in the form of an SIP revision that complies with the procedural requirements of 40 CFR 51.102 and 51.103.

(iv) Documentation of adjustments for enforcement actions. In the periodic plan revision required under 40 CFR 51.309(d)(10), the State of Arizona shall include the following documentation of any adjustment due to an enforcement action:

(A) identification of each source under the State of Arizona 's jurisdiction that has reduced sulfur dioxide emissions pursuant to a settlement agreement or an administrative or judicial order;

(B) for each source identified, a statement indicating whether the milestones were adjusted in response to the enforcement action;

(C) discussion of the rationale for the State of Arizona 's decision to adjust or not to adjust the milestones; and

(D) if SO_2 emissions reductions over and above those reductions needed for compliance with the applicable regulations were part of an agreement to settle an action, a statement indicating whether such reductions resulted in any adjustment to the milestones or allowance allocations, and a discussion of the rationale for the State of Arizona 's decision on any such adjustment.

(4) The annual sulfur dioxide milestone and emissions report for Arizona will document any adjustments that should be made to the milestone for the previous year as follows.

(a) The State of Arizona will document the submittal date of this Implementation Plan to implement the regional WEB Trading Program, and the approval date by the EPA Administrator, if applicable.

(b) If actual emissions and sulfur input are greater than the baseline level in Table 3, and either the BHP San Manuel smelter in Arizona or the Phelps Dodge smelter in New Mexico have not resumed operation, the State of Arizona will determine the milestone adjustment for all copper smelters in Arizona by determining the increase in the milestone based on the proportional increase in sulfur input over baseline levels. For each smelter, the adjustment will not exceed the smelter-specific set-aside listed in Table 8-3.

(c) Arizona shall determine the status of BHP San Manuel copper smelter during the previous year. If the smelter resumed operation during the milestone year, the report shall include:

(i) the date the smelter resumed operation;

(ii) a determination by Arizona that either,

(A) the smelter resumed production consistent with past operations,

(B) the smelter was required to go through new source review, in which case Arizona shall include the new SO_2 permitted limit for BHP San Manuel in the report, or

(C) the smelter resumed operations in a substantially different manner such that emissions will be less than for past operations, in which case Arizona shall determine expected emissions from the operations.

(d) a proposed adjustment to the sulfur dioxide milestone to account for the operation of the BHP San Manuel smelter.

(e) Comparison of actual emissions from all smelters in [state] to the baseline emissions level for that smelter listed in Table 3. If actual emissions and sulfur input are greater than the baseline levels in Table 3, and either the BHP San Manuel smelter in Arizona or the Phelps Dodge smelter in New Mexico have not resumed operation, [state] shall determine the milestone adjustment by determining the increase in the milestone based on the proportional increase in sulfur input over baseline levels. For each smelter, the adjustment shall not exceed the smelter-specific set-aside listed in Table 3.

The following example is for illustrative purposes:

Asarco's baseline SO_2 emissions are 23,000 tons
Asarco's baseline sulfur input is 235,000 tons

For example, in 2005:

Asarco's $S0_2$ emissions were 25,000 tons
Asarco's sulfur input was 250,000 tons.

Because Asarco's 2005 emissions and sulfur input exceeded it's baseline emissions and sulfur input: need to calculate the percent increase in sulfur input in the year 2005
= [(2005 sulfur input) - (baseline sulfur input)] ÷ [baseline sulfur input]
= [250,000 - 235,000] ÷ [235,000]

= [15,000] ÷ [235,000]
= 0.0638
= 6.38%

The adjustment to the milestone based on Asarco's increase in production is to increase the milestone by 1,564 tons of SO_2 (which is ok, since it is less than the maximum of 3,000 tons in Table 3 for Asarco).
adjustment = 6.38% x baseline emissions
adjustment = 6.38% x 23,000

(5) *Compilation of Reports*.

(a) The WRAP will compile the annual emissions reports submitted by all participating states and tribes into a draft regional emission report for sulfur dioxide. The WRAP will follow additional quality assurance procedures developed by states and tribes to identify possible errors in the emissions data, including screening for missing or added sources, name changes, and significant changes in reported emissions. Any questions or anomalies regarding Arizona's report will be resolved by the State of Arizona for resolution prior to the submission of the draft regional emission report.

(b) By December 31 of each year, the WRAP will submit the draft regional emission and milestone report to the State of Arizona and all participating states and tribes and will post the report on the WRAP's web page. The report will include the following information for all states and tribes that have an implementation plan that has been approved by the EPA Administrator under 40 CFR 51.309(h):

(i) Actual regional sulfur dioxide emissions in tons per year,
(ii) Adjustments to account for:
(A) changes in flow rate measurement methods,
(B) changes in emission monitoring or calculation methods, and
(C) enforcement actions or settlement agreements as a result of enforcement actions;
(iii) average adjusted emissions for the last three years for comparison to the regional milestone, if adjustments were made.
(iv) regional milestone adjustments to account for participation by eligible states and tribes and the future operation of smelters in Arizona and New Mexico. A separate report that includes additional states and tribes that have submitted implementation plans that are still under review by the Environmental Protection Agency will also be prepared for information purposes.

(6) The State of Arizona will evaluate the draft regional emissions report and will propose a draft determination that the sulfur dioxide milestone has either been met in the region, or has been exceeded. In the event that the TSA has not submitted a draft regional emissions and milestone report to the State of Arizona by the December 31 deadline for any year, the State of Arizona will prepare the report for that year based upon the annual emissions reports submitted by all participating states and tribes to the WRAP for that year. The State of Arizona will modify the data in these annual emissions reports, or use data where such report(s) have not been submitted, based upon direction received from the Environmental Protection Agency.

(7) The State of Arizona will advertise availability of the draft regional emissions report and will notify the public of the draft determination by publishing a notice in newspapers of general circulation

throughout Arizona. A 30-day public comment period will be established, and a public hearing will be held during the public comment period. The State of Arizona will also submit the draft determination to EPA for review and comment concurrently.

(8) The State of Arizona will consider any comments received during the comment period, and will submit a copy of all comments to the WRAP and to all participating states and tribes along with a response that addresses the comments.

(9) The WRAP will compile the comments and responses from all participating states and tribes and prepare a draft final regional emissions report. The report will be submitted to the states and tribes that are participating in the program and, if necessary, the report will propose a common program trigger date.

(10) The State of Arizona will review and approve the final regional emissions report. The State of Arizona will then submit this report to the Environmental Protection Agency along with a final determination that the milestone either has been met in the region, or that the milestone has been exceeded and the WEB Trading Program has been triggered in Arizona. This determination will be submitted to the Environmental Protection Agency by the end of March, fifteen months following the milestone year. The first determination will be submitted by March 31, 2005, for the 2003 milestone. If the milestone has been exceeded, the common trigger date proposed in the regional report will become the program trigger date for purposes of implementing the WEB Trading Program. In the event that the program trigger date must be established by the State of Arizona in the absence of a regional emissions and milestone report prepared by the WRAP, the program trigger date will be March 31 of the applicable year.

(11) The State of Arizona will publish a notice of the final determination in newspapers of general circulation throughout the state of Arizona. This notice will include the milestone and the final annual regional SO_2 emissions for that year. If the milestone has been exceeded, the notice will specify the program trigger date and the first year that WEB sources must be in compliance with the WEB Trading Program provisions.

8.1.4. <u>Year 2013 Assessment</u>

(1) Initial Assessment in 2013 Periodic SIP Review.

(a) The State of Arizona will work cooperatively through the WRAP with other participating states and tribes to develop a projected emission inventory for SO_2 through the year 2018, using the 2010 regional inventory as a baseline. This projected inventory will be included in the 2010 annual emission and milestone report that will be completed in March 2012 as outlined in section 8.1.3 of this plan.

(b) The State of Arizona will evaluate the projected inventory, and based upon this information will make an assessment of the likelihood of meeting the regional milestone for the year 2018. The State of Arizona will include this assessment as part of Arizona's progress report that must be submitted by December 31, 2013, as required by 40 CFR 51.309(d)(10).

(2) Regional Emissions Report for 2012.

(a) The State of Arizona will prepare an SO_2 emission report for the year 2012 by September 30, 2013, as described in section 8.1.3(1) of this plan. The State of Arizona will include a list of all known or anticipated sources in Arizona that are anticipated to affect total SO_2 emissions in 2018.

This may include permitted sources, projects that are still in the planning stage, or projections from the affected sources of anticipated emissions in 2018. The status of these projects will be described to provide a better understanding of the degree of certainty that individual projects will be completed by 2018.

(b) The WRAP will compile the information from all participating states and tribes, prepare draft SO_2 inventory projections for the year 2018, and estimate the effect of known future sources on SO_2 emissions. Projected 2018 emissions will be compared to the 2018 milestone. This information will be included in the draft regional emissions report for 2012 that will be submitted to the State of Arizona by December 31, 2013, as outlined in section 8.1.3(5) of this plan.

(3) Consensus Decision. The State of Arizona commits to meet with the participating states and tribes in March 2014 to discuss any comments received on the 2018 emission projections in the draft report. The participating states and tribes will decide, through a consensus process, whether it is necessary to trigger the WEB trading program early in order to meet the SO_2 emission reduction goals in 2018.

(4) Early Trigger: Timing. If the participating states and tribes unanimously decide in the March 2014 meeting that an early trigger of the backstop trading program is necessary, the State of Arizona will trigger the WEB Trading Program and the timing of the program elements will be adjusted as follows to ensure that the WEB Trading Program is in place in 2018.

(a) The date of the consensus decision by the participating states and tribes to voluntarily trigger the WEB trading program will become the program trigger date.

(b) Allowances for 2018 will be distributed to WEB sources by January 1, 2015.

(c) The first control period will be the year 2018. WEB sources will need to demonstrate at the end of the first control period that they have enough allowances to cover their 2018 SO_2 emissions.

(5) Public Notification. The State of Arizona will publish notice of the decision in newspapers of general circulation in Arizona. If applicable, the notice will include a statement that the WEB Trading Program is in effect and will specify the program trigger date.

8.1.5. Special Penalty Provisions for the 2018 Milestone

If the WEB Trading Program is triggered as outlined in the section 8.1 of this plan, and the first control period will not occur until after the year 2018, a special penalty shall be assessed for the exceedance of the 2018 milestone.

(1) The State of Arizona will allocate allowances to all WEB sources using the methods established in the 2013 SIP revision described in section 8.4 of this plan. WEB sources will have the option to buy and sell allowances during a two-month allowance transfer period.

(2) At the end of this two-month allowance transfer period, compliance with the allowance limitation will be determined. Penalties will be assessed for SO_2 emissions that are greater than the allowance limitation for each WEB source. However, SO_2 emissions in the year 2018 for each WEB source will be determined in accordance with the Sulfur Dioxide Milestone Inventory requirements.

(3) The 2018 special penalty provision shall continue to be applied each year after 2018 until the 2018 milestones have been achieved.

8.2. Pre-Trigger Emissions Tracking Requirements

8.2.1. SO_2 Emission Inventory

40 CFR 51.309 sets forth emissions inventory requirements for tracking compliance with the SO_2 milestones. Arizona's Article 3 (Permits and Permit Requirements) and Article 7 (Existing Stationary Source Performance Standards) in addition to the requirements of the state-specific WEB Trading Program rule, contain the inventory requirements to satisfy the needs of this program.

(1) Applicability. The sulfur dioxide milestone inventory requirements of R18-2-306 require all stationary sources with actual emissions of 100 tons per year or more of SO_2 in the year 2000, or in any subsequent year, to submit an annual inventory of SO_2 emissions, beginning with the 2003 emission inventory. A source that meets these criteria and then emits less than 100 tons per year in a later year must continue to submit an SO_2 inventory for tracking compliance with the regional SO_2 milestones until 2018 or until the WEB Trading Program has been fully implemented and emission tracking is occurring under the state-specific rule, whichever is earlier.

(2) Enforceable requirements for WEB sources as found in the state-specific rule.

(a) Each source shall submit an annual inventory of SO_2 emissions and smelters also must submit an annual report of sulfur input in tons per year.

(b) Each source shall use appropriate emission factors and estimating techniques and document the emissions monitoring or estimation methodology used.

(c) Each source shall include emissions from start up, shut down, and upset conditions in the annual total inventory.

(d) Each source subject to the federal acid rain program shall use methods from 40 CFR Part 75 to report emissions from all sources.

(e) Each source shall include the rate and period of emissions, the specific installation that is the source of the air pollution, composition of air contaminant, type and efficiency of the air pollution control equipment and other information necessary to quantify operation and emissions, and to evaluate pollution control.

(f) Each source shall retain records for a minimum of 10 years from the date of their creation, or if the record was the basis for an adjustment to a milestone, 5 years from the date of a SIP revision, whichever is longer.

(3) The State of Arizona will quality-assure the submitted inventory data as outlined in the Inventory Preparation Plan. The State of Arizona will screen the inventories to identify changes in emission measurement techniques that would require an inventory and milestone adjustment as outlined in section 8.1 of this plan.

(4) The State of Arizona will retain historical emission inventory records for non-utilities from 1996 and 1998 that may affect milestone calculations under section 8.1 of this plan and allocation decisions under section 8.1 of this plan until the year 2018 to ensure that changes in emissions monitoring techniques can be tracked.

8.2.2. Development of Emission Tracking System

The State of Arizona will work cooperatively with the states and tribes that are participating in the WEB Trading Program to ensure that an emission tracking system for the regional SO_2 inventory is developed and maintained.

8.2.3. Periodic Audit of Pre-Trigger Emission Tracking Database

(1) During the pre-trigger phase when the State of Arizona is tracking compliance with the regional SO_2 milestones, the State of Arizona will work cooperatively with the participating states and tribes to ensure that an independent audit of the tracking database is conducted to make sure that the WRAP is accurately compiling the regional emissions report.

(a) The first audit will occur during the year 2006 and will review data collected during the first two years of the program.

(b) Subsequent audits will occur in 2011, which will cover emissions years 2005-2009, and 2016, which will cover emissions years 2010-2014.

(2) The primary focus of the audit will be the process that is used to compile the regional inventory from the data provided by each state and tribe, and the tracking of accumulated changes during the period between SIP revisions. The audit will also review the accuracy and integrity of the regional reports that are used to determine compliance with the milestones. The audit will not be a full review of Arizona's process for compiling and reporting SO_2 emissions, but will include a broad review of Arizona's inventory management and quality assurance systems, including the presence and exercise of systems to assure data quality and integrity.

(3) The audit will discuss the uncertainty of emissions calculations, and whether this uncertainty is likely to affect the annual determination of whether the milestone is exceeded. It will identify any recommended changes to emissions monitoring or calculation methods or data quality assurance systems. It will also review and recommend any changes to improve the administrative process of collecting the annual emissions data at the state and tribal level, compiling a regional emission inventory, and making the annual determination of whether the WEB Trading Program has been triggered.

(4) Changes to the WEB trading program, including any changes to the milestones due to the results of these periodic audits, will be submitted to EPA as a SIP revision as part of the five-year SIP review required by 40 CFR 51.309(d)(10).

(5) The State of Arizona will advertise the availability of the draft audit report by publishing a notice in newspapers of general circulation in Arizona. A 30-day public comment period will be established, and a hearing will be held during the public comment period. The State of Arizona will respond to comments and provide notice of the availability of the final audit report. The State of Arizona will submit the final audit report to the EPA regional office.

8.3. WEB Trading Program Requirements

8.3.1. Initial Allocation of SO_2 Allowances

(1) Draft Allocation Report. Within six months of the program trigger date, as outlined in section 8.1.3(11) of this plan, the State of Arizona will submit a draft allocation report to all participating states and tribes and to the TSA. This report will contain the following information:

(a) A list of all WEB sources in Arizona as defined in the state-specific rule. Those sources are grouped into two categories:

(i) Category 1: WEB sources that commenced operation prior to January 1, 2003. These sources will receive a floor allocation and will be eligible for the reducible portion of the allocation.

(ii) Category 2: WEB sources that commenced operation on January 1, 2003 or a later date. These sources will receive a floor allocation, but will not be eligible for the reducible allocation. The floor allocation for Category 2 sources will be deducted from the new source set-aside.

WEB sources that have received a retired source exemption will be included in the allocation process in the same manner as WEB sources that are currently operating. However, sources that were permanently shut down prior to the program trigger date are not considered WEB sources and would therefore not be included in the allocation process.

(b) The floor allocation for all WEB sources in Arizona.

(i) For non-utility category 1 WEB sources, the floor allocation shall be as established in the E.H. Pechan Report, *Market Trading Forum Non-Utility Sector Allocation Final Report from the Allocations Working Group* (November 2002). The Pechan Report can be found in Appendix A-8a. If any additional category 1 sources are identified, the State of Arizona shall calculate a floor allocation using the methodology outlined in the E.H. Pechan Report.

(ii) For utility category 1 WEB sources, the floor will be calculated by first assigning a "clean unit" emission rate to each unit. The clean unit emission rate will then be multiplied by an annual heat input (MMBtu) that represents a realistic upper bound for the unit.

[**Note:** The floor level approach described above is designed to address equity issues regarding the allocation process for utilities. The State of Arizona is participating in ongoing discussions with the other participating states, tribes and regional stakeholders to ensure that all equity issues have been addressed.]

Principles

- Each unit will have enough allowances to operate as a clean source and at an operating rate (capacity factor) that is a realistic upper bound for the unit.
- There will not be significant winners and losers in this process.
- The focus is on a fair approach that is applied equally to all sources rather than on state and tribal budgets.
- The allocation process will use data that reflect current conditions, including current monitoring methodologies.

Equity Issues

- Sources that are currently burning very low sulfur coal may see changes in their supply in the future. Historic actual emissions may not reflect future operations.

- Sources that are currently operating at a low utilization may not reach full capacity in the future. Assumptions about growth that are realistic on the regional level may provide a windfall to some sources, and not provide adequate allowances for other sources.

- There are some utility units in the region that are not BART-eligible and are operating at a low level of control for SO_2. The relative responsibility of BART-eligible vs. non-BART-eligible is a consideration in the process.

- Sources that are operating at a high level of control are already bearing the cost of control and this affects their ability to compete in the market.

- Sources that have no SO_2 controls are facing a large expense that could affect their ability to continue to operate.

- Emission rate disparities exist throughout the region.

(iii) For Category 2 WEB sources the floor allocation shall be the lower of the permitted SO_2 annual emissions for the WEB source, or SO_2 annual emissions calculated based on a level of control equivalent to BACT and assuming 100% utilization of the WEB source.

(c) A list of certified early reductions, expressed as tons of SO_2. Early reductions will be calculated and certified as follows:

(i) Any WEB source that installs control technology and accepts new permit emissions limits that are, for a non-utility source, below its floor as established in this section, or, for a utility source, below BACT, may apply for an early reduction credit. The application must show that the floor was calculated in a manner that is consistent with the monitoring requirements and the new permit must contain monitoring requirements that are consistent with the state-specific rule. The credits accumulate from the time the new controls come on line until the program trigger date and will be allocated to the WEB source over a 10 year period. The use of early reduction credits in any control period is limited to no more than five percent, system-wide, of the existing available allowances, as provided in section 8.1.3(2)(f) of this plan.

(ii) The State of Arizona will review the application and will certify early reductions for each full year between 2003 and the program trigger year that meet the requirements of the state-specific rule and this plan.

(iii) A source's certified early reductions for all years will be added together to obtain the total certified early reductions for that source.

(d) A list of all renewable energy plants and sources in Arizona that began operation after October 1, 2000, and the MW of installed nameplate capacity for each of these resources. Renewable energy credits will be granted at a rate of 2.5 tons per MW, and will accumulate from the beginning of the facility's operation. Their use in any control period is limited to no more than five percent, system-wide, of the existing available allowances, as provided in section 8.1.3(2)(g) of this plan.

(e) Historical SO_2 emissions data for all Category 1 sources for the purposes of calculating the reducible allocation.

(i) For utilities, the average of the years 2000 – 2002. Another time period may be used for individual emission units, if needed, to be representative of normal operating conditions.

(ii) For non-utilities, the average of annual SO_2 emissions for the years 1996 and 1998.

(f) Changes due to enforcement actions or settlement agreements as a result of enforcement actions. The adjustment shall be determined in accordance with section 8.1.3 of this SIP. The difference between the WEB source's allocations prior to enforcement and after the enforcement action shall be removed from the allocation pool.

(2) Compiled Allocation Report.

The TSA will compile the information provided by all participating states and tribes into a draft regional allocation report, and will submit this draft regional report to the State of Arizona and all participating states and tribes for review and comment thirty days after receiving the preliminary allocation reports. The draft regional allocation report will include a proposed budget for each state and tribe and the proposed allocation for each WEB source in Arizona.

The following methodology for calculating the proposed regional allocation for utilities and non-utilities is based on the assumption that the states of Arizona, Oregon, New Mexico, Utah and Wyoming are the only participating states in the WEB Trading Program. These 5 states are actively pursuing a SIP under section 309 of the Regional Haze Rule and it is unlikely that any other states will be able to develop a SIP under section 309 by the deadline of December 31, 2003. The State of Arizona will work closely with the other four states that are developing 309 SIPs to ensure that the regional allocation is distributed consistently and fairly and to address any change in status that may affect this process. Tribal nations may participate in the program at a later date under the provisions of the Tribal Authority Rule. There are currently four category 1 sources operating on tribal lands under the jurisdiction of three tribal nations. The following methodology will remain unchanged if any of these tribal nations opt in to the program at a later date because the allocation for any of the four existing tribal sources will be covered by the opt-in adjustment for the tribe, and the allocation for any new sources will be covered by the regional new-source set-aside.

(a) Table 8-4 shows the calculation of the available allocation for existing sources. The base milestone for the 5-state region (i.e., those states currently committed to a SIP under Section 309; namely: Arizona, New Mexico, Oregon, Utah, and Wyoming) calculated in accordance with section 8.1 of this plan is the starting point. The base milestone does not include the smelter set-aside. 20,000 tons of SO_2 is then subtracted for a tribal set-aside.

Table 8-4. Utility/Non-utility Split.

	Base Milestone from Table 2	Tribal Set-Aside	New Source Set-aside	Remaining Allocation	Utility Portion	Non-utility portion
2003	446,904	20,000	6,390	420,514	275,027	145,488
2004	446,904	20,000	6,390	420,514	275,027	145,488
2005	446,904	20,000	6,390	420,514	275,027	145,488
2006	446,904	20,000	6,390	420,514	275,027	145,488
2007	446,904	20,000	6,390	420,514	275,027	145,488
2008	447,014	20,000	12,902	414,112	275,636	138,476
2009	447,123	20,000	12,902	414,221	275,708	138,513
2010	447,333	20,000	12,902	414,331	275,782	138,549
2011	447,333	20,000	12,902	414,331	275,782	138,549
2012	447,333	20,000	12,902	414,331	275,782	138,549
2013	435,455	20,000	19,370	396,085	259,171	136,914
2014	423,676	20,000	19,370	384,306	251,463	132,843
2015	411,898	20,000	19,370	372,528	243,757	128,771
2016	411,898	20,000	19,370	372,528	243,757	128,771
2017	411,898	20,000	19,370	372,528	243,757	128,771
2018	309,087	20,000	19,370	269,717	155,367	114,350

(b) Table 8-5 shows the new source set-aside for the 5-state region.

(i) The new source set-aside is calculated by subtracting the new source set-aside adjustment listed in Table 8-5 for all states and tribes that do not have a federally approved Implementation Plan for the WEB trading program under 40 CFR 51.309 as of the program trigger date from the maximum possible set-aside for each of the first five years of the trading program.

Table 8-5. New Source Set-Aside Adjustment

	2003 - 2007	**2008 - 2012**	**2013 - 2018**
Maximum Possible Set-Aside	9,000	18,000	27,000
State or Tribe	**Adjustment (tons/yr SO_2)**		
1. Arizona	1,757	3,596	5,437
2. California	559	1,039	1,532
3. Colorado	1,480	2,945	4,364
4. Idaho	270	496	721
5. Nevada	302	618	1,011
6. New Mexico	1,267	2,512	3,889
7. Oregon	393	795	1,075
8. Arizona	640	1,293	1,949
9. Wyoming	2,333	4,706	7,020
10. Tribes	No adjustment needed	No adjustment needed	No adjustment needed

(ii) Subtract the floor allocation for all WEB sources in the region that were identified as Category 2 from the new source set-aside for the 5-state region to determine the available allocation for new sources that begin operation after the program trigger date. The allocation process for these new sources is described in section 8.3.3 of this plan.

Example calculation of the new source set-aside.
The example uses the following assumptions:
(i) Emissions exceed the milestones based on an average of the years 2003-2005.
(ii) The program trigger date is March 31, 2007.
(iii) The first 5 years of the program are 2011-2015.
(iii) Five states are participating in the program (AZ, NM, OR, UT, WY).
(iv) New sources that commenced operation between January 1, 2003 and the program trigger date have a total floor allocation of 6,000.

	2011	**2012**	**2013**	**2014**	**2015**
Maximum Possible Set-Aside	18,000	18,000	27,000	27,000	27,000
5-State Adjustment	- 5,098	-5,098	-7,628	-7,628	-7,628
Floor for Category 2 Sources	-6,000	-6,000	-6,000	-6,000	-6,000
Remaining New Source Set-aside	6,902	6,902	13,372	13,372	13,372

(c) The remaining allocation shown in Table 8-5 is available for distribution to category 1 sources. The final two columns in Table 8-5 split this remaining allocation into a utility allocation and a non-utility allocation. Apply any milestone adjustments due to the smelter set-aside as outlined in section 8.1 of this plan to the non-utility allocation listed in Table 8-5.

(d) Subtract the floor allocations for all category 1 utility and non-utility sources in the region from the utility allocation or the non-utility allocation.

(e) Calculate the early reduction allocation.

(i) Divide the number of certified early reduction credits for all WEB sources in the region by ten.

(ii) Add the utility allocation for 2018 to the non-utility allocation for 2018 and then multiply this total by 0.05.

(iii) If the product of paragraph (i) is no more than the product of paragraph (ii), the product of paragraph (i) is the early reduction allocation, and each source is allocated ten percent of its early reduction credits.

(iv) If the product of paragraph (i) is more than the product of paragraph (ii), the early reduction allocation for the region is the product of paragraph (ii). To determine a source's allocation, divide the product of paragraph (ii) by 0.10 times the total number of early reduction credits and apply that ratio to the early reduction credits claimed by the source.

(v) Split the regional early reduction allocation based on the ratio of utility to non-utility allocations in 2018 and subtract the early reduction allocation from the utility and non-utility allocation totals.

(vi) The early reduction allocation will be calculated in a similar manner for the second five-year allocation period under this program, and will then be discontinued for any future allocation periods.

(g) Calculate the regional renewable energy allocation.

(i) Add together the reported MW of installed nameplate capacity for renewable energy facilities reported by the participating states and tribes, and then multiply this number by 2.5.

(ii) Add the utility allocation for 2018 to the non-utility allocation for 2018 and then multiply this total by 0.05.

(iii) If the product of paragraph (i) is no more than the product of paragraph (ii), the product of paragraph (i) is the renewable energy allocation.

(iv) If the product of paragraph (i) is greater than or equal to the product of paragraph (ii), the renewable energy allocation for the region is the product of paragraph (ii). To determine a source's allocation, divide the product of paragraph (ii) by the total number of renewable energy credits and apply that ratio to the early reduction credits claimed by the source.

(v) Split the regional renewable energy allocation based on the ratio of utility to non-utility allocations in 2018 and subtract the renewable energy allocation from the utility and non-utility allocation totals.

(h) Any remaining allowances in the utility allocation or the non-utility allocation after subtraction of the early reduction allocation and the renewable energy allocation is considered the reducible allocation and will be assigned to Category 1 sources.

(i) For non-utility sources, add together the historic SO_2 emissions in accordance with section 8.1.3(1)(e) of this plan for all Category 1 non-utility sources in the region to determine an historic emission total. Determine a percent contribution of SO_2 emissions for each WEB source to the historic emission total. Multiply the non-utility reducible allocation calculated in paragraph ((i)) below by the percent contribution for each WEB source to determine a reducible allocation for each WEB source.

(ii) For utility sources, the reducible allocation will be distributed to sources that emitted above their floor in the baseline period (2000 through 2002) based on their percentage of total floor emissions for sources emitting above the floor times the number of reducible allowances available for the first five years of the WEB Trading Program. The number of allowances for any source receiving a reducible allocation shall not exceed a recent historic emission rate times a heat input that represents a realistic upper bound for the unit.

[Note: The approach for distributing the reducible utility allocation described above is designed to address equity issues regarding the allocation process for utilities. The State of Arizona is participating in ongoing discussions with the other participating states, tribes and regional stakeholders to ensure that all equity issues have been addressed. The principles and equity issues that are under discussion are listed in section 8.1 of this plan.]

(i) Add together the floor allocation, early reduction allocation, renewable energy resource allocation, and reducible allocation for each WEB source and each renewable energy source to determine the proposed allocations for the first five years of the WEB Trading Program.

(j) Add together the proposed allocations for all of the WEB sources in the jurisdiction of each participating state and tribe to determine a draft SO_2 allowance budget for each state and tribe.

(3) Public Comment Period. The State of Arizona will publish notice of availability of the draft regional allocation report in newspapers of general circulation throughout Arizona. A 30-day public comment period will be established, and a hearing will be held during the comment period. The State of Arizona will consider the comments, and will revise the draft report as needed.

(4) Proposed Changes Submitted to Tracking System Administrator. The State of Arizona will submit proposed changes to the budget and source allocations to the TSA within sixty days of receipt of the draft regional allocation report.

(5) Compilation of Changes. The TSA will compile the proposed changes and will submit a final draft regional allocation report to the State of Arizona for approval within 30 days of receipt of the recommended changes.

(6) Final Regional Allocation Report. The State of Arizona will review the final regional allocation report and will determine the budget for Arizona and allocations for WEB sources within Arizona in accordance with the provisions of this plan within thirty days of receipt of the final draft allocation report. The State of Arizona will submit the budget and allocations for all WEB sources in Arizona to EPA, and will notify the TSA that the WEB source allocations should be recorded in the allowance tracking system.

(7) The State of Arizona will notify all WEB sources within Arizona of the number of allowances that have been recorded in their compliance account. The notice will include a warning to the WEB sources that reported annual sulfur dioxide emissions may change due to the implementation of new monitoring methods. Allocations for the first five years of the program will not be adjusted to account for changes due to the new monitoring method. However, allocations during the next five-year distribution will be adjusted as needed to account for paper changes in emissions due to changes in monitoring methodology.

8.3.2. <u>Distribution of Allowances for Future Control Periods.</u>

By December 1 of the year five years after the initial allocation, the State of Arizona will follow the process outlined in section 8.1 of this plan to distribute allowances for the next five-year period. This process will continue every five years until allowances have been allocated through the year 2018.

8.3.3. Distribution of the New Source Allocation

(1) The new source set-aside will be available for two categories of sources.

(a) A new WEB source is eligible to receive an annual allocation equal to the annual sulfur dioxide limit in the source's approval order, beginning with the first full year of operation and in accordance with the provisions of the state-specific rule.

(b) An existing WEB source that has increased production capacity by first obtaining a new approval order is eligible to receive an allocation from the new source set-aside equal to:

(i) the permitted annual sulfur dioxide emission limit for a new unit; or

(ii) the permitted annual SO_2 emission increase for the WEB source due to the replacement of an existing unit with a new unit or the modification of an existing unit that increased the production capacity of the WEB source.

The allocation from the new source set-aside in the first year of operation will be adjusted to account for the number of days that the source is operating in that first year.

EXAMPLE. A new unit with a nameplate capacity of 400 MW is constructed at a power plant with two existing units with nameplate capacities of 400 MW and 300 MW. The two existing units install SO_2 controls and reduce emissions to meet PSD requirements for the construction of the new unit. In this example, the source would continue to receive a floor and a reducible allocation for each of the existing units, and would also be eligible to receive an allocation from the new source set-aside for the new unit. Even though total SO_2 emissions will decrease at this plant due to the construction of the new unit, the allowances allocated to the source will increase to reflect the increase in production capacity of 400 MW of electricity. If the new unit comes on line on July 1 the allocation for the first year will be reduced by 50 percent because the unit was operational for half of the year.

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(2) Allocations from the new source set-aside will remain constant for the applicable WEB source and will be made on an annual basis by March 31 of each year for the current control period. When the next five-year allocation block is distributed as outlined in section 8.1 of this plan, all sources with an allocation under the new source set-aside will receive a five-year allocation block from the new source set-aside, and will continue to receive this allocation in future five-year allocation blocks.

(3) Owners or operators of new WEB sources or modified WEB sources that meet the eligibility requirements of (1) may apply for an allocation from the new source set-aside by submitting a written request to the State of Arizona.

(4) The State of Arizona will review the application for an allocation for accuracy and completeness, and will notify the source of intent to distribute allocations from the regional new source set-aside pending verification that allowances are available in the new source set-aside account. The State of Arizona will then forward the request to the TSA.

(5) The TSA will document the date that the request is received by the TSA. Requests for allocation of allowances from the new source set-aside will be processed in the order received. The TSA will deduct the number of allowances requested from the regional new source set-aside that was established by the participating states and tribes, and will then record an equal number of allowances in the source's compliance account for each remaining year of the five-year period. The TSA will then send

written notification to the source and to the State of Arizona that the allowances have been recorded in the source's compliance account.

(6) If there are insufficient allowances remaining in the new source set-aside to fulfill the request, the source must to purchase the allowances required to demonstrate compliance. Any eligible WEB source that does not receive an allocation from the new source set-aside because the set-aside was depleted will be first in line to receive an allocation when the new source set-aside is increased in the next five-year period as outlined in Table 8-5 of this plan. If there is more than one such source, their allocation requests will be processed in the order they were received by the TSA.

(7) A source that has received a retired source exemption and continues to receive an allocation as a retired WEB source is not eligible to receive an allocation from the new source set-aside.

8.3.4. Regional Tribal Set-aside

(1) Each year after the program is triggered, 20,000 allowances will exist as a tribal set-aside.

(2) The tribal caucus of the WRAP has stated its intent to determine the means for distributing the allowances among the tribes within one year after the program trigger date. The State of Arizona understands that there will be a process that will meet the tracking and data security requirements of the allowance tracking system by which a tribe will move its set-aside allowances into the trading program for the purposes of trading.

(3) The State of Arizona recognizes that the tribal set-aside allowances are bonus allowances for the tribes and, as such, are separate and additional to any allowances included in a tribal budget or the new source set-aside as outlined in the allocation report that is prepared in accordance with section 8.1.3(6) of this plan.

8.3.5. Opt-in Sources.

The WRAP Market Trading Forum has recommended including provisions in this plan that would allow smaller sources to opt in to the program. Opt-in sources may provide a more cost-effective way to reduce overall regional SO_2 emissions, and therefore may strengthen the market incentives of this program. While the benefits of allowing sources to opt in to the program are important, the program must also provide safeguards to ensure that the integrity of the program is not affected. For example, it would be counterproductive to allow sources that were already planning to shut down to opt in to the program and then sell allowances to an existing source. In this example, regional emissions could slowly creep upward in a manner that is not consistent with the goals of the SO_2 milestones.

The State of Arizona is deferring inclusion of provisions for opt-in sources until a future SIP revision to allow time to thoroughly consider how to provide the flexibility and potential benefits to the market by expanding the program while also ensuring that the SO_2 emission reduction goals are maintained.

8.3.6. WEB Allowance Tracking System (WEB ATS)

Section 40 CFR 51.309(h)(4)(v) requires a centralized system for the tracking of allowances and emissions. The centralized system will be referred to as the WEB Allowance Tracking System (WEB ATS or ATS). The WEB ATS must provide that all necessary information regarding emissions, allowances, and transactions is publicly available in a secure, centralized database. The ATS must ensure that each allowance is uniquely identified, allow for frequent updates, and include enforceable procedures for recording data.

The State of Arizona will work cooperatively with other states and tribes participating in the WEB Trading Program to designate this system. The State of Arizona will be responsible for ensuring that all the ATS provisions are completed as described in this plan.

The ATS will not exist unless the program is triggered. Prior to the implementation of the WEB Trading Program, a separate emissions tracking database will be employed to track the ongoing emissions of sources emitting SO_2 at amounts equal to or greater than 100 tons per year. The emissions tracking database, which was used to track and measure SO_2 emissions against the milestones, will still exist once the WEB Trading Program is triggered; however, it will become incorporated into the SO_2 Allowance Tracking System. Both the emissions tracking database and the ATS will be centralized systems and data will be posted in an electronic, Web-based program and available to all persons.

The participating states and tribes will contract with a common TSA to service and maintain the WEB ATS. It is envisioned that the ATS will require the use of a contracted consultant or database design engineer to create a secure, efficient and transparent tracking system. Because the ATS will be utilized by all states and tribes participating in the program, the design will require a uniform approach and level of security that will satisfy regional needs and concerns as well as meet the electronic, Web-based, access needs and security provisions. Due to the dynamic needs of the marketplace, the ATS will require a database that will reflect the current status of allowances and allowance transactions. The ATS will be operational within one year after the program trigger date.

Specifications of the WEB ATS such as emissions tracking, the recording of allowance transactions, account management, system integrity and transparency are outlined in Appendix A-8b to this Plan. Appendix A-8b and requirements found in the state-specific rule detail how a WEB source will register for the ATS and how the source will, through an account representative, establish accounts, transfer allowances, and track unused allowances from a previous year. The account representative will also look to Appendix A-8b to determine the appropriate interface with the ATS.

Neither the State of Arizona nor the TSA will adjudicate any dispute between the parties concerning the authorization of any account representative with regard to any representation, action, inaction, or submission of the account representative.

As an example of how the WEB ATS will generally function, once the WEB Trading Program is triggered, a WEB source will have its allowance allocation determined. At the same time, the WEB source's account representative will register for the ATS, and a compliance account will be established. Each allowance will be assigned a serial number. The allowance serial number will be used by the WEB ATS to track allowance allocations, transfers, and deductions, and to account for any unused allowances from a previous year. The serial number also will be assigned to each allowance recorded in a general account, which is an account for allowances that are not held to meet program compliance requirements. Furthermore, the ATS will track tribal allowance set-asides and new source allowance set-asides not yet assigned to either a compliance or general account.

It is important to note that while this plan has provided a design for and an operational understanding of the ATS, the components of the ATS will need to be examined and possibly altered upon each required SIP revision.

8.3.7. Allowance Transfers

(1) 40 CFR 51.309(h)(4)(viii) requires the Plan to include provisions detailing the process for transferring allowances between parties. Transfers are defined as the conveyance from one account to another account (compliance account or general account) of one or more allowances by whatever means, including but not limited to purchase, trade, or gift in accordance with the procedures established in the state-specific rule. This includes the transfer of allowances for the purpose of retirement. Once an allowance is retired, it is no longer available for transfer to or from any account. Allowances may be purchased by any person for the purpose of retirement.

(2) The TSA will have specific recording duties involving transfers. These required procedures will be detailed in the service contract and will include the following activities.

(a) Recording of Allowance Transfers.

(i) Within five business days of receiving an allowance transfer, except when the transfer does not meet the requirements of the state-specific rule, the TSA will record an allowance transfer by moving each allowance from the transferor account to the transferee account as specified by the request, provided that the transfer is correctly submitted and that the transferor account includes each allowance identified in the transfer.

(ii) Any allowance transfer that is submitted for recording following the allowance transfer deadline and that includes any allowances allocated for a control period prior to or the same as the control period to which the allowance transfer deadline applies will not be recorded until after completion of the compliance account reconciliation.

(iii) Where an allowance transfer submitted for allowance transfer recording fails to meet the requirements of the state-specific rule, the TSA will not record the transfer.

(2) Notification of the Recording of Allowance Transfers. The TSA has specific responsibilities involving the notification of the recording of any transferred allowances, including the failure to record any transfer of allowances. Again, these required procedures will be outlined in the service contract, but include the following.

(a) Within five business days of the recording of an allowance transfer, the TSA will notify the transferor's and transferee's account representatives of both accounts, and make the transfer information publicly available on the Internet.

(b) Within five business days of receipt of an allowance transfer that fails to meet the requirements of the state-specific rule, the TSA will notify the account representatives of both accounts of the decision not to record the transfer, and the reasons for not recording the transfer.

8.3.8. Use of Allowances from a Previous Year

(1) Background. 40 CFR 51.309(h)(4)(ix) allows states to include in the plan provisions for the accounting of unused allowances from a previous year. The unused allowances may be kept for use in future years and there are restrictions on the use of the allowances in accordance with the state-specific rule. The federal rule also requires that allowances kept for use in future years may be used in calendar year 2018 only to the extent that the plan guarantees that such allowances will not interfere with the achievement of the 2018 milestone as outlined in Table 3 of this plan, adjusted according to the provision

of sections 8.1.3(2) (3) and (4) of this plan. The state-specific rule addresses this by prohibiting the use after the year 2017 of allowances allocated for the years 2003 – 2017. This provision ensures that actual emissions will be less than the 2018 milestone because only allowances allocated for the year 2018 could be used to show compliance in that year. The provision also maintains flexibility by resetting the baseline to the year 2018 and then allowing sources to once again use extra allowances to show compliance in any future year. This flexibility is important for sources that have variable operations because the source may build up a reserve of unused allowances for use in a high production year.

The Annex explains the benefits of allowing the WEB source to use unused allowances from previous years, including increased flexibility and early reduction stimulus. The risk in allowing the use of allowances carried from a previous year could be an increase in emissions in later years as the unused allowances are withdrawn for compliance.

Because the regional haze SIP is based on reasonable progress requirements related to the remedying or prevention of any future visibility impairment, it is important to assure the use of these allowances will not interfere with attainment or maintenance of any reasonable progress goals. The safeguard employed here to mitigate this type of risk is termed, “flow control”, and is described in paragraph (2) below.

(2) Flow Control Provisions.

(a) At the end of each control period, WEB sources may transfer allowances in and out of their compliance account for a period of 60 days to ensure that the account will contain enough allowances to cover sulfur dioxide emissions during the previous year. At the end of the sixty-day transfer period, allowances shall be deducted from the compliance account of each WEB sources in an amount equal to the sulfur dioxide emissions of that source during the control period.

(b) After the deductions have been completed, the Tracking System Administrator shall perform the following calculations and prepare a report according to 8.1.5 of this plan.

(i) Determine the total number of allowances remaining in the allowance tracking system that were allocated for the just completed control period and all previous control periods.

(ii) If the number calculated in (i) exceeds 10 percent of the milestone for the next control period, then the flow control procedures found in the state-specific rule shall be triggered for that next control period. These flow control provisions will discourage the excessive use of allowances that were allocated for an earlier control period without establishing an absolute limit on their use. WEB sources will maintain the option to use allowances allocated for an earlier control period, but will be required to use two allowances for each ton of SO_2 emissions. Flow Control operates as follows.

(A) The flow control ratio shall be calculated by multiplying 0.1 times the milestone for the next control period, divided by the total number of unused allowances remaining in the system.

(B) To calculate the number of prior-year allowances that can be used without restriction by a source for the next control period, the TSA shall multiply the prior-year allowances by the flow control ratio. The resulting number of allowances may be used on a one-to-one ratio to show compliance with the source’s emission limitation.

(C) The remaining prior-year allowances may be used on a two-to-one ratio to show compliance. Thus, WEB sources will maintain the option to use allowances allocated for an earlier control period, but will be required to use two of those allowances for each ton of SO_2 emissions.

Example: On March 1, 2010 (the compliance transfer deadline for the 2009 control period) the Tracking System Administrator deducts allowances from the compliance account for each WEB source to cover 2009 SO_2 emissions from that source. After completing these deductions, the TSA reports the following information:

Total number of allowances still in the system for the years 2003 – 2009	=	75,000
2010 milestone (5-state, no smelter)	=	508,223
Percent of milestone	=	14.75 %

Because the number of allowances not used in previous control periods is greater than 10% of the milestone, flow control procedures are triggered. In the annual report required in XX.E.3.j(1)(6) the TSA will then calculate the flow control ratio for 2010:

0.1 x 2010 Milestone ÷ prior year allowances = flow control ratio
0.1 x 508,223 ÷ 75,000 = 0.67

On March 1, 2011 (the compliance transfer deadline for the 2010 control period) the TSA will apply the 2010 flow control ratio before deducting allowances from each WEB source's compliance account

WEB Source A		
2010 Allowances	=	1,000
Remaining Prior Year Allowances	=	500
2010 Emissions	=	1,400

In this example, the TSA would multiply the prior year allowances by 0.67 to determine the number of prior year allowances that could be used without restriction, at a one-to-one ratio. This would equal 335. The remaining prior year allowances would then be used at a 2:1 ratio. 130 allowances would be needed to cover the remaining 65 tons of SO_2 emissions. The TSA would therefore deduct a total of 1,465 allowances (1,000 + 335 + 130) to cover 1,400 tons of SO_2 emissions.

8.3.9. Monitoring/Recordkeeping

(1) For WEB sources subject to 40 CFR Part 75, the TSA shall use data that has been quality assured and finalized by the EPA. For WEB sources subject to a state-specific monitoring protocol, the State of Arizona will quality assure and finalize the data in accordance with these provisions for submission to the TSA.

(2) The data will be verified and submitted to the emissions tracking database as soon as reasonably feasible after annual emissions are reported by the WEB sources. These timelines will be modified, as necessary, according to the monitoring protocols.

8.3.10. Compliance and Penalties

(1) Compliance. When a WEB source exceeds its allowance limitation, the State of Arizona will require the TSA to deduct allowances from the following year's allocation in an amount equal to two times the WEB source's emissions of SO_2 in excess of its allowance limitation. This deduction will be made from the WEB source's compliance account after deductions for compliance are made. If sufficient allowances do not exist in the compliance account for the next control period to cover this amount, the State of Arizona will require the TSA to deduct the required number of allowances, regardless of the control period for which they were allocated, whenever the allowances are recorded in the account.

(2) Penalties. The amount of the financial penalty shall be evaluated at each five-year SIP review, and adjusted to ensure that penalties per ton exceed the expected cost of allowances to ensure that this remains a stringent penalty. The state-specific rule establishes a penalty of $5,000 per ton for each ton of emissions above the source's allowance limitation. This amount is in addition to the two allowances from the next year's allocation to be deducted from the account for each one allowance of exceedance. For a violation of any provision of the market trading program, each day of the control period is a separate violation under Arizona's rule, and each ton of excess emissions is a separate violation.

8.3.11. Periodic Evaluation of the Trading Program.

(1) Annual Report.

(a) Beginning one year after compliance with the trading program is required, the State of Arizona will obtain from the TSA an annual report that contains the following information:

(i) the level of compliance program-wide;

(ii) a summary of the use and transfer of allowances, both geographically and temporally;

(iii) a source-by-source accounting of allocations compared to emissions;

(iv) a report on the use of unused allowances from a previous year, in order to determine whether these emissions have or have not contributed to emissions in excess of the cap; and

(v) the total number of WEB sources participating in the trading program and any changes to eligible sources, such as retired sources, or sources that emit more than 100 tons of SO_2 after the program trigger date.

(b) Within 10 months after the allowance transfer deadline for each control period when compliance with the trading program is required, the TSA will prepare a draft report that lists:

(i) the total number of allowances deducted for the control period,

(ii) the total number of allowances remaining in the Allowance Tracking System allocated for that control period and any earlier control period,

(iii) a proposed determination that flow control procedures have either been triggered or have not been triggered for the next control period, and

(iv) if flow control procedures have been triggered, a draft flow control ratio calculated according to 8.3.8(2).

(c) The State of Arizona will evaluate the draft report, and will propose a determination that flow control procedures either have been triggered or have not been triggered for the next control period.

(d) The State of Arizona will publish a notice of availability of the draft report in newspapers of general circulation in Arizona, and will hold a 30-day public comment period.

(e) After the comment period the State of Arizona will make a final determination that the flow control procedures either have been triggered or have not been triggered for the next control period. If the flow control procedures have been triggered, the State of Arizona will notify all WEB sources in Arizona that flow control procedures will be in effect during the next control period.

(2) Five-year Evaluation.

(a) The State of Arizona will work cooperatively with other participating states and tribes to conduct an audit of the WEB Trading Program no later than three years following the first full year of the trading program, and at least every five years thereafter. This evaluation does not replace the Plan assessments in 2008, 2013, and 2018. The evaluation will be conducted by an independent third party and include an analysis of:

(i) whether the total actual emissions could exceed the values in Table 3 of this Implementation Plan of the WEB Trading Program even though sources comply with their allowances;

(ii) whether the program achieved the overall emission milestone it was intended to reach;

(iii) the effectiveness of the compliance, enforcement and penalty provisions;

(iv) a discussion of whether states and tribes have enough resources to implement the WEB Trading Program;

(v) whether the trading program resulted in any unexpected beneficial effects, or any unintended detrimental effects;

(vi) whether the actions taken to reduce sulfur dioxide have led to any unintended increases in other pollutants;

(vii) whether there are any changes needed in emissions monitoring and reporting protocols, or in the administrative procedures for program administration and tracking;

(viii) the effectiveness of the provisions for interstate trading, and whether there are any procedural changes needed to make the interstate nature of the program more effective; and

(ix) the integrity of the emissions and allowance tracking system, including whether the procedures for recording transactions are adequate, whether the procedures are being followed and in a timely manner, whether the information on sources' emissions are accurately recorded, whether the emissions and allowance tracking system has procedures in place to ensure that the transactions are valid, and whether back-up systems are in place to account for problems with loss of data.

(b) The public will have an opportunity to participate in this trading program evaluation.

(c) In the event that any audit results in recommendations for program revisions, the State of Arizona, in consultation with the WRAP, will make appropriate modifications to this Plan. The State of Arizona will revise this Plan if the program is not meeting its emission reduction goals.

(d) The State of Arizona will submit a copy of the report to the EPA regional office.

8.3.12. Retired Source Exemption

The state-specific rule outlines the procedure that a WEB source must follow to receive a retired source exemption. The exemption would allow the source to continue to receive an allocation, but would exempt the source from monitoring and recordkeeping requirements that would serve no useful function for a source that has ceased operations. The State of Arizona (i.e., the Director) will notify the source of its obligation to apply for a retired source exemption upon the cancellation or relinquishment of a permit.

To receive a retired source exemption, the source must submit a request for the exemption to the State of Arizona. The State of Arizona will review this request, and within 60 days of receipt of the request will notify the source that the retired source exemption has been granted or has been rejected. If the exemption has been rejected, the notification will contain an explanation of the reasons for rejecting the request.

The TSA will record an allocation to a WEB source that has received a retired source exemption. However, the allowances will be recorded in a general account rather than a compliance account for the source.

A WEB source that is permanently retired and that does not request a retired source exemption will forfeit all abandoned allowances in that source's compliance account. The forfeited allowances will not be redistributed to other sources, and will be permanently retired from the Allowance Tracking System. During the next five-year allowance distribution period the retired source will not receive an allocation, and the allowances that would have been distributed to that source will be added to the new source set-aside.

8.3.13. Integration into Permits

40 CFR 51.309 requires that the requirements for emissions reporting and for the trading program be incorporated into a permit that is enforceable as a practical matter by EPA and by citizens to the extent permitted by the Act. It is expected that all WEB sources will at least initially be subject to Arizona's Title V permitting requirements. Arizona's delegated Title V permitting program, the pre- and post-trigger requirements of the market trading program fall under the definition of "applicable requirements", and will be incorporated into each source's Title V permit. As found in the state-specific rule, any source that for any reason and at any time is not required to have a permit under the requirements of the state-specific rule, must obtain a New Source Review permit that incorporates the same requirements. Both types of permits are enforceable both federally and by citizens pursuant to Arizona's SIP.

8.4. 2013 SIP Revision; Backstop for Beginning of Second Planning Period

In addition to the requirements of 40 CFR 51.309(d)(10), the periodic SIP revision due in 2013 will include the following information:

a. Source specific allocations for all WEB sources in Arizona for the year 2018; and

b. Either the provisions of a program designed to achieve reasonable progress for stationary sources of SO_2 beyond 2018 or a commitment to submit a SIP revision containing the provisions of such a program no later than December 31, 2016. The program will ensure that the requirements of 40 CFR 51.309 for the first planning period, including requirements that cannot be measured until after 2018, such as the determination of compliance with the 2018 milestone.

This 2013 SIP revision will provide certainty to sources regarding their potential liability under the special penalty provisions for the year 2018 outlined in section 8.1.5 of this plan. The calculation of these allocations is delayed until 2013 to provide certainty about the number of sources that will qualify as WEB sources at that time; the allocations needed for new sources in the region, and the magnitude of renewable energy development and early reductions that will be included in the allocation process. It is difficult to estimate the impact of these factors in 2003 because circumstances may change during the next 10 years.

If the 2018 milestone is not met, the starting point for the next planning period shall be the 2018 milestones, not actual emissions in 2018.

8.5 Geographic Enhancement Program

The requirements for geographic enhancement are discussed on page 35757 in the Preamble to the RHR (64 FR 35714, July 1, 1999). These requirements are related to Section 51.309(f)(1) which describes requirements for the Annex. The Annex allows states to submit a SIP, or tribes a TIP, which adopts an alternative measure to regional haze BART. Geographic enhancement is a voluntary approach that can be included in the Annex for addressing reasonably attributable visibility impairment (RAVI) for stationary sources, under the provisions of Section 51.302(c). RAVI is different from regional haze in that it addresses "hot spots" or situations where visibility impairment in a Class I area is reasonably attributable to a single source or small group of sources in relatively close proximity to the Class I area. The geographic enhancement approach would allow states or tribes to use the efficiencies and reduced cost provided by the market trading program in the Annex to accommodate situations where RAVI needs to be addressed. Additional information is contained in the WESTAR report, *Recommendations for Making Attribution Determinations in the Context of Reasonably Attributable BART*,[17] contained in Appendix A-8c.

(a) Procedure for addressing Reasonably Attributable Visibility Impairment under the Regional Haze Rule. Pursuant to 40 CFR 51.309(f)(4), the State of Arizona shall use the following process to address reasonably attributable impairment (RAVI) in any Class I area, and the potential need for Best Available Retrofit Technology (BART), as specified in 40 CFR 302(c):

(1) The State of Arizona will work with the National Park Service of the Department of Interior, and the U.S. Forest Service of the Department of Agriculture, on the agreed upon principles that will be followed for addressing RAVI within the context of regional SO_2 milestones and a backstop emission trading program that have been developed to address regional haze. As part of

[17] WESTAR , "Recommendations for Making Attribution Determinations in the Context of Reasonably Attributable BART", report to WRAP, [Date]

the Federal Land Managers' obligation to protect the visibility in the areas that Congress has designated as mandatory Class I Federal areas, in the course of certifying impairment, the National Park Service or U.S. Forest Service may make recommendations to the State of Arizona regarding a source or sources to which impairment may be reasonably attributable. Within the context of established regional milestones for SO_2 and a backstop trading program, the National Park Service and U.S. Forest Service will use the following screening process in making these recommendations as part of the certification process:

(i) The National Park Service or U.S. Forest Service determines that sulfate concentrations are not decreasing since the year 2000, based on ambient monitoring, and

(ii) There are BART-eligible sources of sulfur dioxide within 150 km of the mandatory Federal Class I area, and

(iii) The BART-eligible sources have not installed control technology to reduce sulfur dioxide emissions at a rate equivalent to capture of 85% of potential annual emissions.

(2) In approximately 2009 to 2010, but no later than December 2010, the State of Arizona will conduct a public meeting to facilitate the exchange of information regarding current visibility monitoring data at Class I areas in Arizona or in nearby states within 100 miles of any BART-eligible sources located in Arizona. The purpose of the meeting will be to provide as much information as possible to all interested parties about the potential for a certification to occur. The information will include visibility trends, as well as the type of impairment that is occurring at individual areas (e.g., haze, episodic impairment, and other types of screening criteria). The goal of this meeting is to provide information to sources and to the trading market so that potential problems could be addressed in the most cost-effective manner.

(3) If the National Park Service or U.S. Forest Service certifies impairment, the State of Arizona will fulfill its obligation to determine attribution and if necessary determine BART for the applicable source or group of sources in accordance with Arizona's SIP for visibility protection submitted to EPA in Chapter 5 of this Implementation Plan.

(i) The WESTAR report titled *Recommendations for Making Attribution Determinations in the Context of Reasonably Attributable BART*, contained in Appendix A-8c, periodically augmented by new techniques and information available at the time of review, will be used to provide a toolbox of appropriate technical criteria and techniques for determining attribution.

(ii) If attribution is determined, then the following alternative remedy solutions will be considered when determining BART for the applicable source:

(A) BART-level controls could be installed on the attributed source or group of sources;

(B) SO_2 emission reductions that may be more cost-effective or have other air quality benefits could be required at nearby sources in lieu of, or in combination with controlling the attributed source to achieve greater visibility improvements that the application of BART.

9. LONG-TERM STRATEGY FOR MOBILE SOURCES

9.1. Regulatory History and Requirements

In its June 1996 Report, the GCVTC recommended EPA move forward on new national vehicle emission and fuel standards to reduce emissions from mobile sources. The GCVTC also recommended other regional and local strategies be considered to manage mobile source emissions. One of the local strategies was to establish emission budgets for those pollutants in urban areas shown to significantly contribute to visibility impairment in any of the 16 GCVTC Class I areas. The budget caps were to be set at the 2005 emission levels.

When EPA finalized the RHR in July 1999, the rule acknowledged the GCVTC recommendations related to national vehicle emission and fuel standards. EPA included a status of planned actions on those recommendations as of July 1999 (Preamble to the regional haze rule, 64 FR 35753). EPA noted these new measures were over and above those included in the RHR for mobile sources that simply required a cap on emissions in significantly contributing urban areas at the 2005 level. EPA also indicated that emission reductions resulting from new standards adopted after the RHR was approved would be creditable toward reasonable progress. EPA also committed to work with the states if new national standards impacted the efficacy of regional or local strategies.

After the RHR rule was finalized, EPA established new standards for on-road vehicle emission and fuel standards (65 FR 6698). As a result, current mobile source emission projections developed by WRAP for the GCVTC Transport Region indicate overall mobile source emissions will decline continuously from 2003 through the end of the SIP planning period in 2018, which exceeds the level of emission reductions that EPA approved as meeting reasonable progress; i.e., holding mobile source emissions from major urban areas to their lowest level during the planning period. In addition, new standards for non-road vehicles were proposed by EPA on April 15, 2003, and are expected to be finalized in the near future. These new standards for non-road vehicles will further reduce overall mobile source emissions.

At the April 2003 WRAP Board meeting, the WRAP approved a recommendation that EPA modify the RHR eliminating the current requirements related to mobile source emission significance determination and budgets for urban areas (40 CFR 309(d)(5)), and replace those requirements with a new requirement focused on tracking mobile source emission reductions resulting from national standards to assure reasonable progress. This action was based on the finding that emissions of all pollutants from on-road and non-road mobile sources, except for sulfur dioxide from non-road engines, are expected to decline significantly through 2018. The overall emission trends for mobile sources are summarized in Table 9-1 contained in Section 9.2, below, with additional details contained in Chapter 5 of the WRAP TSD. If EPA adopts new low-sulfur standards for non-road mobile sources, then non-road mobile source sulfur dioxide emissions would also decline dramatically through 2013 with a very small increase expected through 2018.

On July 3, 2003, EPA issued a proposed rule (68 FR 39888) and a direct final rule (68 FR 39842) to amend the mobile sources provision of the Regional Haze Rule consistent with the recommendations of the WRAP. One adverse comment was received, so the direct final rule was withdrawn. On December 22, 2003, EPA promulgated the final rule (68 FR 71009) changing the mobile source requirements in 40 CFR 51.309. The revisions changed the requirements under 40 CFR 51.309(d)(5)(i) and eliminated the previous requirements under 40 CFR 51.309(d)(5)(ii & iii) for setting mobile sources emissions budgets using the lowest projected level as a planning objective and performance indicator for each urban area.

The former 40 CFR 51.309(d)(5)(iv), which addresses the other GCVTC mobile source recommendations, was retained as 40 CFR 51.309(d)(5)(ii). The new Section 51.309(d)(5)(i)(A) requires statewide inventories of mobile source emissions, for each 5-year implementation plan reporting period required under 40 CFR 51.309(d)(10), to be reviewed to demonstrate a continuous decline in emissions of each pollutant of concern over the planning period through 2018. Should mobile source emission not decline as expected, the State of Arizona will review control options for mobile sources and determine if additional controls are needed, consistent with the criteria for reasonable progress. If the State of Arizona determines that additional controls are needed, Arizona will prepare a revision to the implementation plan within one year after the progress report is due under 40 CFR 51.309(d)(10)(i), as required under 40 CFR 51.309(d)(10)(ii)(D).

In addition to the new revisions to 40 CFR 51.309(d)(5)(i) and the elimination of the former Sections 51.309(d)(5)(ii) and (iii), a backstop provision as outlined by the WRAP was added. The new 40 CFR 51.309(d)(5)(i)(B), requires the State of Arizona to assess the need for any long-term strategies to address SO_2 from non-road mobile sources by no later than December 31, 2008. Under this provision, Arizona will determine if a SIP revision is necessary to address SO_2 from mobile sources by considering whether the emission reductions anticipated or achieved by any Federal standards in place addressing fuel sulfur content for non-road engines are sufficient to meet reasonable progress.

To assist in the investigative and deliberative process related to mobile source emissions and their significance, ADEQ established a Mobile Source Work Group (MSWG) made up of a wide range of Arizona stakeholders including industry, environmental, metropolitan planning organization representatives, and regulators. The MSWG monitored the WRAP Mobile Source Forum process and work products. In addition, the MSWG collected and analyzed data to assist in the deliberative process. The MSWG provided ADEQ tabular information on projected emissions in addition to recommendations for the mobile source regional haze SIP component. The MSWG issued a final memoranda summarizing findings and recommendations to ADEQ that are contained in Appendix A-9a, entitled “Arizona Mobile Source Work Group Findings and Recommendations Related to Mobile Source Emissions.”

9.2. Inventory of Current and Projected Emissions from Mobile Sources

(a) Inventory of Current and Projected Emissions from Mobile Sources. Pursuant to 40 CFR 51.309(d)(5)(i)(A), the State of Arizona, in collaboration with the WRAP, assembled a comprehensive statewide inventory of mobile source emissions. This is summarized in Table 9-1, and is described in detail in the WRAP TSD in Chapter 1 and Chapter 5. This emission inventory showed the year with the lowest level of emissions would be at the end of the SIP planning period in 2018 instead of 2005 as anticipated by the GCVTC. The substantial reduction of projected mobile source emissions from 2003 to 2018 is due to the adoption of new on-road vehicle emission and fuel standards by EPA. The figures in Table 9-1 do not include the anticipated reduction from the pending proposal to reduce sulfur content of non-road sources.

Table 9-1. Statewide Mobile Source Emissions for Arizona (Tons per Day)

Year	VOC	NOx	$PM_{2.5}$	SO_2	Total
1996	553.2	655.0	37.2	33.3	1,278.7
2003	448.7	496.5	23.0	20.9	989.1
2008	319.9	381.2	22.0	10.0	733.1
2013	256.9	296.7	19.1	9.5	582.2
2018	222.0	237.3	18.0	18.6	495.9

Source: 1996 from WRAP 1996 Base Emission Inventory
2003-2018 from WRAP Mobile Source Worksheets

(b) Program to assure continuous decline in mobile source emissions. Pursuant to 40 CFR 51.309(d)(5)(i)(A), the State of Arizona commits to monitoring the emissions from mobile sources to assure a continuous decline in emissions as defined in 40 CFR 51.309(b)(6). If Arizona determines that a continuous decline in emissions is not being achieved, additional control measures will be reviewed to determine if they are needed to demonstrate reasonable progress. If Arizona determines such measures are needed, Arizona will submit an SIP revision to address the identified control measures.

(c) Backstop provision to address potential increase in non-road emissions in the event proposed Federal standards are not finalized. Pursuant to 40 CFR 51.309(d)(5)(i)(B), the State of Arizona commits to provide for a SIP revision no later than December 31, 2008, containing long-term strategies necessary to reduce emission of SO_2 from non-road mobile sources consistent with the goal of reasonable progress. The need for a SIP revision will be determined by a consideration of the emission reductions achieved or anticipated to be achieved by proposed Federal standards should those standards addressing fuel sulfur content for non-road engines not be in place.

9.3. Other GCVTC Strategies for Mobile Sources

Pursuant to 40 CFR 51.309(d)(5)(ii), the State of Arizona has reviewed the other mobile source recommendations contained in the GCVTC report. The results of that review are included in Chapter 13 of this SIP that addresses all recommendation of the GCVTC report, including mobile source recommendations.

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10. LONG-TERM STRATEGY FOR FIRE PROGRAMS

10.1. Regulatory History and Requirements

In its 1996 final report, the GCVTC recognized that past land management practices, including decades of fire suppression, have led to an increase of accumulated forest fuels. Wildfires are becoming larger in size, unnaturally destructive, and more dangerous and costly to control. Fire, however, is a component of most natural ecosystems in the West and therefore must be a component of processes to meet land management, human health and visibility objectives. The GCVTC recognized that prescribed fire and wildfire levels are projected to increase significantly for decades to come, and that programs to minimize emissions and visibility impacts, and to educate the public, should be implemented.

The Regional Haze Rule (40 CFR 51.309(d)(6)) requires documentation that all federal, state and private prescribed fire programs in the state evaluate and address the degree of visibility impairment from smoke. In addition, a statewide inventory and emissions tracking system must be established for volatile organic compounds, nitrogen oxides, elemental and organic carbon, and fine particle emissions from fire. Any administrative barriers to the use of alternatives to burning should be identified and removed where possible along with an enhanced smoke management program based on specific criteria that addresses visibility as well as health and nuisance objectives. Finally, annual emission goals for fire shall be established, in cooperation with states, tribes, federal land managers and private entities, to minimize emissions increases from fire to the maximum extent feasible.

The WRAP's effort to document and understand the incidence of fire and its effect on visibility in Class I areas has been extensive and productive. Chapter 6 of the WRAP TSD, “Assessment of Fire Programs,” details the results of WRAP’s analyses of fire on visibility to date. Different emission reduction scenarios for the 2018 projected inventories were the basis for the analyses. WRAP modeling shows that emissions from fire will continue to affect visibility for some time on an episodic basis.

10.2. Prescribed Fire Program Evaluation

Pursuant to 40 CFR 51.309(d)(6)(i), the State of Arizona evaluated the State’s Enhanced Smoke Management Plan and all Federal, State, and private prescribed fire smoke management programs in the State, based on the potential to contribute to visibility impairment in the 16 Class I areas of the Colorado Plateau, and how visibility protection from smoke is addressed in planning and operation. The State of Arizona relied upon the WRAP report *Assessing Status of Incorporating Smoke Effects into Fire Planning and Operations* (see Appendix A-10a) as well as EPA’s *Interim Air Quality Policy on Wildland and Prescribed Fires* (see Appendix A-10b) as a guides for making this evaluation along with input from a stakeholder-based work group familiar with the policies and regulations related to fire and land management within the State. The State of Arizona also evaluated whether the State’s existing fire regulations as part of an Enhanced Smoke Management Plan contained the following elements: actions to minimize emissions; evaluation of smoke dispersion; alternatives to fire; public notification; air quality monitoring; surveillance and enforcement; and program evaluation. The result of this evaluation process was the determination that revisions to Arizona’s existing fire regulations, R18-2-602, “Unlawful Open Burning,” and Article 15, “Forest and Range Management Burns,” would be necessary.

10.3. Emission Inventory and Tracking System

The State of Arizona has made revisions to R18-2-602, “Unlawful Open Burning,” and Article 15, “Forest and Range Management Burns,” to allow for the tracking of all types of fire in the State.

These state-approved rules along with the related public participation and review process, can be found in Appendix A-10c, with Appendix A-10d containing supporting information related to the promulgation of these rules. Most of the changes made to Article 15 relate directly to the requirement of Section 309(d)(6), including to the collection and recording of burn data. Changes to R18-2-602 allow Arizona to meet the tracking requirements in 12 counties throughout the state. The three remaining counties, Maricopa, Pima and Pinal, have their own fire rules (Maricopa County Rule 341; Pima County Rule 17.12.480, et seq.; and Pinal County Rule 3-8-700 and 3-8-710.). The three counties will revise their existing rules to comply the requirements of R18-2-602. The State of Arizona commits to submit updated county rules based on the revised Arizona rules in a SIP revision by December 31, 2004.

In addition to its own emissions tracking, the State of Arizona will review the WRAP data on post-burn activity and utilize the WRAP's regional emission tracking system. In addition, fire emission inventory updates will be provided in future progress reports, as part of the periodic SIP revisions, pursuant to 40 CFR 51.309(d)(10). See Appendix A-10e, entitled, *Policy on Fire Tracking Systems* for further information on the emissions inventory and tracking system to be utilized by Arizona.

10.4. Strategy for Use of Non-burning Alternatives

The State of Arizona is continuing to develop a process with key public and private entities, including the State Department of Agriculture, State Land Department, Federal Land Managers', farming and forestry associations, etc. to identify and remove administrative barriers to the use of non-burning alternatives to prescribed fire on federal, state, and private lands, pursuant to 40 CFR 51.309(d)(6)(iii). The process is collaborative and provides for continuing identification and removal of administrative barriers, and considers economic, safety, technical and environmental feasibility criteria, and land management objectives. This process is outlined in the related sections of the Arizona fire rules (see Table 10.1, "Alternative to fire"). In developing this process, the State of Arizona will rely on two documents: (1) *Nonburning Alternatives for Vegetation and Fuel Management* (see Appendix A-10f), and (2) *Burning Management Alternatives on Agricultural Lands in the Western United States* (see Appendix A-10g), prepared by the WRAP that describe a variety of non-burning alternatives and methods of assessing their potential applicability.

10.5. Enhanced Smoke Management Program

Pursuant to 40 CFR 51.309(d)(6)(iv), the smoke management programs that operate within Arizona are consistent with the WRAP *Enhanced Smoke Management Programs for Visibility* (see Appendix A-10h). This approach calls for programs to be based on the criteria of efficiency, economics, law, emission reduction opportunities, land management objectives, and reduction of visibility impacts. The WRAP *Enhanced Smoke Management Programs for Visibility* lists the previously identified elements under 40 CFR 51.309(d)(6)(i) as well as adding "burn authorization" and "regional coordination" elements to ensure visibility protection and to meet the designation of "enhanced."

An Enhanced Smoke Management Plan (ESMP) comprises a series of key policies and management practices. In general the ESMP must specifically address visibility effects and apply to all fire sources as do all smoke management plans in the State of Arizona. The ESMP should also apply uniformly to source sectors or be tailored to source sectors and/or geographical areas. In addition, the ESMP must provide the opportunity to work collaboratively with state, tribal, local, and federal agencies, and private parties while considering the criteria of efficiency, economics, law, emission reduction opportunities, land management objectives, and reduction of visibility impact. The State of Arizona

ESMP meets all of these requirements. The State of Arizona will conduct annual meetings of all affected parties to discuss smoke management issues and objectives.

Arizona's Article 15 (R18-2-1501-1515), Forest and Range Management Burns, and R18-2-602 (Section 602), Unlawful Open Burning, upon revision now includes the following specific elements required of an ESMP, and are enumerated in the Table 10-1.

Table 10-1. Inclusion of ESMP Elements Into Arizona Regulations

Enhanced Smoke Management Plan Element	Rule Citation
Actions to minimize emission from fire	R18-2-1509 R18-2-602(D)(3)(e)
Evaluation of smoke dispersion	R18-2-1506 and 1510 R18-2-602(D)(3)(m) and (o) R18-2-602(B)(3)(d)
Alternative to fire	R18-2-1503(C)(8), 1503(D) and 1503(G) R18-2-602(H)*
Public notification of burning	R18-2-1513 R18-2-602(D)(3)(g)
Air quality monitoring	R18-2-1508 and 1511 R18-2-602(H)*
Surveillance and enforcement	R18-2-1514 R18-2-602**
Program evaluation	R18-2-1503 R18-2-602(H)*
Burn Authorization	R18-2-1505 and 1508 R18-2-602(D)(3)(g)
Regional Coordination	R18-2-1513 and 1515 R18-2-602(H)*

* R18-2-602(H) allows the State of Arizona to examine at its annual meeting any need to address monitoring, regional coordination, or alternatives to burning as they arise in an overall discussion of program evaluation for unlawful opening burning. Issues that could arise in these areas are difficult to determine ahead of time, and are driven by proximity and volume.

** Any violations under R18-2-602 have penalty authority under Arizona Revised Statute 49-501. A copy of ARS 49-501 can be found in Appendix A-10i.

10.6. Annual Emission Goal

Pursuant to 40 CFR 51.309(d)(6)(v), efforts will be made within the State of Arizona to minimize emission increases in fire, excluding wildfire, to the maximum extent feasible, through the use of annual emission goals, in accordance with the WRAP *Annual Emission Goals for Fire* (see Appendix A-10j).

The *Annual Emission Goals for Fire* recognizes that Emission Reduction Techniques (ERTs) can be used to minimize emissions from fire. The State of Arizona commits to the establishment of a collaborative mechanism for setting annual emission goals, and development of a process for tracking their attainment on a yearly basis. The authority to proceed with this commitment can be found in Arizona's revised Article 15, subsection 1503 and 1509. It can also be found in the tracking timeline contained within Arizona's revised R18-2-602 rule. A list of current ERTs is contained in the rule appendix to R18-2-602.

The projection and tracking of ERT use is a minimum element of the quantifiable annual emission goal. The Annual Emissions Goal will utilize the projection of total emissions inventory for prescribed fire and agricultural burning, as provided by the emissions inventory and tracking systems outlined in Section 10.3 of this chapter, such that the effect of projected emission reduction techniques or percentage of ERT use is shown in relation to projected total emissions. Should projected annual emissions not be available, the State commits to submit a timeline to develop the necessary inventory. Where ERT use or other emission reduction methods cannot be quantified with confidence due to the current state of the science (such as for agricultural burning), the State of Arizona commits to participate in the development of further refinements in emission reduction or emissions averted calculation methodologies.

The use of ERTs to meet the 51.309(d)(6)(iv) requirement, as with the ESMP, is subject to economic, safety, technical and environmental feasibility, and land management objectives.

11. AREA SOURCES OF DUST EMISSIONS FROM PAVED AND UNPAVED ROADS

11.1. Regulatory History and Requirements

In its 1996 report to EPA *Recommendations for Improving Western Vistas* the GCVTC stated that dust emissions from vehicles traveling on paved and unpaved roads are generally near-field transport issues rather than long-range transport issues, especially with respect to larger, coarse materials that settle out of the atmosphere before being transported long distances. Due to considerable uncertainty regarding the ability of emission and air quality models to accurately characterize the contribution of road dust to visibility impairment, the GCVTC also recommended further analysis to resolve the uncertainties regarding both near-field and distant effects of road dust prior to recommending any remedial actions.

As a result, the Regional Haze Rule (40 CFR 51.309(d)(7)) requires states to assess the impact of dust emissions from paved and unpaved roads on regional haze in the 16 Class I areas located on the Colorado Plateau in the SIPs due by December 31, 2003. The WRAP, the GCVTC's successor organization, analyzed this issue, including efforts to improve methods for estimating road dust emission inventories as applied to regional scale modeling and characterization of transport and deposition. The WRAP's modeling work demonstrated road dust is not a measurable contributor on a regional level to visibility impairment in the 16 Class I areas. Due to this finding, no additional road dust control strategies are needed in the current SIP. The State of Arizona, in consultation with the WRAP, will perform further assessments of road dust impacts on visibility in the 16 GCVTC Class I areas in the progress updates and status reports due in 2008, 2013 and 2018. Based on these assessments, if road dust emissions are determined to be a significant contributor to visibility impairment, the State of Arizona commits to implement emissions management strategies to address the impact as necessary and appropriate to demonstrate reasonable progress.

11.2. Strategy for Road Dust Sources

Impact of paved and unpaved road dust emissions and contribution to visibility impairment finding. Pursuant to 40 CFR 51.309(d)(7), a regional scale assessment was made by the WRAP of the impact of dust emissions from paved and unpaved roads from transport region states on the 16 Class I areas of the Colorado Plateau. Chapter 7 of the WRAP TSD contains the results of the following technical work: (1) a summary of 1996 and 2018 emission inventories for re-entrained road dust from paved and unpaved roads; (2) a description of the definition of significance for road dust in the 16 Class I areas; (3) road dust modeling results – regional versus localized air quality impacts; and (4) a discussion of WRAP's finding of no measurable contribution to regional haze. Based on these findings, no emission management strategies have been identified at this time.

Tracking of Road Dust Emissions. The State of Arizona commits to track road dust emissions with the assistance of the WRAP, and provide an update on paved and unpaved road dust emission trends, including any modeling or monitoring information regarding the impact of these emissions on visibility in the Colorado Plateau 16 Class I areas. These updates shall include a re-evaluation of whether road dust is a measurable contributor to visibility impairment. These updates shall be part of the periodic SIP revisions, pursuant to 40 CFR 51.309(d)(10).

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12. POLLUTION PREVENTION AND RENEWABLE ENERGY PROGRAMS

12.1. Regulatory History and Requirements

In its 1996 Report, the GCVTC recommended several pollution prevention strategies from education to supporting development of renewable energy sources. The GCVTC also identified regional goals of renewable energy usage of 10% by 2005 and 20% by 2015. These are referred to below as the "10/20 goals." The GCVTC also recommended that progress towards this goal should be evaluated every five years, in conjunction with regular reviews of emissions reductions and progress toward the national visibility goal.[18] 40 CFR 51.309(d)(8) includes the regulatory language for the GCVTC's recommendations.

The Air Pollution Prevention (AP2) Forum was created in September, 1998 by WRAP to study the issues related to pollution prevention required in 40 CFR 51.309(d)(8), and to develop work products the states and tribes could rely on when developing SIPs. The AP2 Forum's documents may be found at www.wrapair.org. These include information related to identifying barriers and policies that could lead to increased investment in renewable energy and energy efficiency in the Grand Canyon Visibility Transport Region. The Forum also performed an analysis related to potential emissions reductions, energy cost savings, and secondary environmental and economic benefits of meeting the GCVTC's 10/20 goals.

The Arizona Department of Environmental Quality established a Pollution Prevention Work Group (P2WG) to assist in developing the material necessary for this SIP. The P2WG included representatives from utilities, environmentalists, state energy regulators, and local regulators. The P2WG work products relied upon the work of the WRAP AP2 Forum, and independent research necessary to assemble the materials in this chapter.

Arizona's P2WG reviewed WRAP's policy on renewable energy and energy efficiency. Appendix A-12a entitled "*Arizona Pollution Prevention Work Group Review of WRAP Policy on Renewable Energy and Energy Conservation*" contains a copy of a comment letter sent to WRAP's Air Pollution and Prevention Forum (AP2 Forum) along with a copy of the WRAP Policy entitled, "Renewable Energy and Energy Efficiency As Pollutuion Prevention Strategies For Regional Haze."

12.2. Approach to Addressing Requirements Under 40 CFR 51.309(d)(8)

Pursuant to 40 CFR 51.309(d)(8), the following sections, (1) identify, describe and/or inventory programs being implemented by various companies, organizations and agencies in the State of Arizona, including renewable energy programs, incentive programs, programs to preserve and expand energy conservation efforts, and programs to demonstrate progress towards renewable energy goals; and (2) project emission reductions, visibility improvements and other impacts anticipated to result from such programs. Arizona's approach to address the specific requirements of 40 CFR 51.309(d)(8) are summarized in Table 12-1.

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[18] *Recommendations for Improving Western Vistas,* Grand Canyon Visibility Transport Commission; Western Governors' Association: Denver, CO, June 10, 1996, page 30.

Table 12-1. Arizona's Approach to Address 40 CFR 51.309(d) Requirements

Citation in 40 CFR 51.309(d)	Description of Requirement	Addressed in Section
(d)(i)	Description of Existing Pollution Prevention Programs	12.3
(d)(i)	Renewable Energy Generation Capacity and Production	12.4
(d)(i)	Summary of Anticipated Renewable Energy Contribution	12.5
(d)(ii)	Incentive Programs	12.6
(d)(iii)	Programs to Preserve and Expand Energy Conservation	12.7
(d)(iv)	Potential for Renewable Energy	12.8
(d)(v)	Projection of Pollution Prevention Programs on Visibility	12.9
(d)(vi)	Programs Relied on to Achieve GCVTC Renewable Goals	12.10
(d)(vi)	Future Progress Reports	12.11

The inclusion in the SIP of these programs and estimated emission reductions and impacts shall not render such programs and estimates mandatory and/or federally enforceable, nor are such programs or estimates relied on for purposes of meeting the visibility goals established as part of the SIP planning process. These programs are voluntary or state programs that were never intended to be federally enforceable, and the projected emission reductions are estimates only. It is expected that these programs and the associated emissions impacts will change over time and will be reflected in the progress reports for 2008, 2013, and 2018 required under 40 CFR 51.309(d)(10).

12.3. Description of Existing Pollution Prevention Programs in Arizona

Pursuant to 40 CFR 51.309(d)(8)(i), Tables 12-2 and 12-3 summarizes all pollution prevention programs currently in place in Arizona. Table 12-2 summarizes the renewable energy programs currently in place. Table 12-3 summarizes the energy efficiency programs currently in place for Arizona. Table 12-4 summarizes planned renewable energy projects as of 2002.

Table 12-2. Summary of Renewable Energy Programs Currently in Place in Arizona

Program Title	Program Description
Environmental Portfolio Standard	The Arizona Corporation Commission (ACC) approved rules implementing the Environmental Portfolio Standard, in March 2002 (ACC R14-2-1618). The standard requires a minimum percentage of retail electricity sales to be from eligible solar electric or "environmentally friendly renewable electricity technologies." Technologies included are: photovoltaics, solar thermal resources that generate electricity, solar water heaters, solar air conditioning systems, in-state landfill gas generators, wind generators, and biomass generators. The standard began with 0.2% in 2001, rises to 1.1% in 2007, and then remains stable until 2012. 2001 0.2% 2002 0.4% 2003 0.6% 2004 0.8% 2005 1.0% 2006 1.05% 2007-12 1.1% At least 50% of the portfolio standard must be solar electric in early years, increasing to 60% solar electric in 2004. The portfolio includes incentives or "extra credit multipliers" for early installation, for installation in Arizona, for using equipment manufacturers in Arizona, for use in "distributed"

Program Title	Program Description
	applications or various programs including green pricing, net metering, solar leasing, or customer-sited systems. This standard only applies to electric suppliers who are regulated by the Arizona Corporation Commission. It does not apply to municipal utilities, irrigation districts, electrical district, and other quasi-governmental utilities. Further information can be found at the Arizona Corporation Commission website, http://www.cc.state.az.us/utility/electric/R14-2-1618.htm

2001/2002Arizona Environmental Portfolio Standard Results (in kWh Credits[1])

	2001	2002
Arizona Public Service		
Solar Electricity (Utility)	17,237,202	9,126,664
Solar Hot Water	6,541,328	2,208,334
Solar Air Conditioning	---	---
Landfill Gas	11,307,931	44,938,574
Biomass	---	---
Wind	---	---
Total	34,786,461	56,273,572
	(99.1% of requirement)	(59.68% of requirement)
Tucson Electric Power		
Solar Electricity (Utility)	2,990,538	9,006,169
Solar Hot Water	---	---
Solar Air Conditioning	---	---
Landfill Gas	6,884,068	16,024,836
Biomass	---	---
Wind	---	388,070
Total	9,874,606	25,419,075
	(71.7% of requirement)	(79.31% of requirement)
Citizens Communications		
Solar Electricity	152,000	39,000
Total	152,000	39,000
	(6% of requirement)	(1% of requirement)
Navopache Electric		
Landfill Gas	150,000	644,377
Total	150,000	644,377
	(50% or requirement)	(50% or requirement)

[1] The portfolio includes incentives or "extra credit multipliers" for early installation, for installation in Arizona, for using equipment manufacturers in Arizona, for use in "distributed" applications or various programs including green pricing, net metering, solar leasing, or customer-sited systems. Therefore the Total number of actual kWh achieved is less than the kWh credits shown in the table above. Further information can be found at http://www.cc.state.az.us/utility/electric/R14-2-1618.htm.

The lead agency in implementing this strategy is the Arizona Corporation Commission.

Program Title	Program Description
Regulated Utility Customer Funding or System Benefit Charge Funding for Renewables	Regulated utilities in Arizona have utility customer funding or system benefit charge (SBC) funding to support low income, demand-side management (DSM), environment, renewables, and other programs beneficial to society. A portion of the funds is targeted to the development of renewable energy, including the support of the Environmental Portfolio Standard. System benefit charges (SBC) are funds approved by the state's regulatory oversight body, the Arizona Corporation Commission. Further information can be found at: http://www.cc.state.az.us/utility/electric/rules-electric.htm Arizona Public Service: 2002 -- $7 million in approved spending, of which $6 million was used for renewable energy programs and technology development, and $1 million for low-income customer

Program Title	Program Description
	support. In addition, under the EPS program, APS collected an additional$6,571,745 for renewable energy programs in 2002. Tucson Electric Power: 2002 --$3 million in approved SBC spending, of which $2 million was for renewable energy programs and $1 Million for low income and energy efficiency programs. In addition, the EPS surcharge collected $2.4 million for renewables.
Salt River Project Customer Funding	Salt River Project (SRP) has a SBC that supports customer assistance programs, renewable energy development and maintenance, and other programs. Since December 31, 1998, the SBC has generated approximately $123 million. In 2002, this generated $3.8 million in funding for renewable resources. In addition, SRP designated additional program funding each year and plans to continue this funding in future years. SRP customers support renewable energy programs through the SRP EarthWise Energy green pricing program. Revenues received from these premiums are used to build new renewable energy projects in the community.
Government Purchase Requirements	ARS 34-452 Arizona law requires that new state building projects over six thousand square feet follow prescribed solar design standards and that solar improvements be evaluated on the basis of life cycle costing. Such new buildings include state office buildings, school districts, community college districts and universities. These projects must include evaluation of (a) proper site orientation, (b) active and passive solar energy systems for space heating, (c) solar water heating, and (d) use of solar day-lighting devices. The life cycle costing requirements state that solar energy and energy conservation design, equipment and materials shall be used if the simple payback in energy savings is eight years or less. http://www.azleg.state.az.us/ars/34/00452.htm
Consumer Education and Information	Million Solar Roofs program – educates consumers on solar products and encourages them to install photovoltaics on homes and businesses. The major utilities in the state operate programs to market the renewable energy they produce. APS – Solar Partners SRP- EarthWise Energy TEP-Greenwatts APS has programs to educate customers about renewable energy and energy efficiency. Examples include: Project SOL (http//:projectsol.aps.com) where customers can learn about solar power and see how they can be used to generate electricity; the APS Solar Test and Research Center (www.aps.com/solar) where customers and students are provided tours of one of the leading solar research center in the world to see and learn about the latest in solar technology; and the APS web site www.aps.com where anyone with access to the web can keep abreast of APS' many renewable and energy efficiency programs including home energy audits and energy savings and conservation information. SRP also has a Customer Support Group that helps with program development and evaluation, and to assist in communicating program messages to the community. The Arizona Solar Energy Industries Association operated the Solar Options in Arizona program through their hotline for consumer education. They also have homeowners' association education program on installation of solar hot water systems. Arizona Solar Center is a website run by a non-profit offering a variety of information for consumers. Tucson Coalition for Solar – conducts an annual home tour and ongoing education on renewable energy.
Net Metering	In 1981, the ACC adopted a net metering rule (Decision No. 52345) requiring the state's regulated utilizes to offer net metering for renewable and cogeneration resources with the capacity of 100 kilowatts or less. Excess electricity generated by the system is purchased at each utility's avoided cost. Further information can be found on the net metering rule at: http://www.eren.doe.gov/greenpower/netmetering/index.shtml#AZ Arizona Public Service (APS) company filed in 1994 to allow net billing of all renewable energy generators under 10kW. Net excess generation under the APS tariff is purchased at the utility's avoided cost.

Program Title	Program Description
	Tucson Electric Power Company (TEP) filed two net metering tariffs in 1996 that were revised in 2003. The first is Tariff 101which applies to all qualifying non-firm customers, and Tariff 102 applies to all qualifying firm customers. Under both tariffs, net metering is allowed for QFs whose maximum monthly usage is 100 kW or less. These tariffs are for customers who have installed either a single solar to electricity or wind to electricity conversion system of AC electrical peak capability of 10 kW or less, and meet all TEP qualifications. Excess net generation is credited to the customer's account each billing month (when applicable), and credits may be applied throughout the calendar year. However, each January any remaining credit to the customer's account will be zeroed out.
Information Disclosure	1996 Arizona Corporation Commission Rule R14-2-1617 ACC adopted disclosure provisions as part of the 1996 Retail Electric Competition Rules. Under the disclosure provision, all retail suppliers of electricity must disclose composition, fuel mix, and emissions characteristics upon request. http://www.cc.state.az.us/utility/electric/rules-electric.htm
Green Pricing	Arizona Public Service Solar Partners APS was the first utility in the state to develop a green energy option for its customers in 1996 with the APS Solar Partner Program. APS customers have the option to support the development of solar power in APS service territory by purchasing 15kWh of 100% solar power for $2.64 though the APS Solar Partner Program. Customers may choose as many 15 kWh blocks of solar power as they wish. The funds raised go towards the development of additional new solar power plants for APS Solar Partners. APS has installed a combination of fixed, tracking and concentrating solar technologies and will continue to install new solar power plants that are the most cost effective for our customers. www.aps.com/solarpartners Salt River Project: SRP provides a solar energy purchase option to its customers. Dubbed EarthWise Energy, SRP customers can purchase 100-watt block of solar power capacity for $3.00 per month. For more details see http://www.eren.doe.gov/greenpower/gp_munipu.html#srp TEP Green Watts: Launched in January 2000, Green Watts is a TEP program that enables supporters to invest directly in the creation of "green" power. For each Green Watt that a customer adopts, TEP will generate 20-kilowatt hours per moth from renewable energy resources. The first Green Watt is $2.00 and each additional Green Watt is $1.50. This amount appears as a line item on a customer's monthly statement. Every ten Green Watts that are adopted save a ton of coal per year from being used and encourages environmental conservation in Southern Arizona. 100% of the dollars raised go directly to building and maintaining renewable facilities in Arizona. http://greenwatts.com/gw_pages/gw_Home.html
Economic Incentive for Renewable Manufacturers	Arizona's Environmental Portfolio Standard provides extra credit for Arizona solar-electric capacity that incorporates Arizona-built components. From the rules (C.2.b): In-State Manufacturing and Installation Content Extra Credit Multiplier: Solar electric power plants shall receive up to a .5 extra credit multiplier related to the manufacturing and installation content that comes from Arizona. The percentage of Arizona content of the total installed plant cost shall be multiplied by .5 to determine the appropriate extra credit multiplier. So, for instance, if a solar installation included 80% Arizona content, the resulting extra credit multiplier would be .4 (which is .8 X .5).
Financial Incentives	Environmental Technology Facility Credit – Allows a personal or corporate income tax credit of 10% of the cost of construction of a qualified environmental technology manufacturing, producing or processing facility. (Source: DSIRE Database http://www.ncsc.ncsu.edu) Solar and Wind Energy System Tax Credit- ARS-43-1083, ACC R14-2-1618, Provides a personal income tax credit of 25% of the cost of a solar or wind energy device. (Source: DSIRE Database http://www.ncsc.ncsu.edu) Solar and Energy Equipment Tax Exemption – Provides a retail sales tax exemption of up to $5000 for solar and wind energy equipment. Legislation http://www-solar.mck.edu/finance/AZ08.htm (Source: DSIRE Database http://www.ncsc.ncsu.edu/dsire.htm) APS offers the APS EPS Credit Purchase program. This program provides a financial incentive to APS customers for the installation of solar electric and solar water heating systems on customer

Program Title	Program Description
	homes. Customers that choose to include Photovoltaic systems on their homes or businesses can receive $2.00 per watt-dc for the installation of systems up to 5 kW. In addition, APS also provides an incentive to customers that replace or supplement electric water heaters with solar water heating. Customers receive $350 for the professional installation of a new solar water heating system. APS pays these customers for opportunity to use the environmental benefits from these systems to meet its own EPS goals. Once the system is professionally installed, the customer submits the application to APS and APS pays the customer directly. http://www.aps.com/my_community/Solar/eps.html TEP SunShare: Launched in 2002, TEP's SunShare program is designed to encourage customers to install new photovoltaic equipment at their residence or business. TEP currently offers two options for those who are interested in investing in solar. SunShare, option #1, requires that customers provide their own photovoltaic equipment while SunShare Kit, option #2, requires that customers purchase the solar equipment from TEP. Under the SunShare programs, systems of 1kW to 5kW are eligible. The customer may either purchase a qualifying system, 1kW thru 5kW, from a third party or may purchase one to five 1-kW system kits from TEP. Under SunShare, option #1, TEP will credit the customer $2,000 per AC kW of proven, installed solar generating capacity. Under the SunShare Kit, option #2, TEP will credit the customer $2,000 for each 1kW system, up to $10,000 for five systems. The kit includes panels, inverter, supports, meter, and meter socket. The retail cost for a 1 kW solar kit is approximately $9,000 plus installation costs. However, a kit purchased from TEP will cost $4000 after the $2000 credit. TEP also offers a net metering option which credits the customer with the energy sent into the grid on a kWh basis. http://greenwatts.com/gw_pages/gw_sunshare.html

Table 12-3 summarizes the energy efficiency programs currently in place for Arizona. There is a long list of energy efficiency programs, including programs offered by the State Energy Office and the utilities. Summaries of the programs are provided. A few programs have listed quantification information in terms of energy savings or program expenditures; many are not quantified because this type of information is currently not available.

Table 12-3. Summary of Energy Efficiency Programs in Place in Arizona

Program Title	Program Description	**2002 Status**	**Ref.**
Arizona Energy Office, Arizona Dept of Commerce	The Energy Office's $2.3 million annual budget is funded through a combination of federal funds and Petroleum Violation Escrow funds. Director: Craig Marks (602) 771-1139 craigm@azcomerce.com http://www.azcommerce.com?energy/default.asp	The Energy Office's mission is to encourage energy efficiency and renewable-energy usage, provide energy education and community outreach, offer policy advise to the Executive and Legislative branches, and help Arizona low-income residents to reduce their utility bills and improve their comfort and safety.	3,4
Low Income Weatherization	The Energy Office administers Arizona's $3 annual million (federal and private funds), low-income, weatherization program. The primary mission of this program is to reduce the energy required for space heating and cooling for income eligible households applying for assistance through one of ten sub-grantees, statewide. This program receives its primary funding from the U.S. Department of Energy and the U.S. Department of Health and Human Services. The program also leverages additional funds through partnership with utilities,	17,000 homes weatherized to date. In 2002, 695 homes were weatherized statewide, with present- value utility savings of three million dollars. In addition to approximately $2.2 million in federal funds, the utilities provided the following: 2002 Utility Funding:	3

Program Title	Program Description	**2002 Status**	**Ref.**
	and other federal and state housing programs. Many aspects of the Residential Training and Technical Assistance Programs are now incorporated into the training of Weatherization sub-grantees, which assures that savings are maximized. The following are done under the program: • Adding thermal insulation to the residential building envelope, most typically attic insulation. Shading sun-exposed windows, primarily for houses using central refrigeration cooling. • Implementing air leak control measures to reduce excessive infiltration of outside air. • Testing, tuning and maintaining heating and cooling equipment. • Reducing duct leakage where heating and central refrigerated air is distributed by a forced air system. • Installing low-flow showerheads and other general energy and water efficiency measures. • Other energy conservation improvements as identified by the home energy auditor.	SW Gas $350,000 APS $302,397 TEP $180,000 Citizens $68,885 Co-ops $4,500 Total $905,782	
Special Project Grants	The Energy Office administers the State Energy Project – Special Project Grants. Each year states submit proposals in response to a DOE solicitation identifying how specific technologies could be implemented in their region of the country. DOE then selects the projects that best meet national energy goals. The Energy Office publicizes grant availability, helps prepare grant applications, and administers grants. The Energy Office is currently administering $2,865,375 SEP Special Project funds.	<u>2002 Special Project Awards</u> $800,000 to Pinnacle West for Hydrogen Power Park $75,000 to Tucson USD for Tucson Solar Schools $100,000 for Teaching Energy Conservation Supports Implementation of Energy Codes in Tucson Metro Area and Southern Arizona Communities $25,000 for Tucson Regional Clean Cities Coordinator $48,808 to AZ Energy Office to Film New Solar in Arizona Documentary $45,000 to Energy Office for State Industries of the Future Program Federal IOF – 9 Industries Targeted to Improve Energy Efficiency and Productivity, and to Manage Waste Streams AZ IOF Chapter Will Target 4 of the Federal IOFs – Agriculture, Aluminum, Forest Products, and Mining Goal – Establish Industry, Government, University Partnerships, With MOU Executed by 2004.	

Program Title	Program Description	**2002 Status**	**Ref.**
Residential-Market Training and Technical Transfer	Over 30,000 new homes are built each year in metro-Phoenix, making it one of the largest new home markets in the United States. Thousands more homes are built each year in other fast-growing Arizona communities. Improving the energy efficiency of new homes has an enormous impact on Arizona's energy usage. The Energy Office has long partnered with Arizona utilities to provided technical assistance and training for the building trades on the latest energy efficiency technologies and techniques, including: Infrared imaging to analyze insulation performance; Smoke generation to show duct leakage; and Using pressure diagnostics, such as the blower door testing, duct blasters, and digital monometers, to confirm envelope integrity. Overall the goal is to encourage builders and subcontractors to take a scientific systems approach to home construction and incorporate energy-efficient techniques into the building process.	Arizona's largest HVAC contractor now seals all ductwork, which has saved Arizonans over $27 million in energy bills since 1997. Over the past year, in partnership with the home-building industry and Arizona utilities, the Arizona Energy Office provided 23 days of training to over 2,500 attendees from the building-trades industry. Because of the innovations and techniques brought to the market, builders have helped develop and introduce Energy Star-certified homes into the Arizona market. Energy Star is a joint program offered by the U. S. Environmental Protection Agency and the U. S. Department of Energy. Energy Star certification requires a home to be 30% more efficient than the 1995 Model Energy Code, which saves the average homebuyer approximately $400 a year. Of the 34,000 Energy Star homes built nationally in 2001, over 8,000 were built in Arizona. Arizona homebuilders are also national leaders in offering guaranteed heating and cooling costs. These homes are typically 40% to 50% more efficient than required by the 1995 Code, and have guaranteed annual heating and cooling costs of approximately $ .30 per square foot. Regional and national homebuilders now market entire subdivisions where each home comes with guaranteed energy bills.	
Municipal Energy Management Program	The MEMP (Municipal Energy Management Program) encourages and assists in the development and implementation of energy management programs by facilitating the planning process and providing the necessary basic tools, staff training and technical assistance. As part of MEMP, the Energy Office makes funds available for energy saving projects. Those eligible to apply include incorporated Arizona cities, towns, counties, improvement districts, and Indian tribes with populations under 70,000. The MEMP approach to energy conservation is a simple and direct step-by-step approach. The first step is to understand where energy is being consumed and how much it costs, based on the utility bill analysis and audits. The second step identifies strategies for lowering energy costs. The third step assists in incorporating energy management into future development through an energy management plan.	$150,000 awarded to Arizona communities in 2002	

Program Title	Program Description	**2002 Status**	**Ref.**
Federal Energy Management Program	Goal: reduce the cost and environmental impact of the federal government by advancing energy efficiency and water conservation, promoting the use of distributed and renewable energy, and improving utility management decisions at federal sites. Funds are occasionally available to the Arizona Energy Office to partner with Indian communities and military bases or other federally-owned facilities	Ak Chin Community. This outreach was funded by thee Western Area Power Administration and FEMP. The Energy Office performed the following services for the Community: Residential Energy Audits Weatherization Training	
Market Design Initiatives	Salt River Project's M-Power is a residential prepayment program, which uses a special electric meter located outside the home, a small display unit located inside the home and smart cards, which work in a way similar to prepaid telephone calling cards. The SRP M-Power display shows how much energy is used daily and hourly, and when to buy more energy via the smart cards. With actual information on cost of consumption, customers conserve and can save as much as 10% on electric bills. At the same time, SRP reduces turn-off and turn-on costs, while improving customer satisfaction.		
Regulated Utility Customer Funding or System Benefit Charge Funding for Energy Efficiency	Tucson Electric Power: 2002 --$3 million in approved SBC spending, of which $2 million was for renewable energy programs and $1 million for low income and energy efficiency programs. Arizona Public Service: 2002 - $7 million in approved spending, of which $6 million was used for renewable energy programs and technology development, and $1 million for low-income customer support and other programs. In addition, under the EPS program, APS collected an additional $6,571,745 for renewable energy programs in 2002. See also the listing in Table 12-2 under the heading Regulated Utility Customer Funding or System Benefit Charge Funding for Renewable Energy.		
Residential New Construction and New Home Guarantee Programs	To help promote the value of energy efficient residential construction, APS works with builders and building material vendors to provide buyers with a heating and cooling guarantee. All participating builders must offer their homebuyers a 2-year guarantee that the monthly costs to heat and cool their home will be less than a specified amount. APS has promoted the concept of guaranteed heating and cooling bills through a multi-media campaign including TV, print, on-line, and point-of-sale materials. In 1997, TEP designed and implemented the first utility operated new home guarantee program in the nation. The program philosophy addresses the	Currently four of the top ten production builders in the Phoenix metro area are participating in the program and over 3500 home lots have been committed. Since inception to December 2002, there were 5590 homes either completed, in some progress of completion or waiting for	

Program Title	Program Description	**2002 Status**	**Ref.**
	issues of affordability, durability, comfort, health and safety using scientific laws of airflow, moisture-flow and pressure management within a home. Homes are constructed to high standards set by TEP and include on-site inspections of framing areas related to energy performance, insulation installation, and HVAC system design and installation. On-site testing is also provided to measure duct leakage, whole-house infiltration and pressure management within the home under various operating conditions. If a home passes all inspection and testing criteria, the homeowner receives a guarantee from TEP that heating and cooling costs will not exceed a predetermined average cost per day (calculated on each separate model home) and a guarantee for comfort for a pre-set time period. Homes permitted prior to February 20, 2003 receive a 3-year guarantee and homes permitted after February 20, 2003 receive a 5-year guarantee. Homeowners who purchase a TEP Guarantee home qualify for a specially designed rate-tariff that reduces the cost of all electricity used in the home by 12% annually compared to the standard residential electric rate. The homeowners also have the option to increase this electric rate savings to either 18% or 22% depending on their selection of TOU and/or the installation of solar water heating systems.	construction to begin. The program is operated within the utility structure with quality control provisions and the guarantee provided by a utility. All TEP Guarantee Homes qualify for ENERGY STAR since the qualifications from TEP are more stringent than ENERGY STAR. TEP provides the DOE/EPA program documents to customers along with the Guarantee certification.	
New Construction Energy Efficiency Research and Training	In partnership with the Arizona Energy Office, APS has conducted extensive research and testing on new residential construction with blower doors, duct blasters, infrared cameras, and other diagnostic tools. The result of these tests is a list of building construction details that need the most focus to improve home performance. In 1998, APS and the Arizona Energy Office began offering Building Science training for residential builders. TEP hosts quarterly education programs to target audiences of builders, sub-contractors, and city/county code officials, architects and consumers. These programs are designed to educate all audiences on the scientific approach of building new homes or retrofitting existing homes to gain the maximum benefit in affordability, durability, comfort and health and safety. TEP also adds matching funds for grants provided to the City of Tucson 'Teaching Energy Conservation' project which educates consumers, builders, contractors, consumers and code officials on various conservation related issues. The SRP-Certified Home (SCH) program was introduced in May 1995. For a subdivision to be	In 1998, APS and the Arizona Energy Office began offering Building Science training for residential builders. To date, over 2000 building industry members have attended. Coupled with the heating/cooling guarantee program, this has resulted in substantial improvements in the real world performance of residential new construction as confirmed through field studies by the Arizona Energy Office. Between 1999 and 2002, approximately	

Program Title	Program Description	**2002 Status**	**Ref.**
	SRP certified, SRP works directly with the builder to ensure that each home design meets our energy-efficiency standards. SRP certification means the home design includes certain energy-efficient features. Certification is based on the SRP-Certified Homes Point Sheet that primarily is a construction specification trade-off system. With the system, one design feature may be substituted for another if the overall design complies with the SRP-Certified Home energy consumption standard. Between 1999 and 2002, approximately 21,000 SCH contracts were signed. In 2002 SRP announced a new addition to the SRP-Certified Home program. Energy Code Compliance certification is now available upon request. SRP can provide REM/Design compliance reports for 1998/2000 International Energy Conservation Codes (IECC), CABO Model Energy Code (MEC), and ASHRAE 90.2 By adding the new "Code Compliance" feature to the program we can now assist builders in meeting the energy efficiency codes required by the various municipalities.	21,000 SCH contracts were signed.	
Qualified Contractor Program	APS offers referrals to customers seeking qualified, professional HVAC contractors for service or replacement of their existing AC/heat pumps. To qualify for the program, residential HVAC contractors are required to meet stringent requirements and complete ongoing rigorous APS education courses for their service technicians.	To date, APS has subsidized technical training for over 6000 service technicians. APS currently provides free contractor referrals to approximately 4000 customers each year, ensuring that units are properly serviced and installed.	
High Efficiency Appliance Programs	APS High Efficiency Air Conditioners Program For several years APS has worked with the air conditioner contractor community. This partnership has been instrumental in moving the market for resale air conditioners and heat pumps to high efficiency equipment. Evidence suggests that the resale market is about 90% 12 SEER, which is 15% more efficient than standard equipment, reducing demand and energy consumption. SRP Rebates on Highly-Efficient Refrigerators and Heat Pumps – Over the last several years, SRP has independently offered customers rebates on highly efficient refrigerators and heat pumps.	Since 1998, APS and contractors have distributed over 20,000 copies of the Consumer's Guide to an Energy Efficient Air Conditioning System as an education tool for customers. SRP has issued more than 8,500 rebates on refrigerators labeled by ENERGY STAR® as exceeding federal standards and more than 1,000 rebates on heat-pumps with a 13-SEER rating that also meet additional strict criteria.	
Time of use rates	APS Time of use rates - Approximately 40% of all residential customers are on a time of use rate. It is one of the highest penetrations of TOU rates in the country. APS is one of the only utilities nationwide to offer a demand rate for residential customers. Most new APS customers apply for one of the two		

Program Title	Program Description	**2002 Status**	**Ref.**
	TOU rates. Evidence suggests it reduces demand and shifts load. A recent survey of customers indicates that over 75% of TOU customers do shift some of their energy use to off-peak time periods. Customers feel it gives them control over their electric bill and helps conserve peak energy. SRP has approximately 140,000 customers on our peak-load shifting program, Time-of-Use (TOU). Residential TOU customers average 75% off-peak usage annually, while non-TOU residential customers average 72% - 73% off-peak usage annually. The result of TOU is that SRP has been successful in shifting 2%-3% of our average annual energy consumption to off-peak.		
Peak Reduction Campaign	Commercial Peak Reduction Campaign -- Since the summer of 2001, APS has promoted a voluntary summer peak energy management initiative with commercial customers. Participating customers pledge to save energy on extreme summer days when temperatures exceed 110 degrees in Phoenix. Customers receive an email on "Peak Power Days" asking them to turn thermostats up two degrees, turn off unnecessary lights and equipment, and adjust the schedule of energy-intensive processes. The campaign has helped shave peak consumption and heightened awareness of the need to save energy on extreme summer days.		
Shade Trees Campaign	The TEP Trees Program promotes energy conservation and the environmental benefits associated with planting low-water usage trees and other vegetation. Desert-adapted trees have been provided to residential neighborhoods, low-income families, public areas and schools by TEP. The residential trees are to be located on the south, west and east sides of homes in the TEP service area with the objective of continuing positive community service as well as providing Demand-Side Management ("DSM") benefits. Residential Program: There were 3,000 trees distributed to roughly 1,500 homes for the period January 1, 2002 through December 31, 2002. School and Community Programs: For the period January 1, 2002 through December 31, 2002, this program provided 105 fifteen-gallon-sized and 41 five-gallon-sized trees to 43 schools. In addition, 63 community projects received 115 fifteen-gallon-sized and 111 five-gallon-sized trees.		

Program Title	Program Description	**2002 Status**	**Ref.**
Energy Efficiency Education	APS provides a free on line energy analysis on aps.com. It allows customers and prospective customers to analyze their home and business energy use and identify customized energy efficient measures. APS provides seasonal energy savings tips online and in customer bill inserts. SRP Energy Savings Solutions Campaign Energy Savings Solutions (ESS) is a multi-media campaign, which runs from May through September. The goal of ESS is to educate customers about effective energy management. ESS provides customers with useful and easy ways to lower their energy usage and enables customers to make informed decisions everyday by demonstrating how home energy conservation efforts can help reduce energy costs. TEP provides free class sets of booklets to schools in its area, including, "Learning to Save Energy", which is geared to grades 3-5. TEP also offers teacher training and back up materials for two hands-on activities: The Insulation Station (which deals with residential energy issues) and The Energy Patrol (where a class or group of students learn about energy efficiency, and then try to "patrol" their school, helping remind others how to save energy). TEP also provides seasonal energy tips on-line and in mailings to customers and handouts at presentations.		
Energy Star	Customer Education on Purchasing Decisions SRP has been an ENERGY STAR® partner since 1999. This DOE/EPA program establishes stricter efficiency criteria for new products. As a partner, SRP has been able to not only increase awareness of ENERGY STAR, but also to provide information for customers so that they can make informed purchase decisions. This information has been incorporated into our monthly newsletters and our Energy Savings Solutions campaign and has also been heavily featured in on-going publications to both residential and commercial customers via *Powerful Solutions* and *eNews*.		
Energy Efficiency Audits	For approximately the last two years, SRP has been working with third party contractors and other entities such as the Arizona Department of Commerce to provide free or low cost energy efficiency audits and educational programs to energy consumers in the commercial, industrial and government sectors. The focus of the programs to date has been on high-efficiency lighting retrofits, energy information services, and improvements to compressed air systems.		

Program Title	Program Description	**2002 Status**	**Ref.**
	TEP offers the Energy Advisor, a quick, free, online analysis of a home's or business's monthly energy use, as well as suggestions on how to reduce energy costs.		
State Energy Efficiency Demonstration Program	Working with the Department of Administration and agency facility managers, the Energy Office provides training, technical assistance and funding to implement energy savings and demand-reduction measures in state-controlled facilities. Matching grant program.	Ongoing.	
State Facility Managers Training Program	Based on results of the forensic audits and utility tracking, the Energy Office provides training and technical assistance to state facility management staff with the goal of identifying actions that may be taken to decrease electricity consumption in state facilities. This training will assist facility managers in performing diagnostics on their facilities, complete retrofits on equipment and buildings, and track energy consumption.	Ongoing.	
Energy Efficient Schools	Energy Office partnership with School Facilities Board. A jointly funded engineer works with architects and vendors to incorporate cost-effective, energy-efficient designs and equipment. Energy audits of existing facilities are also available.	Significant opportunities have been found in replacement of HVAC package units, lighting retrofits, and central heating and cooling systems, for a total avoided energy costs of $8,916,197 per year.	
State Energy Code	HB 2541 (2001) Is a voluntary model energy code (AZ=home rule). This bill designates the State Energy Code as a legislative tool to create incentives for the use of energy saving devices and practices. It established a State Energy Code Advisory Commission to review and recommend changes to the State Energy Code. http://www.azleg.state.az.us/legtext/44leg/2r/bills/hb2451p/pdf	Energy Code Advisory Commission. Code Advisory Commission members were appointed. First meetings held by the Energy Office to provide technical support to Arizona municipalities In 2001, the Energy Office applied for and received a $100,000 grant from the U. S. Department of Energy to build on the legislative initiative and to initiate an outreach and training program for municipalities, governmental entities, code officials, and the building industry on codes and the impact on Arizona's energy consumption. In 2002, Energy Office efforts on codes are being concentrated in the areas of 1) codes adoption, and 2) training provided to the building industry designed to help insure that structures designed to code will also perform as designed.	1
Governor's Awards for Energy Efficiency	The Energy Office recognizes local governments, state agencies, and educational institutions for exceptional energy-conservation accomplishments.	The 2002 Governor's Awards for Energy Efficiency were presented to Arizona cities, educational institutions and state government agencies in recognition of successful energy conservation programs. Awards of Excellence, the highest honor, went to the City of Bullhead City, Arizona School Facilities Board, Mesa Unified School District and the Tucson Unified School District.	

Program Title	Program Description	**2002 Status**	**Ref.**
		The City of Tucson received Awards of Merit for two energy-saving projects. Awards of Merit were also given to the City of Coolidge, Arizona Department of Administration, Arizona Department of Public Safety and the Arizona Department of Game and Fish. The Arizona Department of Emergency and Military Affairs received Awards of Merit for two energy-conservation projects. In addition, Awards of Special Recognition were bestowed on the City of Tucson, Arizona Department of Administration, Arizona Department of Emergency and Military Affairs, Isaac Elementary School District and the Scottsdale Unified School District. The City of Mesa and the City of Phoenix both received Awards of Special Recognition for two energy-saving projects. http://www.azcommerce.com/Energy/eaward.htm	
Rebuild America	U.S. D.O.E. Program supported by Arizona Energy Office. - Helps businesses and communities reduce energy use in buildings.	Ongoing. Energy-efficiency seminar presented to Arizona school officials in September 2002.	1
Green Buildings	Green buildings are use design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment The concept includes: - Sustainable site planning - Safeguarding water and water efficiency - Energy efficiency and renewable energy - Conservation of materials and resources - Indoor environmental quality	City of Scottsdale Green Building Program. This is weighted rating checklist that emphasizes a system's approach by requiring 26 prerequisites. Established in 1998, 47 builders, 129 homes constructed by 2002. http://www.ci.scottsdale.az.us/greenbuilding/ Southern Arizona Green Building Alliance (in progress) This green building program is in its infancy and details are still being determined Contact Loretta Ishida, The Development Center of Appropriate Technology (520) 624-6628 Loretta@dcat.net, http://www.dcat.net	2
Leadership in Energy & Environmental Design (LEED)	This program facilitates positive results for the environment, occupant health and financial return. It defines "green" by providing a standard for measurement, prevents false or exaggerated claims, and promotes whole-building, and integrated design process. LEEDS evaluated and recognizes performance in accepted green design categories, existing and proven technologies. There are four levels of certification.	April Green Building Forum – sponsored by Phoenix, Scottsdale and Surprise. New capital mall buildings including Arizona Department of Environmental Quality and Department of Administration buildings built in 2002.	1
Utility Tracking	Developed by the Energy Office for entities with multiple accounts (e.g., schools, municipalities, large businesses). Uses Microsoft Excel to track utility usage by meter. Captures data from utility's web site. The program identifies problems, and raises questions.	Ongoing.	1

Program Title	Program Description	**2002 Status**	**Ref.**
National Industries of the Future	Administered by Department of Energy – Office of Industrial Technologies 9 Industries targeted that together supply 90% of the materials vital to US economy. The 9 industries are: agriculture, aluminum, chemicals, forest products, glass, metal casting, mining, petroleum, and steel. Goal: Promote energy efficiency and manage waste streams.	Arizona Industries of the Future being developed by Energy Office with D.O.E grant. 4 industries targeted - Agriculture - Aluminum - Forest Products - Mining	1
Industrial Assessment Centers	Administered by DOE, OIT Enables eligible small and medium-sized manufacturers to have comprehensive industrial assessments performed at no cost to the manufacturers. Teams of engineering faculty and students from the center, located at 26 universities around the country, conduct energy audits, or industrial assessment and provide recommendations to manufacturers to help them identify opportunities to improve productivity, reduce waste, and save energy.	Recommendations from industrial assessments have averaged about $55,000 in potential annual savings for each manufacturer ASU operates one of the 28 National Centers Director: Dr. Patrick E. Phelan (480) 965-1625 phelan@asu.edu	1
Income Subtraction for Construction of an Energy Efficient Residence	For taxable years beginning from and after December 31, 2001, through December 31, 2010, Arizona law (A.R.S. 43-1031) allows a subtraction for a residence that is 50% more efficient than the 1995 Model Energy Code (MEC). The subtraction is allowed for selling one or more new energy efficient residences located in Arizona. The subtraction is equal to 5% of the sales price excluding commissions, taxes, interest, points, and other brokerage, finance and escrow charges. The subtraction cannot exceed $5,000 for each new qualifying residence. A home's energy efficiency must be demonstrated by a score of at least 90 points (indicating that the home is 50% better than the MEC threshold) on a home energy rating. A Certified Home Energy Rater must provide the home energy rating.	Ongoing	4
Building America	Building America is a private/public partnership that provides energy solutions for production housing. The Energy Office assists in disseminating the results of this effort to the Arizona market place.	Ongoing	4
Governor's Smart Energy Usage Program	"Conservation saves money, which makes sense during tight budget times. And decreased energy production saves water, which makes sense during a drought. These two reasons provide more-than-enough motivation to conserve this summer," Arizona Governor Jane Dee Hull said when announcing the Smart Energy: Phase II program for summer 2002. As a result of the success of the 2001 campaign, Governor Hull ordered all agencies under her	The Smart Energy campaigns of 2001 and 2002 require state agencies to set thermostats up two degrees to save energy. As a result it is estimated that these conservation efforts reduced energy usage from 7 to 10 percent and saved the state $115,000 in utility bills during the summer of 2001 The campaign also called upon Arizonans to do their part. "Two Degrees - No Sweat" encouraged Arizonans to save energy by raising thermostats two degrees.	4

Program Title	Program Description	**2002 Status**	**Ref.**
	jurisdiction to take a number of energy-saving steps for the second summer in a row. The Governor also asked that state residents voluntarily comply with the "Arizona Smart Energy: Phase II" program. As part of the Smart Energy: Phase II program, the Governor asked all state employees to implement the following energy saving measures: • Every agency will use power management tools like Energy Star to keep computers, monitors and other devices in stand-by mode when not in use. • Employees will turn off lights and office equipment, as much as possible, when they expect to be out of the office for more than one hour. • Agencies will reduce all lighting that does not affect productivity, health or safety. • Thermostats in all state-controlled facilities, will be increased during the months of June through September by two degrees or brought within the 76-79 degrees F range, whichever is greater. • Agencies will implement a professional, casual-dress policy from June through September, consistent with the type of work being performed.		

1 Presentation by Craig Marks, of the Arizona Energy Office, Department of Commerce, to the Pollution Prevention Workgroup, July 26, 2002.
2 "Summary of Green Building Programs," Prepared for National Renewable Energy Laboratory, by National Association of Home Builders Research Center, Second Edition, August 2002.
3 U.S Department of Energy, Office of Building, Technology, State & Community Projects, http://www.eere.energy.gov/buildings/state_energy/
4 Arizona Department of Commerce, Energy Office, http://www.azcommerce.com/Energy/default.asp

The regional haze rule and the 10/20 goals look ahead to future years. While not specifically required, Arizona is providing the following Table 12-4 on renewable energy capacity that is planned as of 2002 to provide information on projects that are in the planning stages and have the potential to provide additional renewable energy capacity in the future.

Table 12-4. Planned Renewable Energy Capacity as of 2002

Program Title	Program Description	Ref.
Land fill Gas Pipeline Project	This is a partnership with Salt River Project, Detroit Edison and Salt River Pima Maricopa Indian Community. The pipeline is between Salt River and Tri-Cities Landfills. It extends the fuel supply to the Tri-Cities Landfill Gas Generation Plant. Facility is expected to be commissioned in the second quarter of 2004	1
Arizona Falls Project	This SRP sponsored project will generate 750 kW. It has roof mounted solar placed on the turbine building. Facility is to be commissioned in second quarter of 2003.	1

Program Title	Program Description	Ref.
Mesa City Library Photovoltaic Parking	This is a 25kW system with covered parking for 34 spaces. Provides green energy for SRP Earthwise Energy customers. Project is expected to be completed May 2003.	1
SRP Park & Ride Photovoltaic	This SRP sponsored project is for a 100kW PV system on parking structures. The PV system is expected to be complete in July 2003. It also has a goal to increase public awareness of renewable energy.	1
APS Prescott Airport Solar Power Plant	APS Prescott Airport Solar Power Plant - Prescott – 5 MW projected in 3 yrs (possibly expandable to 10 MW), This is currently the largest single axis tracking system in the state and is expected to become the largest PV site in the country consisting of both single axis tracking and concentrating PV technologies.	2
APS Solar Trough	APS is building a 1MW demonstration solar thermal trough project that will be tested for performance compared to photovoltaic technologies.	2
APS Dish Stirling tests	10 Units ordered for test once the technology demonstrates performance and price characteristics that exceed photovoltaics.	2
APS Landfill Gas to Energy	There a two 3 MW and one 70 kW landfill gas opportunities being explored by APS. Additionally, new technologies including for generating electricity from methane are being explored including reciprocating engines and micro turbines.	2
APS Wind	APS is exploring wind opportunities as they become available and demonstrate financial viability.	2
APS Biogas	Biogas - Possible opportunities being explored by APS include Water Treatment Plant (6 MW) and Bovine Power (2 MW) using an anaerobic digestion process to convert animal waste into biogas which can the be used to generate electricity.	2
APS Geothermal	APS is beginning evaluation of technology for potential future installation in SE AZ (10 MW).	2
APS Biomass	APS is Exploring the development of Plasma gasification, waste wood (3 MW) biomass opportunities to extract energy from the waste wood resulting from forest management processes due to the State's extended draught and the bark beetle infestation.	2
Springerville Solar Generating Station	As of December 2002, TEP has 2.4 MW solar capacity installed at the Springerville Generating Station in Eastern Arizona. By the end of 2003, the Springerville facility will have 3.5MW of capacity and TEP will have 4MW of capacity overall.	3

1 "Overview of SRP's Renewable Energy Program," Presentation by Herjinder Hawkins to PPWG on March 24, 2003.
2 "Renewable Energy Opportunities in Arizona," Presentation by Cassius McChesney to PPWG on June 2002.
3 "Statewide Economic Study 2002 – Arizona's Energy Infrastructure," Prepared for the Arizona's Department of Commerce by Rebecca Holmes, SRP, and Craig Marks, ACC, September 2002, p. 13.

12.4. Inventory of All Renewable Energy Generation Capacity and Production in Arizona

Pursuant to 40CFR 51.309 (d)(8)(i), Table 12-5 summarizes all renewable energy generation capacity and production in use or planned as of 2002 (expressed in MW and MWh). Appendix A-12b entitled *Details of Renewable Energy Generation and Capacity* contains a detailed inventory of existing and currently planned renewable energy production projects and their references.

Table 12-5. Summary of Renewable Energy Generation Capacity and Production

Categories	Existing Capacity in 2002 **(MW)**	Existing & Planned Capacity as of 2002 **(MW)**	Total Production **in 2002 (MWh)**
Solar	6.222	6.733	10,579.764
Methane	9.500	9.570	63,715.000
Wind	0	0	0
Wood Chips	0	3.000	0
Low-Impact Hydro	0	0.750	0
TOTAL	**15.722**	**20.053**	**74,294.764**

The total electric-energy production in the State of Arizona for 2000 was 89,101,000 megawatt-hours. (Energy Information Administration). The approximate percentage of renewable electric energy generated in 2002 was 0.08%. Generation capacity as of 2002 is summarized in Table 12-6.

Table 12-6. Summary of Arizona's Total Energy Generation Capacity and Production[19]

Rank	**Operator**	**Plant Name**	**Fuel**	**MW**	**Percent**
1	Arizona Public Service Company	Palo Verde	Uranium	3,730	19.2%
2	Salt River Project	Navajo (SRP)[20]	Coal	2,255	11.6%
3	U.S. Bureau of Reclamation	Glen Canyon	Water	1,300	6.7%
4	Pinnacle West	Redhawk Units 1 and 2	Gas	1,060	5.4%
5	U.S. Bureau of Reclamation	Hoover AZ	Water	1,042	5.4%
6	Arizona Public Service Company	Cholla	Coal	995	5.1%
7	Tucson Electric Power Co	Springerville	Coal	800	4.1%
8	Salt River Project	Coronado	Coal	760	3.9%
9	Duke Energy North America	Griffith Energy Project	Gas	620	3.2%
10	Salt River Project	Agua Fria	Gas	619	3.2%
11	Duke Energy North America	Arlington Valley	Gas	570	2.9%
12	Arizona Electric Power Cooperative	Apache	Coal/Gas	560	2.9%
13	Reliant Energy Power Gene	Desert Basin	Gas	560	2.9%
Total, Top 13 Plants				14,871	76%
Balance of State				4,581	
Arizona Total				**19,412**	**MW**

Sources:

Statewide Economic Study 2002, Arizona Energy Infrastructure, Prepared for the Arizona Department of Commerce, September 2002, pg. 7.

Second Biennial Transmission Assessment, 2002-2011, Arizona Corporation Commission, P Plus Corporation, December 2002, pg. 107-124

12.5. Summary of Anticipated Renewable Energy Contribution

The approximate percentage of renewable electric energy generated in Arizona for 2002 was 0.08%. Generation capacity as of 2002 is summarized in Table 12-6 above. Pursuant to 40CFR 51.309 (d)(8)(i), Appendix A-12b entitled of this SIP summarizes the State of Arizona's anticipated contribution toward meeting the GCVTC renewable energy goals for 2005 and 2015. Also see Section 12.10, below.

[19] Based on summertime generating capacity.
[20] This facility is on tribal lands (Navajo Nation).

12.6. Incentive Programs

Pursuant to 40CFR 51.309 (d)(8)(ii), Table 12-7 below identifies incentive programs in the State of Arizona that reward efforts to go beyond compliance and/or achieve early compliance with air pollution related requirements.

Table 12-7. Summary of Arizona's Incentive Programs

Program Title	Program Description
Market Trading	Arizona has opted into the Section 309 regional SO_2 "cap-and-trade program", as outlined in the Annex, under the Regional Haze Rule.
Western Backstop SO_2 Trading Program Early Reduction Credits	As further described in Section C1.1 of the stationary source provisions of this plan, industrial sources of SO_2 subject to the trading program which, upon verification by the State, reduce emissions to levels below their floor amount prior to the program trigger date shall receive additional emission allowances. Such allowances may be used by the source for compliance purposes or may be sold to other parties, hence, providing an incentive for sources to go beyond compliance (i.e., their floor) or to achieve early compliance (i.e., reductions prior to the program trigger date).
Western Backstop SO_2 Trading Program Renewable Energy Credits	As further described in Section C1.1 of the stationary source provisions of this plan, allowances shall be provided to the owners of renewable energy facilities installed since October 1, 2000. Such allowances will hold a market value and therefore provide an incentive for power suppliers to invest in renewable energy facilities with zero or very low air pollutant emissions.

12.7. Programs to Preserve and Expand Energy Conservation Efforts

Pursuant to 40 CFR 51.309 (d)(8)(iii), Table 12-8 identifies programs in Arizona that preserve and expand energy conservation efforts.

Table 12-8. Programs that Preserve and Expand Energy Conservation in Arizona

Program Title	Program Description
Energy Conservation in State Buildings	Legislation passed in 2003 requires that state agencies (the Department of Administration and Transportation and the Board of Regents) reduce energy use by 10 percent by July 1, 2008 and 15 percent by July 1, 2011. Preserve and Expansion Description: This program will expand energy efficiency activities of state agencies. Industry projections for savings from implementation of this measure are projected to be $11 million per year by 2011, with $90 million of cumulative energy efficiency savings over the period 2004-2015.
Purchase of Energy Star Projects by State Agencies	Legislation passed in 2003 requires all state agencies to purchase products certified as Energy Star or certified under FEMP in all categories unless the products is shown not to be cost effective on a life cycle cost basis. Preserve and Expansion Description: State agencies already purchase some products that are Energy Star certified. This program will expand existing energy efficient equipment purchase and have a long-term effect on energy use by state agencies. School districts and all political subdivisions can also purchase these energy star products off of the state contacts, which could further increase the impact of this program.

Program Title	Program Description
Regulated Utility Customer Funding or System Benefit Charge Funding for Energy Efficiency	Tucson Electric Power: 2002 --$3 million in approved SBC spending, of which $2 million was for renewable energy programs and $1 million for low income and energy efficiency programs. Arizona Public Service: 2002 - $7 million in approved spending, of which $6 million was used for renewable energy programs and technology development, and $1 million for low-income customer support and other programs. In addition, under the EPS program, APS collected an additional $6,571,745 for renewable energy programs in 2002. See also the listing in Table 12-2 under the heading Regulated Utility Customer Funding or System Benefit Charge Funding for Renewable Energy.
Residential New Construction and New Home Guarantee Programs	To help promote the value of energy efficient residential construction, APS works with builders and building material vendors to provide buyers with a heating and cooling guarantee. All participating builders must offer their homebuyers a 2-year guarantee that the monthly costs to heat and cool their home will be less than a specified amount. Currently four of the top ten production builders in the Phoenix metro area are participating in the program and over 3500 home lots have been committed. APS has promoted the concept of guaranteed heating and cooling bills through a multi-media campaign including TV, print, on-line, and point-of-sale materials. In 1997 TEP designed and implemented the first utility operated new home guarantee program in the nation. The program philosophy addresses all of the issues of affordability, durability, comfort, health and safety using scientific laws of airflow, moisture-flow and pressure management within a home. Homes are constructed to high standards set by TEP and include on-site inspections of framing areas related to energy performance, insulation installation, and HVAC system design and installation. On-site testing is also provided to measure duct leakage, whole-house infiltration and pressure management within the home under various operating conditions. If a home passes all inspection and testing criteria, the homeowner receives a Guarantee from TEP that heating and cooling costs will not exceed a predetermined average cost per day (calculated on each separate model home) and a guarantee for comfort for a pre-set time period. Homes permitted prior to February 20, 2003 receive a 3-year guarantee and homes permitted after February 20, 2003 receive a 5-year guarantee. Homeowners who purchase a TEP Guarantee home qualify for a specially designed rate-tariff that reduces the cost of all electricity used in the home by 12% annually compared to the standard residential electric rate. The homeowners also have the option to increase this electric rate savings to either 18% or 22% depending on their selection of TOU and/or the installation of solar water heating systems. There are currently over 5500 homes either completed, in some progress of completion or waiting for construction to begin. The program is operated within the utility structure with quality control provisions and the guarantee provided by a utility. All TEP Guarantee Homes qualify for ENERGY STAR since the qualifications from TEP are more stringent than ENERGY STAR. TEP provides this DOE/EPA program documents to customers along with the Guarantee certification. The SRP-Certified Home (SCH) program was introduced in May 1995. For a subdivision to be SRP certified, SRP works directly with the builder to ensure that each home design meets our energy-efficiency standards. SRP certification means the home design includes certain energy-efficient features. Certification is based on the SRP-Certified Homes Point Sheet that primarily is a construction specification trade-off system. With the system, one design feature may be substituted for another if the overall design complies with the SRP-Certified Home energy consumption standard. Between 1999 and 2002, approximately 21,000 SCH contracts were signed. In 2002 SRP announced a new addition to the SRP-Certified Home program. Energy Code Compliance certification is now available upon request. SRP can provide REM/Design compliance reports for 1998/2000 International Energy Conservation Codes (IECC), CABO Model Energy Code (MEC), and ASHRAE 90.2 By adding the new "Code Compliance" feature to the program we can now assist builders in meeting the energy efficiency codes required by the various municipalities.
New Construction Energy Efficiency	In partnership with the Arizona Energy Office, APS has conducted extensive research and testing on new residential construction with blower doors, duct blasters, infrared cameras, and other diagnostic tools. The result of these tests is a list of building construction details that need the most focus to improve home performance. In 1998, APS and the Arizona Energy Office began offering Building

Program Title	Program Description
Research and Training	Science training for residential builders. To date, over 2000 building industry members have attended. Coupled with the heating/cooling guarantee program, this has resulted in substantial improvements in the real world performance of residential new construction as confirmed through field studies by the Arizona Energy Office. TEP hosts quarterly education programs to target audiences of builders, sub-contractors, and city/county code officials, architects and consumers. These programs are designed to educate all audiences on the scientific approach of building new homes or retrofitting existing homes to gain the maximum benefit in affordability, durability, comfort and health and safety. TEP also adds matching funds for grants provided to the City of Tucson 'Teaching Energy Conservation' project which educates consumers, builders, contractors, consumers and code officials on various conservation related issues.
Qualified Contractor Program	APS offers referrals to customers seeking qualified, professional HVAC contractors for service or replacement of their existing AC/heat pumps. To qualify for the program, residential HVAC contractors are required to meet stringent requirements and complete ongoing rigorous APS education courses for their service technicians. To date, APS has subsidized technical training for over 6000 service technicians. APS currently provides free contractor referrals to approximately 4000 customers each year, ensuring that units are properly serviced and installed.
High Efficiency Appliance Programs	APS High Efficiency Air Conditioners Program For several years APS has worked with the air conditioner contractor community. This partnership has been instrumental in moving the market for resale air conditioners and heat pumps to high efficiency equipment. Evidence suggests that the resale market is about 90% 12 SEER, which is 15% more efficient than standard equipment, reducing demand and energy consumption. Since 1998, APS and contractors have distributed over 20,000 copies of the Consumer's Guide to an Energy Efficient Air Conditioning System as an education tool for customers. SRP Rebates on Highly-Efficient Refrigerators and Heat Pumps – Over the last several years, SRP has independently offered customers rebates on highly efficient refrigerators and heat pumps. SRP has issued more than 8,500 rebates on refrigerators labeled by ENERGY STAR® as exceeding federal standards and more than 1,000 rebates on heat-pumps with a 13-SEER rating that also meet additional strict criteria.
Time of use rates	APS Time of use rates - Approximately 40% of all residential customers are on a time of use rate. It is one of the highest penetrations of TOU rates in the country. APS is one of the only utilities nationwide to offer a demand rate for residential customers. Most new APS customers apply for one of the two TOU rates. Evidence suggests it reduces demand and shifts load. A recent survey of customers indicates that over 75% of TOU customers do shift some of their energy use to off-peak time periods. Customers feel it gives them control over their electric bill and helps conserve peak energy. SRP has approximately 140,000 customers on our peak-load shifting program, Time-of-Use (TOU). Residential TOU customers average 75% off-peak usage annually, while non-TOU residential customers average 72% - 73% off-peak usage annually. The result of TOU is that SRP has been successful in shifting 2%-3% of our average annual energy consumption to off-peak. TEP has approximately 7,700 customers on our peak-load shifting program, Time-of-Use (TOU). Residential TOU customers average 80% off-peak usage annually, while non-TOU residential customers average 77% - 78% off-peak usage annually. The result of TOU is that TEP has been successful in shifting 2%-3% of our average annual energy consumption to off-peak.
Peak Reduction Campaign	Commercial Peak Reduction Campaign **--** Since the summer of 2001, APS has promoted a voluntary summer peak energy management initiative with commercial customers. Participating customers pledge to save energy on extreme summer days when temperatures exceed 110 degrees in Phoenix. Customers receive an email on "Peak Power Days" asking them to turn thermostats up two degrees, turn off unnecessary lights and equipment, and adjust the schedule of energy-intensive processes. The campaign has helped shave peak consumption and heightened awareness of the need to save energy on extreme summer days.

Program Title	Program Description
Shade Trees Campaign	The TEP Trees Program promotes energy conservation and the environmental benefits associated with planting low-water usage trees and other vegetation. Desert-adapted trees have been provided to residential neighborhoods, low-income families, public areas and schools by TEP. The residential trees are to be located on the south, west and east sides of homes in the TEP service area with the objective of continuing positive community service as well as providing Demand-Side Management ("DSM") benefits. Residential Program: There were 3,000 trees distributed to roughly 1,500 homes for the period January 1, 2002 through December 31, 2002. School and Community Programs: For the period January 1, 2002 through December 31, 2002, this program provided 105 fifteen-gallon-sized and 41 five-gallon-sized trees to 43 schools. In addition, 63 community projects received 115 fifteen-gallon-sized and 111 five-gallon-sized trees.
Energy Efficiency Education	APS provides a free on line energy analysis on aps.com. It allows customers and prospective customers to analyze their home and business energy use and identify customized energy efficient measures. Approximately 30,000 customers have used this service since 2001. APS offers an energy answer line service to answer questions about home energy efficiency. This service receives about 6000 calls per year. APS provides seasonal energy savings tips online and in customer bill inserts. SRP Energy Savings Solutions Campaign Energy Savings Solutions (ESS) is a multi-media campaign, which runs from May through September. The goal of ESS is to educate customers about effective energy management. ESS provides customers with useful and easy ways to lower their energy usage and enables customers to make informed decisions everyday by demonstrating how home energy conservation efforts can help reduce energy costs. TEP provides free class sets of booklets to schools in its area, including, "Learning to Save Energy", which is geared to grades 3-5. TEP also offers teacher training and back up materials for two hands-on activities: The Insulation Station (which deals with residential energy issues) and The Energy Patrol (where a class or group of students learn about energy efficiency, and then try to "patrol" their school, helping remind others how to save energy). TEP also provides seasonal energy tips on-line and in mailings to customers and handouts at presentations.
Energy Star	Customer Education on Purchasing Decisions SRP has been an ENERGY STAR® partner since 1999. This DOE/EPA program establishes stricter efficiency criteria for new products. As a partner, SRP has been able to not only increase awareness of ENERGY STAR, but also to provide information for customers so that they can make informed purchase decisions. This information has been incorporated into our monthly newsletters and our Energy Savings Solutions campaign and has also been heavily featured in on-going publications to both residential and commercial customers via *Powerful Solutions* and *eNews*.
Energy Efficiency Audits	For approximately the last two years, SRP has been working with third party contractors and other entities such as the Arizona Department of Commerce to provide free or low cost energy efficiency audits and educational programs to energy consumers in the commercial, industrial and government sectors. The focus of the programs to date has been on high-efficiency lighting retrofits, energy information services, and improvements to compressed air systems. TEP offers the Energy Advisor, a quick, free, online analysis of a home's or business's monthly energy use, as well as suggestions on how to reduce energy costs.
Pre-Pay Program	SRP has approximately 31,000 customers on our pre-pay program, M-Power. M-Power customers have reduced their energy consumption by 10% on average. This energy conservation is due to the intensive educational information provided by the program and the discipline required from the customer. M-Power is the largest program of its kind in North America.
Arizona Energy Office, Arizona Dept of Commerce	The Energy Office's $2.3 million annual budget is funded through a combination of federal funds and Petroleum Violation Escrow funds. Director: Craig Marks (602) 771-1139 craigm@azcomerce.com

Program Title	Program Description
	http://www.azcommerce.com?energy/default.asp
Low Income Weatherization	The Energy Office administers Arizona's $3 annual million (federal and private funds), low-income, weatherization program The primary mission of this program is to reduce the energy required for space heating and cooling for income eligible households applying for assistance through one of ten sub-grantees, statewide. This program receives its primary funding from the U.S. Department of Energy and the U.S. Department of Health and Human Services. The program also leverages additional funds through partnership with utilities, and other federal and state housing programs. Many aspects of the Residential Training and Technical Assistance Programs are now incorporated into the training of weatherization sub-grantees, which assures that savings are maximized.
Special Project Grants	The Energy Office administers the State Energy Project – Special Project Grants. Each year states submit proposals in response to a DOE solicitation identifying how specific technologies could be implemented in their region of the country. DOE then selects the projects that best meet national energy goals. The Energy Office publicizes grant availability, helps prepare grant applications, and administers grants. The Energy Office is currently administering $2,865,375 SEP Special Project funds.
Residential-Market Training and Technical Transfer	Over 30,000 new homes are built each year in the harsh desert environment of metro-Phoenix, making it one of the largest new home markets in the United States. Thousands more homes are built each year in other fast-growing Arizona communities. Improving the energy efficiency of new homes has an enormous impact on Arizona's energy usage. The Energy Office has long partnered with Arizona utilities to provided technical assistance and training for the building trades on the latest energy efficiency technologies and techniques, including: Infrared imaging to analyze insulation performance; Smoke generation to show duct leakage; and Using pressure diagnostics, such as the blower door testing, duct blasters, and digital monometers, to confirm envelope integrity. Overall the goal is to encourage builders and subcontractors to take a scientific systems approach to home construction and incorporate energy-efficient techniques into the building process.
Municipal Energy Management Program	The MEMP (Municipal Energy Management Program) encourages and assists in the development and implementation of energy management programs by facilitating the planning process and providing the necessary basic tools, staff training and technical assistance. As part of MEMP, the Energy Office makes funds available for energy saving projects. Those eligible to apply include incorporated Arizona cities, towns, counties, improvement districts, and Indian tribes with populations under 70,000. The MEMP approach to energy conservation is a simple and direct step-by-step approach. The first step is to understand where energy is being consumed and how much it costs, based on the utility bill analysis and audits. The second step identifies strategies for lowering energy costs. The third step assists in incorporating energy management into future development through an energy management plan.
Federal Energy Management Program	Goal: reduce the cost and environmental impact of the federal government by advancing energy efficiency and water conservation, promoting the use of distributed and renewable energy, and improving utility management decisions at federal sites. Funds are occasionally available to the Arizona Energy Office to partner with Indian communities and military bases or other federally-owned facilities
State Energy Efficiency Demonstration Program	Working with the Department of Administration and agency facility managers, the Energy Office provides training, technical assistance and funding to implement energy savings and demand-reduction measures in state-controlled facilities. Matching grant program.
State Facility Managers Training Program	Based on results of the forensic audits and utility tracking, the Energy Office provides training and technical assistance to state facility management staff with the goal of identifying actions that may be taken to decrease electricity consumption in state facilities. This training will assist facility managers in performing diagnostics on their facilities, complete retrofits on equipment and buildings, and track

Program Title	Program Description
	energy consumption.
Energy Efficient Schools	Energy Office partnership with School Facilities Board. A jointly funded engineer works with architects and vendors to incorporate cost-effective, energy-efficient designs and equipment. Energy audits of existing facilities are also available.
State Energy Code	HB 2541 (2001) Is a voluntary model energy code (AZ=home rule). This bill designates the State Energy Code as a legislative tool to create incentives for the use of energy saving devices and practices. It established a State Energy Code Advisory Commission to review and recommend changes to the State Energy Code.
Governor's Awards	The Energy Office recognizes local governments, state agencies, and educational institutions for exceptional energy-conservation accomplishments.
Rebuild America	U.S. D.O.E. Program supported by Arizona Energy Office help businesses and communities reduce energy use in buildings.
Green Buildings	Green buildings are use design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment The concept includes: - Sustainable site planning - Safeguarding water and water efficiency - Energy efficiency and renewable energy - Conservation of materials and resources - Indoor environmental quality
Leadership in Energy & Environmental Design (LEED)	This program facilitates positive results for the environment, occupant health and financial return. It defines "green" by providing a standard for measurement, prevents false or exaggerated claims, and promotes whole-building, and integrated design process. LEEDS evaluated and recognizes performance in accepted green design categories, existing and proven technologies. There are four levels of certification.
Utility Tracking	Developed by the Energy Office for entities with multiple accounts (e.g., schools, municipalities, large businesses). Uses Microsoft Excel to track utility usage by meter. Captures data from utility's web site. The program identifies problems, and raises questions.
National Industries of the Future	Administered by Department of Energy – Office of Industrial Technologies Nine industries targeted that together supply 90% of the materials vital to US economy. The 9 industries are: agriculture, aluminum, chemicals, forest products, glass, metal casting, mining, petroleum, and steel. Goal: Promote energy efficiency and manage waste streams.
Industrial Assessment Centers	Administered by DOE, OIT Enables eligible small and medium-sized manufacturers to have comprehensive industrial assessments performed at no cost to the manufacturers. Teams of engineering faculty and students from the center, located at 26 universities around the country, conduct energy audits, or industrial assessment and provide recommendations to manufacturers to help them identify opportunities to improve productivity, reduce waste, and save energy.
Income Subtraction for Construction of an Energy Efficient Residence	For taxable years beginning from and after December 31, 2001, through December 31, 2010, Arizona law (A.R.S. 43-1031) allows a subtraction for a residence that is 50% more efficient than the 1995 Model Energy Code (MEC). The subtraction is allowed for selling one or more new energy efficient residences located in Arizona. The subtraction is equal to 5% of the sales price excluding commissions, taxes, interest, points, and other brokerage, finance and escrow charges. The subtraction cannot exceed $5,000 for each new qualifying residence. A home's energy efficiency must be demonstrated by a score of at least 90 points (indicating that the home is 50% better than the MEC threshold) on a home energy rating. A Certified Home Energy Rater must provide the home energy rating.
Building America	Building America is a private/public partnership that provides energy solutions for production housing. The Energy Office assists in disseminating the results of this effort to the Arizona market place.

Program Title	Program Description
Governor's Smart Energy Usage Program	"Conservation saves money, which makes sense during tight budget times. And decreased energy production saves water, which makes sense during a drought. These two reasons provide more-than-enough motivation to conserve this summer," Arizona Governor Jane Dee Hull said when announcing the Smart Energy: Phase II program for summer 2002. As a result of the success of the 2001 campaign, Governor Hull ordered all agencies under her jurisdiction to take a number of energy-saving steps for the second summer in a row. The Governor also asked that state residents voluntarily comply with the "Arizona Smart Energy: Phase II" program. As part of the Smart Energy: Phase II program, the Governor asked all state employees to implement the following energy saving measures: - Every agency will use power management tools like Energy Star to keep computers, monitors and other devices in stand-by mode when not in use. - Employees will turn off lights and office equipment, as much as possible, when they expect to be out of the office for more than one hour. - Agencies will reduce all lighting that does not affect productivity, health or safety. - Thermostats in all state-controlled facilities will be increased during the months of June though September by two degrees or brought within the 76-79 degree range whichever is greater. - Agencies will implement a professional, casual-dress policy from June through September, consistent with the type of work being performed.

12.8. Potential for Renewable Energy

Pursuant to 40CFR 51.309 (d)(8)(iv), the State of Arizona has made an assessment of areas where there is the potential for renewable energy to supply power in a cost-effective manner. This section summarizes the findings of this assessment beginning with a review of the geographic distribution of renewable energy potential contained in Figures 12-1 through 12-4.

Figure 12-1. Map of Arizona Solar Photovoltaic Resources

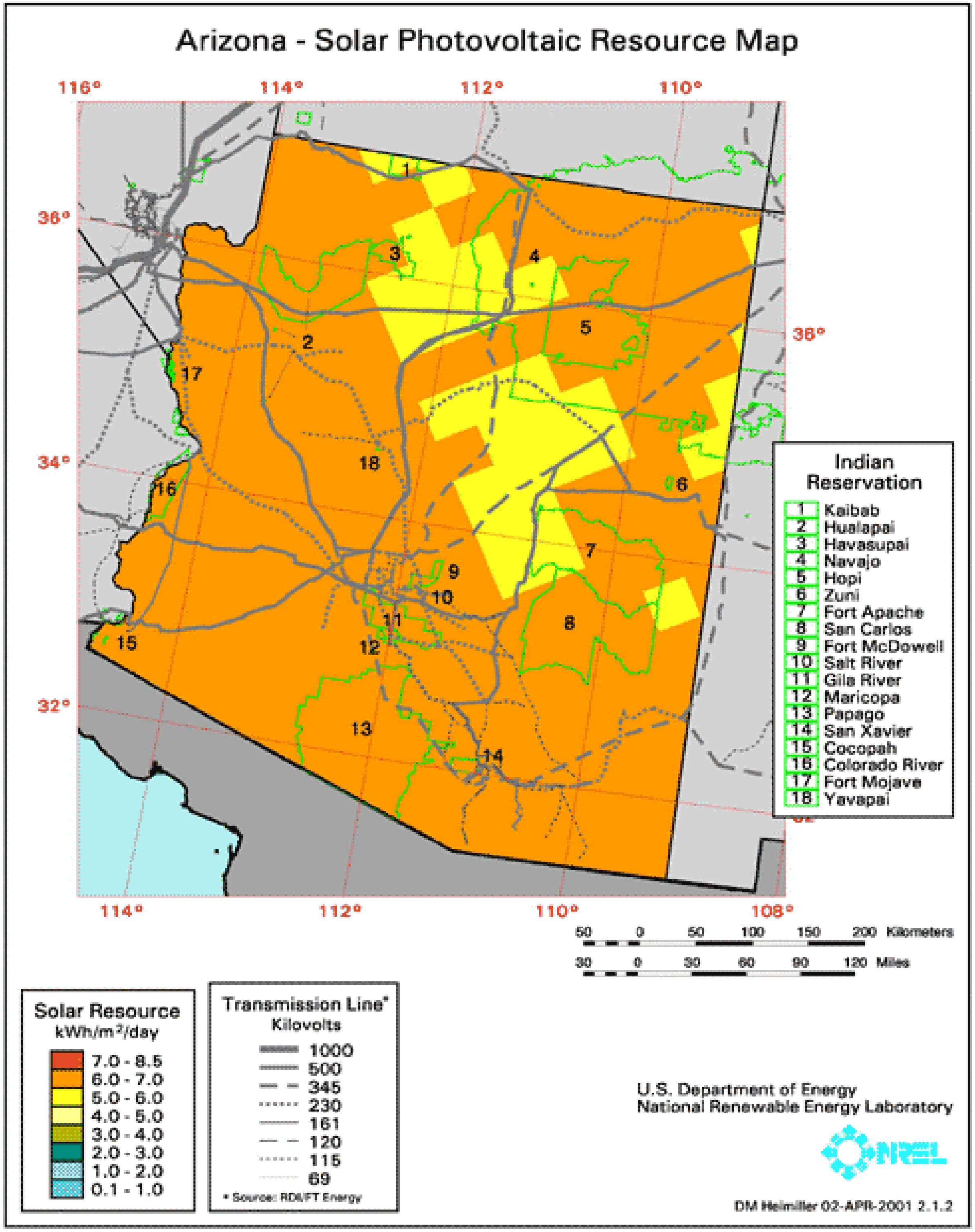


Figure 12-2. Map of Arizona Concentrating Solar Power Resources

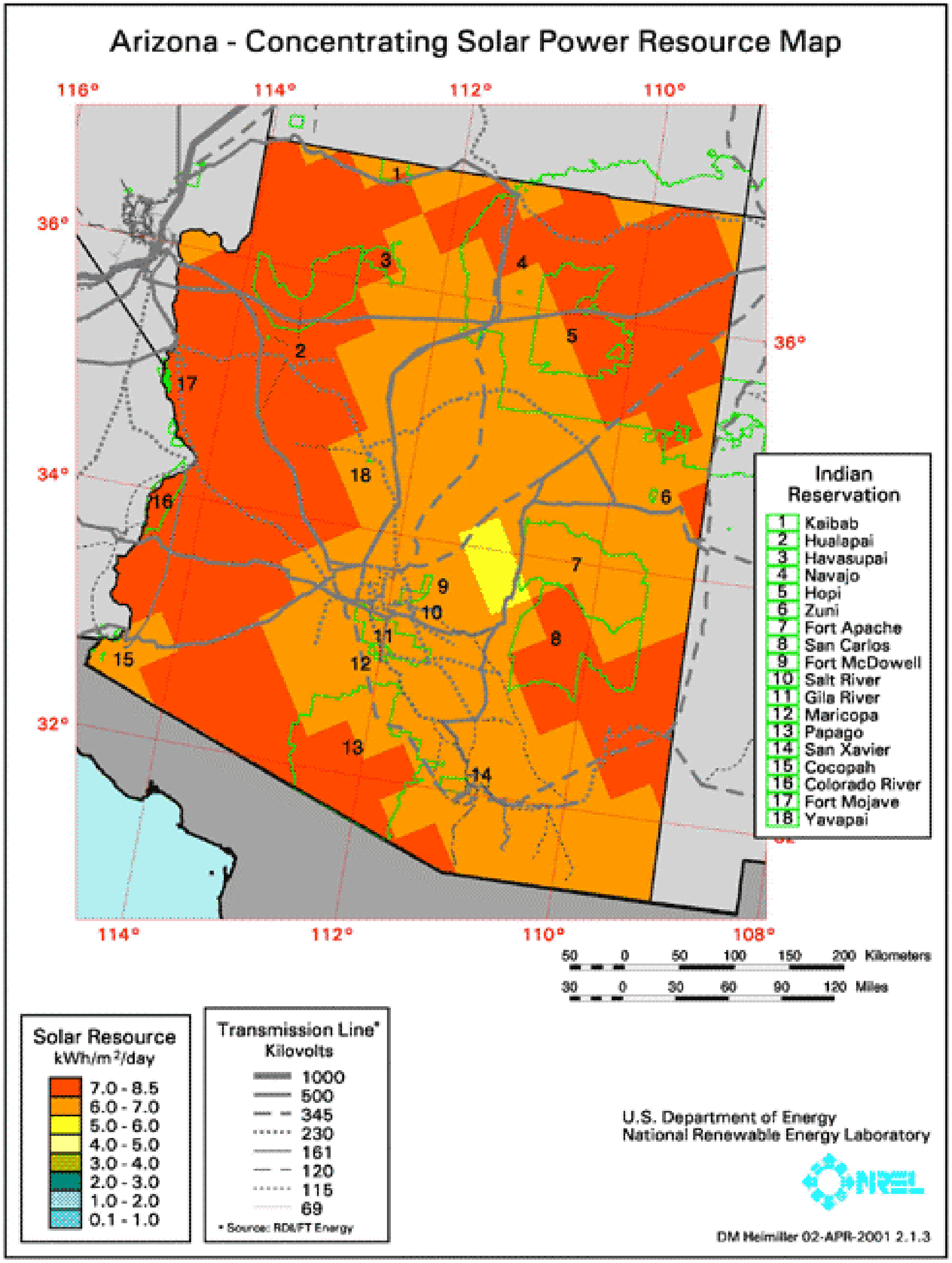


Figure 12-3. Map of Arizona Biomass Energy Resources

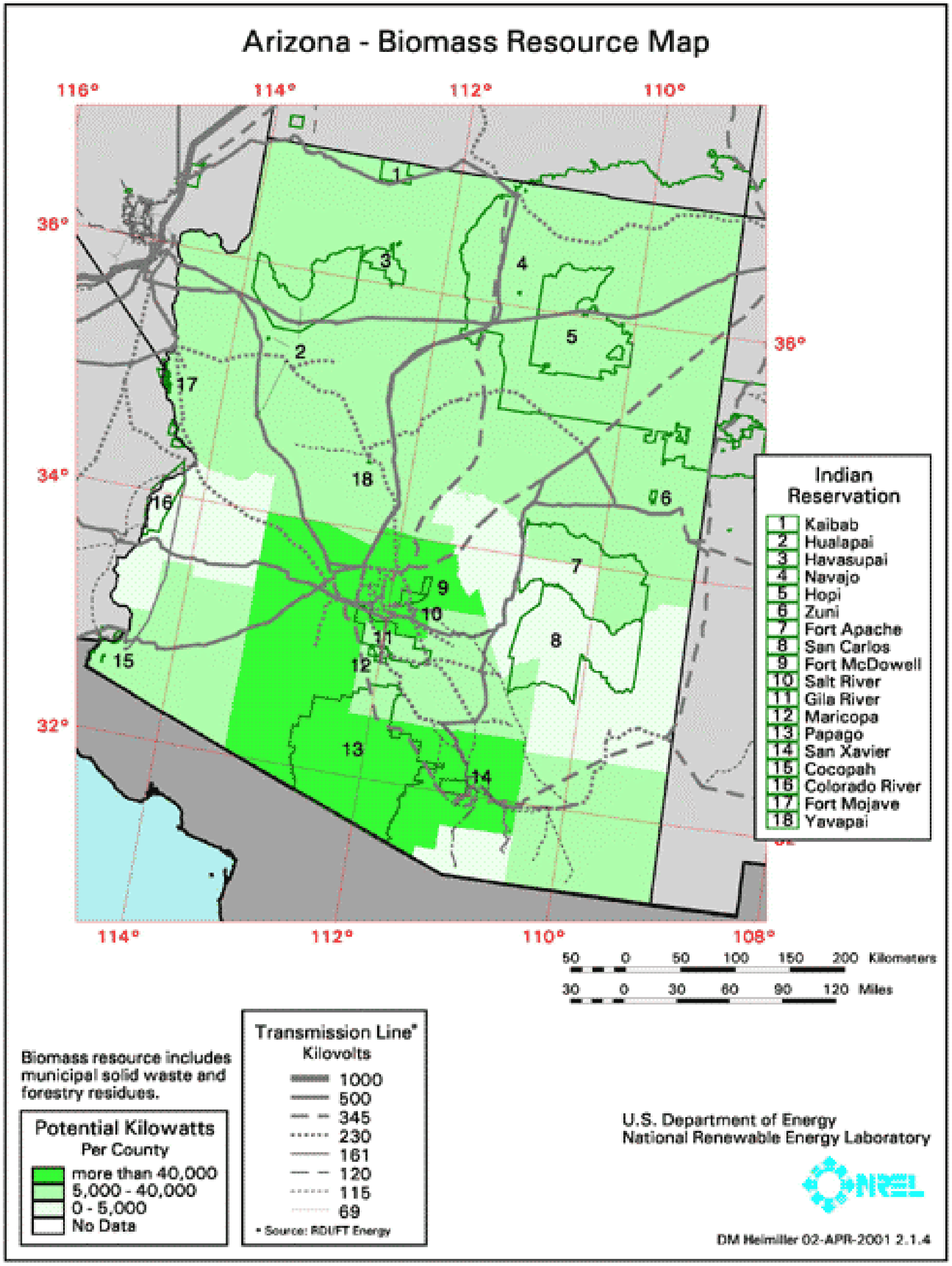
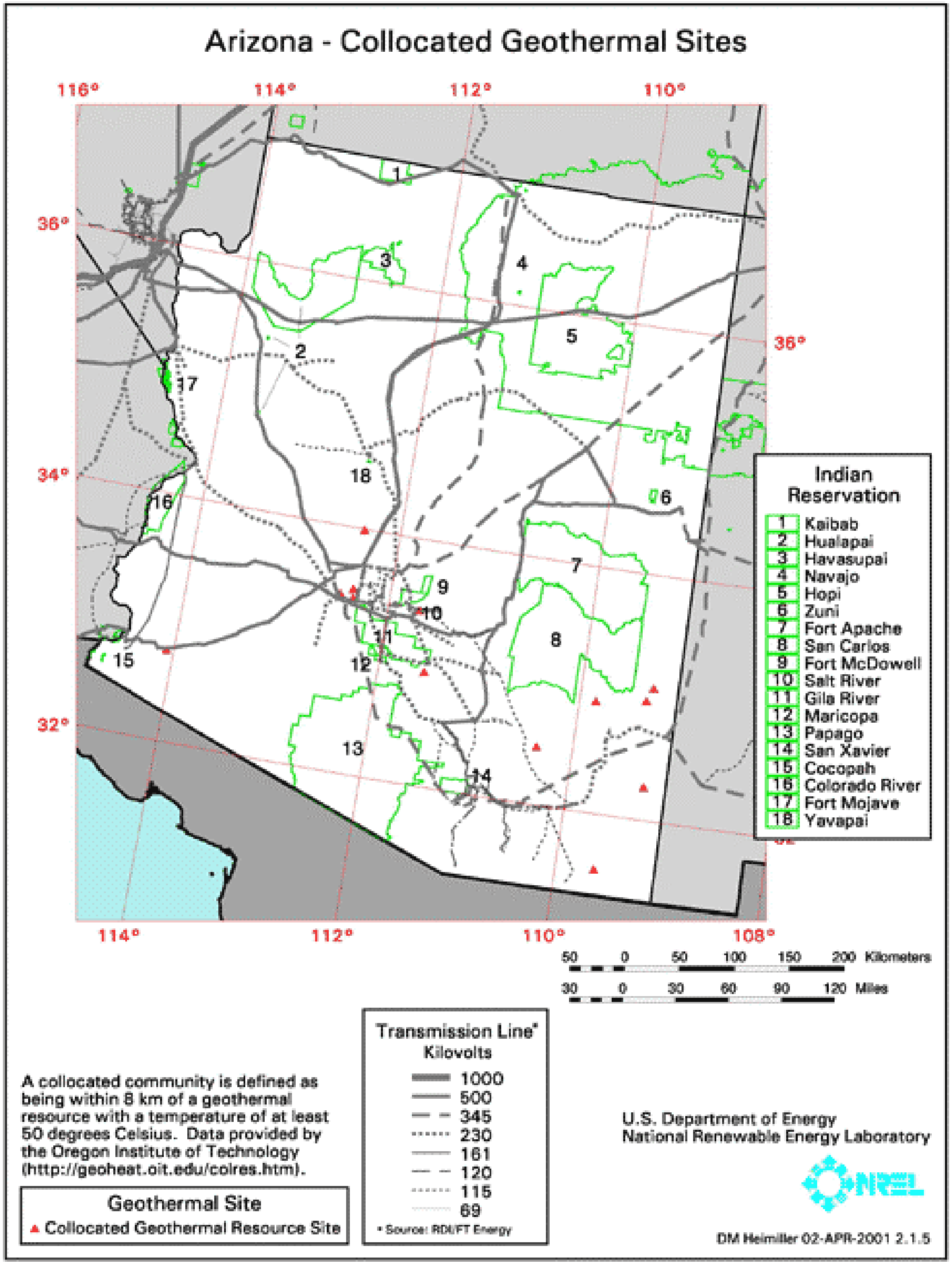


Figure 12-4. Map of Arizona Collocated Geothermal Energy Resources

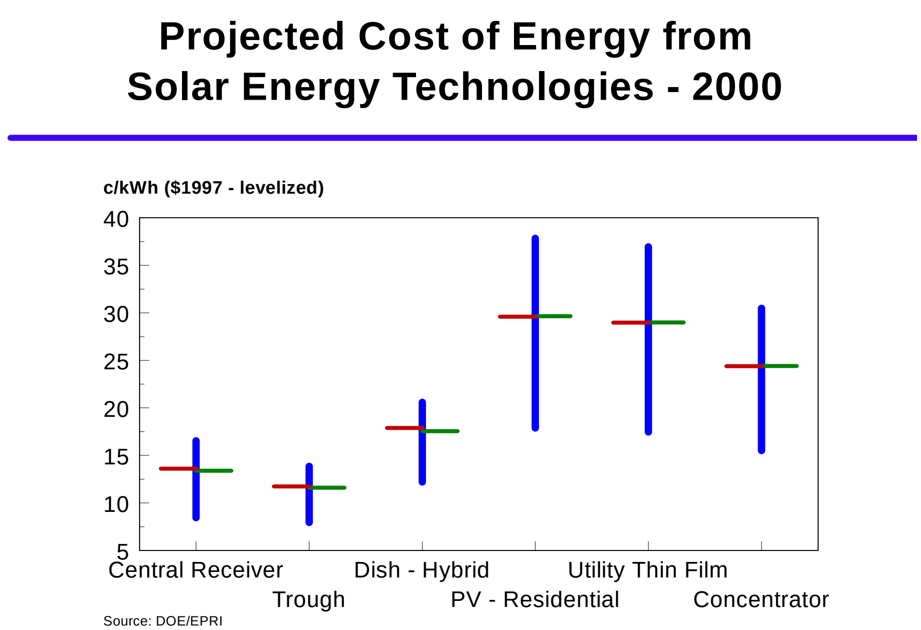


Arizona is not blessed to the same degree with wind resources as Montana, geothermal resources as Nevada, or the hydroelectric resources of the northwest. However, Arizona has renewable energy resources that have yet to be tapped. A consortium of business, government and academic institutions are actively evaluating the state's wind resources. Initial data suggest that commercial-scale wind resources may exist in the state on developable lands. The cost of utility scale wind installations has dropped dramatically in the past decade resulting in a robust new wind industry. Between 2000 and 2001, wind generated installations doubled in capacity and in 2001 alone, 1,700 MW of wind were installed in the U.S. Depending on the wind resource and local, state and federal subsidies, costs are equal to or nearing the cost of generating electricity with conventional fuels.

Projects are underway to evaluate or develop electricity generation projects in two areas of the state. In addition, large reserves of geothermal resources are available for direct use, hot water applications. Renewable resource development is site specific, dependent on access, and availability of transmission, land ownership issues and economics of developing the known resource.

In terms of renewable energy resources, Arizona leads the nation in potential solar-energy resources. Solar electric generating plants cost much more than plants that employ conventional technologies. Large natural gas-fired, combined-cycle plants can be built for approximately six-hundred dollars per kilowatt, while the best solar technologies are still estimated to cost at least six to ten times as much.

Figure 12-5. Projected Cost of Solar Energy Technologies



Source: WRAP AP2 Renewables, "Recommendations of the Air Pollution Prevention Forum to Increase Generation of Electricity from Renewable Energy Resources," p. I-13.

Table 12-9. Cost Estimates of Solar Options

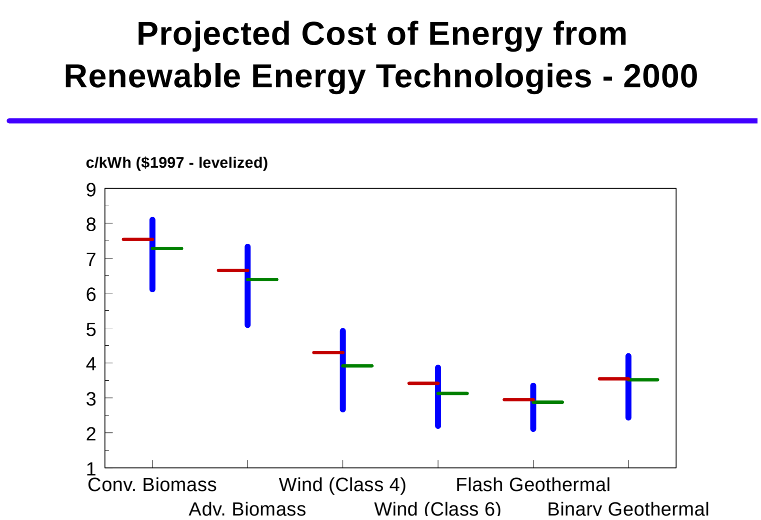
Technology	Plant Size (MW)	Cost ($Million)	Cost per kilowatt
Parabolic Trough	50	200	4,000
Power Tower	15	60	4,000
Dish Engine	1	6	6,000
Photovoltaic	1	6	6,000
Concentrating Photovoltaic	1	6	6,000
Organic Rankine Cycle Trough	1	<5	<5,000

Source: Presentation by Dr. Peter Johnson, Arizona Public Service Company, June 2002

Balanced against the higher capital costs of solar technologies are lower operation and maintenance costs. Fuel is the most expensive component of conventional power generation; sunlight is free. However, a conventional plant can be called on (dispatched) at any time, while solar plants can operate only while the sun is out and generation will be reduced on cloudy days. Because electricity cannot be stored cost effectively, the inability to dispatch the plant is a significant drawback to solar and wind-powered generation. Overall, solar electric generation cannot compete yet with conventional plants on pure economics. But solar generation requires no imported fuel, produces no air emissions, and consumes no water. Further, like any newer technology, it is expected that costs will come down as economies of scale are realized and production techniques improve.

Finally, solar and other renewable generation have cost-effective applications in remote areas where it may be too expensive to extend a power line. For example, solar energy is being used to provide electricity for landfills, ranches, rural streetlights, emergency phones, and entire homes. Solar water heating can be cost effective even in urban areas, particularly in competition with electric water heating. Overall, the next ten years should see substantially increased penetration of solar and other renewable resources into Arizona's generation mix.

Figure 12-5. Projected Cost of Renewable Energy Technologies



Source: WRAP AP2 Renewables, "Recommendations of the Air Pollution Prevention Forum to Increase Generation of Electricity from Renewable Energy Resources," p. I-13.

12.9. Projections of Renewable Energy Goals, Energy Efficiency, and Pollution Prevention Activities

Pursuant to 40CFR 51.309 (d)(8)(v), projections have been made by the WRAP of the short and long term emissions reductions, visibility improvements, cost savings, and secondary benefits associated with “renewable energy goals, energy efficiency and pollution prevention activities.” A complete description of the WRAP projections is contained in the report *ICF Assessment of Renewable Energy and Energy Efficiency Programs* included as Appendix A-12c. Projections of visibility improvements for the 16 Class I areas on the Colorado Plateau are provide in Section 14.2. These projections include the combined effects of all measures in this SIP, including air pollution prevention programs. Although emission reductions and visibility improvements from air pollution prevention programs are expected at some level, they were not explicitly calculated because the resolution of the regional air quality modeling system is not currently sufficient to show any significant visibility changes resulting from the marginal nitrogen oxide emission reduction described above for air pollution prevention programs. Details of the modeling methodology are contained in the WRAP TSD in Chapter 8 entitled, “Assessment of Pollution Prevention.”

12.10. Programs to Achieve GCVTC Renewable Energy Goal

Pursuant to 40 CFR 51.309 (d)(8)(vi), the programs relied upon by the State of Arizona to demonstrate progress in achieving the renewable energy goal of the GCVTC that renewable energy comprise 10 percent of the regional power needs by 2005 and 20 percent by 2015 are the environmental portfolio standard, and the utility customer funding or system benefit charge funding for renewables in addition to the other programs that are listed in Table 12-2. The approximate percentage of renewable electric energy generated in Arizona for 2002 was 0.08%. Generation capacity as of 2002 is summarized in Table 12-6 above.

Appendix A-12b entitled *Details of Renewable Energy Generation and Capacity* provides additional information on the programs relied upon by Arizona to meeting the 10/20 regional goals. Appendix A-12c entitled *ICF Assessment of Renewable Energy and Energy Efficiency Program*, contains the regional modeling assessment performed by WRAP on the potential economic and visibility impacts associated with achieving the 10/20 regional goals. Section 12.8, above, contains an assessment of the potential for renewable energy resources.

12.11. Future Progress Reports

Pursuant to 40 CFR 51.309 (d)(8)(vi), the State of Arizona commits to submit progress reports in 2008, 2013 and 2018, describing the State’s contribution toward meeting the GCVTC renewable energy goals. This description will be consistent with Section 12.9 above. To the extent that is not feasible for the State to meet its contribution to these goals, the State commits to identify measures that were implemented to achieve its contribution, and explain why meeting its contribution was not feasible.

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13. OTHER GCVTC RECOMMENDATIONS

13.1. Regulatory History and Requirements

The recommendations of the GCVTC are presented throughout the June 1996 final report with varying degrees of specificity. Not all are included in the Regional Haze Rule. However, some of the recommendations were intended as a menu of options, with no expectation that any geographic area would implement all of them. The GCVTC pointed out in its final report that:

> Some of the Commission's recommendations ask the EPA to take specific **actions** or institute particular **programs**, in cooperation with the tribes, states and federal agencies as implementing bodies. Other recommendations provide a range of potential policy or strategy **options for consideration** by the EPA and implementing entities. As the EPA develops policies and takes actions based on this report, this distinction between "actions" and "options" should be maintained with diligence. That is, recommendations intended as policy options should not become mandated actions or regulatory programs. [**BOLD** emphasis in original]

13.2. Other Long-term Strategy Components

(a) Evaluation of additional Grand Canyon Visibility Transport Commission recommendations. Pursuant to 40 CFR 51.309(d)(9), the State of Arizona has evaluated the "additional" recommendations of the Grand Canyon Visibility Transport Commission, to determine if any of these recommendations can be practicably included in this SIP. The State of Arizona reviewed the Commission's 1996 report, *Recommendations for Improving Western Vistas*, to identify those recommendations that were not incorporated into Section 309 of the Regional Haze Rule. This evaluation is described in Appendix A-13a of this SIP.

(b) Implementation of Additional Recommendations. The State of Arizona has identified those additional strategies that have been implemented at the national, regional, state, and local levels. Based on the evaluation made by the State of Arizona, as described in Appendix A-13a, no additional measures have been identified as being practicable or necessary to demonstrate reasonable progress at this time. The State of Arizona will re-evaluate the status of implementation of additional recommendation in future plan revisions required under 40 CFR 51.309(d)(10).

13.3. Sources In and Near GCVTC Class I Areas

Pursuant to 40 CFR 51.309(d)(9), the SIP must provide for implementation of all other recommendations in the Commission report that can be practicably included as enforceable emission limits, schedules of compliance or other enforceable measure to make reasonable progress toward remedying existing and preventing future regional haze in the GCVTC Class I areas. The GCVTC report also recognizes the importance of visibility issues related to emission sources in and near Class I areas and includes recommendations regarding emissions within and near these areas. In addition, the GCVTC recommendations for road dust include actions contained in the "In and Near" section of the report to address the control or reduction of emissions related to road dust.

The State of Arizona has in place existing strategies to address the requirements of 40 CFR 51.309(d)(9) for area sources of dust. The State of Arizona commits to the evaluation of sources of dust in and near the GCVTC Class I areas and will develop and implement controls as necessary to demonstrate reasonable progress toward the national goal in future SIP revisions as required under 40 CFR 51.309(d)(10).

The State of Arizona continues to address the impact of road dust and other dust sources at the Colorado Plateau Class I areas and has reviewed, with the help of Federal Land Managers (FLMs) with knowledge of the Grand Canyon National Park, Mt. Baldy Wilderness Area, Petrified Forest National Park, and Sycamore Canyon Wilderness Area, the type of localized sources of dust that may affect visibility in and near these four areas. Descriptions of the Class I areas and summaries of the observational and quantitative information provided by the Federal Land Managers to the Arizona Regional Haze SIP Dust Management Work Group are found below and in Appendix A-13b, Tables 1 through 4.

In addition, in-and-near micro-inventories are being developed by the WRAP for the four Arizona Class I areas within the 16 GCVTC Class I areas. Further, the Dust Emissions Joint Forum is endeavoring to determine the affects of both regionally and near-field wind-blown dust. This work fulfills the need identified by the GCVTC to develop accurate emission inventories and air quality modeling to determine appropriate emission control strategies from road dust and other dust sources for each Class I area.

13.3.1. <u>Grand Canyon National Park</u>

The Grand Canyon National Park encompasses 1,218,375 acres of the Colorado River canyon and adjacent uplands. This natural preserve is under the jurisdiction of the U.S. National Park Service. Intensive visitor use is confined to relatively small areas on the North and South rims, while most of the park is remote and primitive. Large areas of Forest Service, Tribal, and private lands surround the Park. A summary of emission information for sources of dust within and near the Grand Canyon area is contained in Appendix A-13b, Table 1, including information for paved and unpaved roads and wind generated emissions.

13.3.2. <u>Mt. Baldy Wilderness Area</u>

The Mt. Baldy Wilderness is located in the White Mountains along the southern edge of the Colorado Plateau and comprises 7,079 acres pine and fir forest on the northeastern flank of Mt. Baldy. The Wilderness and areas to the east are primarily under the jurisdiction of the Apache-Sitgreaves National Forest. Tracts of State and private land are also included in this multi-use region. Areas to the west are under the jurisdiction of the Fort Apache Indian Reservation. The FLM survey of dust sources includes information on seasonal recreational access roads. A summary of emission information for the Mt. Baldy area is found in Appendix A-13b, Table 2.

13.3.3. <u>Petrified Forest National Park</u>

The Petrified Forest National Park covers 93,533 acres of grasslands and high desert plateau. State, Tribal, and private land are adjacent to the Park. The FLM survey of potential sources of dust in this popular preserve includes information on wind generated emissions. A summary of emission information for the Petrified Forest area is found in Appendix A-13b, Table 3.

13.3.4. Sycamore Canyon Wilderness

The Sycamore Canyon Wilderness area comprises 55,937 acres of pine and fir forest on the Colorado Plateau and extends southwest, ending at the desert mouth of sycamore creek in the Verde Valley. The wilderness and surrounding area is primarily under the jurisdiction of the Prescott, Coconino, and Kaibab National Forests. Areas of State, Tribal, and private lands are also located near the Wilderness. The FLM survey of potential sources of dust in this recreational area includes information on wind generated emissions. A summary of emission information for the Sycamore Canyon area is found in Appendix A-13b, Table 4.

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14. PROJECTION OF VISIBILITY IMPROVEMENT

The Western Regional Air Partnership (WRAP) performed extensive data gathering and modeling to determine the impact of the regional haze program on visibility at the 16 GCVTC Class I areas on the Colorado Plateau. The WRAP work effort began with development of a regional comprehensive inventory of emissions for all categories of sources. In addition, econometric models and new technology profiles were used to project changes in emissions over time expected from implementation of current requirements under the Clean Air Act (CAA). The WRAP also estimated emission changes resulting from the programs contained in the long-term strategy for regional haze under 40 CFR 51.309.

The emission inventories and projections were then used by the WRAP Regional Modeling Center to estimate aerosol concentrations and visibility changes at each of the 16 Class I areas using the Community Multi-scale Air Quality (CMAQ) model to estimate aerosol concentrations from the emission inventories and projections.

The WRAP results are contained in the WRAP Technical Support Document (WRAP TSD) and include detailed descriptions of the emission inventory and projection methods, as well as the air quality modeling techniques and results (see WRAP TSD Chapter 1). The projection of expected visibility changes are contained in Chapter 2 of the WRAP TSD. The following sections contain an overview of the resultant projected changes in emissions and visibility resulting from the implementation of the Regional Haze Rule.

14.1. Effect on Emissions of Long-term Strategy Components

14.1.1. Inventory Methodology and Scope

The WRAP 1996 base emission inventories used for assessment of visibility included the following pollutants:

- Volatile Organic Compounds (VOCs);
- Oxides of Nitrogen (NO_X);
- Carbon Monoxide (CO);
- Sulfur Dioxide (SO_2);
- Particulate Matter smaller than 10 microns (PM_{10});
- Particulate Matter smaller than 2.5 microns ($PM_{2.5}$); and,
- Ammonia (NH_3).

For visibility modeling, the $PM_{2.5}$ emission inventory was broken down into components, or species, representing the key visibility impairing species of interest. Breaking down the $PM_{2.5}$ into its components is necessary since each component has a different effect on visibility. These $PM_{2.5}$ species are organic carbon particles, elemental carbon particles, and other fine material (soils and dusts). The factors used to allocate $PM_{2.5}$ into its components are based on source-specific speciation factors. In addition, the coarse material (CM) fraction of PM_{10} (i.e., PM_{10} minus $PM_{2.5}$) was also computed, since course particulate matter has a different effect on visibility than fine particulate matter.

The geographic domain for the inventory included the 22 states west of the Mississippi River, and portions of Mexico and Canada. The inventory included emissions from the following categories of sources:

- Area Sources;
- Stationary Point Sources;

- Mobile Sources (both on-road and non-road);
- Road Dust (both from paved and unpaved road surfaces);
- Fire Emissions (agricultural burning, prescribed fire, and wildfire);
- and, Biogenic Sources.

In addition to the 1996 base year emission inventory used for model validation, a projected base year emission inventory for the year 2018 was developed from the base 1996 inventory and other information related to growth and technology issues, but excluding expected changes from control strategies required by the Regional Haze Rule. This 2018 base case emission inventory was then modified to reflect the impact of the control strategies required by the Regional Haze Rule. This is referred to as “Scenario 2” in the WRAP TSD, and are referred to as “2018 w/309” in the tables below.

The ADEQ established an Emission Inventory Work Group (EIWG) made up of key Arizona stakeholders to assist with the review of WRAP’s emission inventory for Arizona’s SIP sources. This review was performed in two parts.

First, the EIWG reviewed the WRAP’s 1996 base emission inventory, comparing estimates with other Arizona reference inventories used for non-attainment SIPs. The EIWG’s findings were summarized in a memorandum to WRAP (see Appendix A-14a). The EIWG concluded that the 1996 inventory was adequate for current Regional Haze SIP modeling, but identified several areas that should be addressed in future WRAP emission inventory improvement projects.

Second, the EIWG reviewed the 2018 emission growth/projection factors used to develop the 2018 inventory. This review included an analysis of accuracy of earlier projections, such as the growth factors used in the GCVTC Integrated Assessment System, and more recent projections performed by the Arizona Department of Economic Security, U.S. Census Bureau data, and forecasts prepared by the metropolitan planning organizations. Although differences were found, the EIWG concluded that the long-range forecast factors were within the level of uncertainty in any long-range economic forecast. Areas for future improvement of the WRAP inventory projections were summarized in a memorandum to WRAP (also in Appendix A-14a).

In addition to the EIWG, ADEQ also established the Technical Assessment Work Group (TAWG) to review the assessment and modeling methodologies used by the WRAP. The TAWG reviewed the WRAP TSD and identified areas for future improvements in a memorandum to WRAP (also in Appendix A-14a).

14.1.2. **<u>Projected Changes in Emissions for Arizona</u>**

The projected change in emissions for the State of Arizona are summarized in Table 14-1. As shown, emissions of sulfur dioxide are expected to decrease by 36% by 2018. In addition, by 2018 emissions of oxides of nitrogen and volatile organic compounds are expected to decline by 16% and 25%, respectively. Table 14-2 shows similar emission reductions for the nine-state GCVTC Transport Region. Appendix A-14b, Tables 1 through 3, provide more detailed summaries of emissions by source category, including emissions estimates for the 2018 WRAP Base Case. Also, Appendix A-14b, Table 4, summarizes the detailed county-level emission for Arizona. Information in Appendix A-14b were derived from WRAP county-level emission inventories contained in the WRAP TSD emission appendices.

Table 14-1. Changes in Emissions from 1996 to 2018 for Arizona Sources (Tons per Year)

Year	$PM_{2.5}$*	CM	SO_2	NOx	VOC
1996	147.9	98.8	217.9	454.0	372.3
2018 w/309	143.3	103.6	139.3	383.2	277.8
% Change	**-3%**	**5%**	**-36%**	**-16%**	**-25%**

* $PM_{2.5}$ includes organic carbon, elemental carbon, and fine soils/dusts.

Table 14.2. Changes in Emissions from 1996 to 2018 for 9 GCVTC States (Tons per Year)

Year	$PM_{2.5}$*	CM	SO_2	NOx	VOC
1996	1,196.7	1,170.6	1,036.3	3,952.1	3,325.3
2018 w/309	1,228.3	1,198.4	808.9	2,691.8	2,339.2
% Change	**3%**	**2%**	**-22%**	**-32%**	**-30%**

* $PM_{2.5}$ includes organic carbon, elemental carbon, and fine soils/dusts.

14.2. Projected Changes in Visual Air Quality

14.2.1. Applicable Class I Areas

This projection of visibility improvement addresses the 16 Class I areas of the Colorado Plateau, as defined in 40 CFR 51.309(b)(1) that are described in Chapter 3 of the WRAP TSD.

14.2.2. Projected visibility improvement

Pursuant to 40 CFR 51. 309(d)(2), Tables 14-3 and 14-4 indicate the projected visibility conditions in deciviews for each of the 16 Class I areas, from the baseline emission projection year of 1996 through December 31, 2018. These projections were made for the 20% worst days and 20% best days, and are expressed in deciviews (dV). The first column represents the best estimate of actual visibility conditions in 1996. Because the IMPROVE monitoring network was significant expanded from 1999 through 2001, the actual visual air quality values in the first column represent the most recent and representative five years of monitoring data from 1997 through 2001. The second column represents the expected conditions in 2018 without the implementation of the strategies and programs contained in this SIP. The final column represents the expected conditions in 2018 with the implementation of this SIP strategies and programs. Chapter 2 and Appendix A of the WRAP TSD describe the control strategies included in the air quality modeling projections.

Table 14-3. Projected Visibility Improvement at the 16 Colorado Plateau Class I Areas in 2018 on the Average 20% Worst Days, resulting from implementation of "All 309 Control Strategies".

Colorado Plateau Class I Area	State	1996 - 20% Worst Days' Visibility (dV) (Base Case)	2018 - 20% Worst Days' Visibility (dV) (Base Case - all controls "on the books" as of 2002)	2018 - 20% Worst Days' Visibility (dV) (All §309 Control Strategies including Optimal Smoke Management)
Grand Canyon National Park	AZ	12.30	11.62	11.51
Mount Baldy Wilderness	AZ	14.30	12.22	11.96
Petrified Forest National Park	AZ	13.00	11.99	11.74
Sycamore Canyon Wilderness	AZ	15.40	11.63	11.48
Black Canyon of the Gunnison NP Wilderness	CO	11.30	10.90	10.60
Flat Tops Wilderness	CO	10.50	11.04	10.73
Maroon Bells Wilderness	CO	10.60	11.15	10.84
Mesa Verde National Park	CO	13.10	12.24	11.84
Weminuche Wilderness	CO	10.60	11.19	10.84
West Elk Wilderness	CO	11.30	11.08	10.72
San Pedro Parks Wilderness	NM	10.70	12.33	11.71
Arches National Park	UT	12.10	12.41	12.15
Bryce Canyon National Park	UT	11.80	12.26	11.95
Canyonlands National Park	UT	12.10	12.41	12.18
Capitol Reef National Park	UT	12.10	12.51	12.36
Zion National Park	UT	13.60	12.13	12.03

Table 14-4. Projected Visibility Improvement at the 16 Colorado Plateau Class I Areas in 2018, on the Average 20% Best Visibility Days, resulting from implementation of "All 309 Control Strategies".

Colorado Plateau Class I Area	State	1996 - 20% Best Days' Visibility (dV) (Base Case)	2018 - 20% Best Days' Visibility (dV) (Base Case - all controls "on the books" as of 2002)	2018 - 20% Best Days' Visibility (dV) (All §309 Control Strategies including Optimal Smoke Management)
Grand Canyon National Park	AZ	4.80	4.76	4.64
Mount Baldy Wilderness	AZ	5.50	5.49	5.36
Petrified Forest National Park	AZ	6.50	5.18	5.10
Sycamore Canyon Wilderness	AZ	6.30	4.85	4.75
Black Canyon of the Gunnison NP Wilderness	CO	4.60	3.89	3.75
Flat Tops Wilderness	CO	3.10	3.96	3.81
Maroon Bells Wilderness	CO	3.10	3.90	3.80
Mesa Verde National Park	CO	5.50	4.40	4.33
Weminuche Wilderness	CO	3.10	3.89	3.74
West Elk Wilderness	CO	4.60	3.97	3.82
San Pedro Parks Wilderness	NM	4.00	5.59	5.36
Arches National Park	UT	5.50	4.85	4.61
Bryce Canyon National Park	UT	4.30	3.91	3.89
Canyonlands National Park	UT	5.60	4.87	4.67
Capitol Reef National Park	UT	5.60	4.85	4.75
Zion National Park	UT	5.90	3.81	3.75

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15. STATE PLANNING/INTERSTATE COORDINATION AND TRIBAL IMPLEMENTATION

15.1. Participation in Regional Planning and Coordination

Pursuant to 40 CFR 51.309(d)(11), the State of Arizona has participated in regional planning and coordination with other states in developing its emission reduction strategies under 40 CFR 51.309, related to protecting the 16 Class I areas of the Colorado Plateau. This participation was through Arizona's leadership of the Grand Canyon Visibility Transport Commission (GCVTC) and participation in the Western Regional Air Partnership (WRAP). The State of Arizona has provided staff in leadership positions of many of the WRAP committees and forums, and encourages participation of Arizona stakeholders in the WRAP process. The State of Arizona has been nominated to assume the position of Co-chair of the WRAP and will continue to participate actively in WRAP activities.

In order to coordinate implementation issues associated with this SIP, the State of Arizona will serve on the recently established "309 Coordinating Committee" of the WRAP. This standing committee is chartered to perform the necessary implementation tracking for the states and tribes submitting SIPs and TIPs to address the requirements of 40 CFR 51.309.

15.2. Applicability to Tribal Lands

Pursuant to 40 CFR 51.309(d)(12), and in accordance with the Tribal Authority Rule (63 FR 7253, February 12, 1998), all Tribes have the option to develop a regional haze Tribal Implementation Plan (TIP) for their lands to assure reasonable progress in the 16 Class I areas of the Colorado Plateau. As such, no provisions of this SIP are applicable to tribal lands.

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16. PERIODIC IMPLEMENTATION PLAN REVISION

(a) Periodic Progress Reports for demonstrating Reasonable Progress. Pursuant to 40 CFR 51.309(d)(10)(i), the State of Arizona commits to submit to EPA periodic progress reports for the years 2008, 2013 and 2018. The demonstration may be conducted by the WRAP, with assistance from Arizona, and shall address the elements listed under 40 CFR 51.309(d)(10)(i)(A) through (G) for the Colorado Plateau areas:

1. Implementation status of this SIP's measures;
2. Summary of emissions reductions;
3. Assessment of the 20% most/least impaired days;
4. Analysis of emission reductions by pollutant;
5. Analysis of significant changes in anthropogenic emissions;
6. Assessment of this SIP's adequacy; and
7. Assessment of visibility monitoring strategy.

(b) Actions to be taken concurrent with Periodic Progress Reports. Pursuant to 40 CFR 51.309(d)(10)(ii), the State of Arizona commits to take one of the following actions based upon information contained in each periodic progress report:

1. Provide a negative declaration statement to EPA saying that no SIP revision is needed if reasonable progress is being made, in accordance with section *(a)* above;

2. If the State finds that the SIP is inadequate to ensure reasonable progress due to emissions from outside the State, the State of Arizona commits to notify EPA and the other contributing state(s), and initiate efforts through a regional planning process to address the emissions in question. The State of Arizona commits to identify in the next progress report the outcome of this regional planning effort, including any additional strategies that were developed to address the plan's deficiencies;

3. If the State finds that the SIP is inadequate to ensure reasonable progress due to emissions from another country, the State of Arizona commits to notify EPA and provide information on the impairment being caused by these emissions; or

4. If the State finds that the SIP is inadequate to ensure reasonable progress due to emissions from within Arizona, the State of Arizona commits to develop additional strategies to address the plan deficiencies and revise the SIP no later than one year from the date that the progress report was due.

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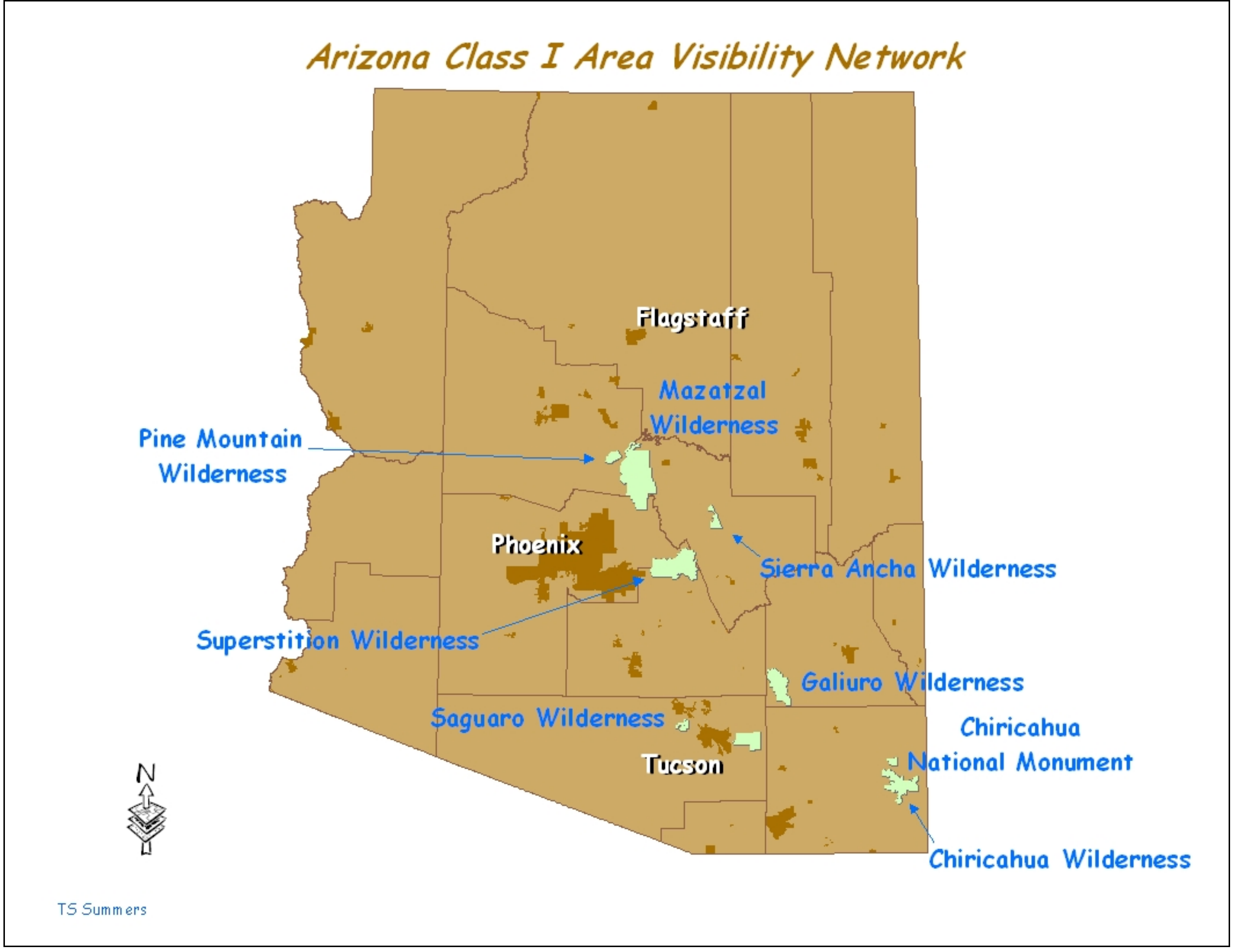
17. DECLARATION OF TREATMENT FOR ADDITIONAL CLASS I AREAS UNDER 40 CFR 51.309(g)

The requirements for reasonable progress for Additional Class I areas are discussed on page 35758 in the Preamble to the RHR. Section 309 of the RHR requires that the first SIP due by December 31, 2003 address the 16 Class I areas of the Colorado Plateau. Additional Class I areas do not need to be addressed until December 31, 2008. 40 CFR 51.309(g)(1) requires states to declare in the SIP due by December 31, 2003 whether the Additional Class I areas will be addressed under 40 CFR 51.308, or under 40 CFR 51.309(g).

a. *Declaration for Additional Class I areas.* Pursuant to 40 CFR 51.309(g)(1), the State of Arizona commits to submittal of a SIP supplement under 40 CFR 51.309(g) for the eight Additional Class I areas in the State of Arizona. Arizona shall submit the SIP revision for the eight Additional Class I areas as early as practicable, but no later than December 31, 2008. The eight Additional Class I areas in Arizona that will be addressed under 40 CFR 51.309(g) include: Chiricahua National Monument and Chiricahua, Galiuro, Mazatzal, Pine Mountain, Saguaro, Sierra Ancha, and Superstition Wilderness Areas. These Additional Class I areas are shown in Figure 17-1.

Figure 17-1 Arizona Additional non-GCVTC Class I Areas.



The State of Arizona, if necessary to address reasonable progress for non-GCVTC Additional Class I areas outside of Arizona, will rely the procedures under 40 CFR 51.309(g)(2) and (3) and submit a SIP revision by December 31, 2008, to address reasonable progress for any such areas.

18. PUBLIC PARTICIPATION AND REVIEW PROCESS

Public participation and review process documents for the rulemakings described in this SIP can be located in the appendix for the related chapter in which those rules are references (e.g., for the RAVI rule see Chapter 5; for WEB trading program rule see Chapter 7; and, for the fire rules see Chapter 10). This chapter contains the public participation and review process documents associated with the SIP only.

18.1. Public Hearing Notice

Notices of the public hearings were published in *The Arizona Republic* (Phoenix and statewide), *The Arizona Daily Star* and *Tucson Citizen* (Tucson Newspapers), and the *Arizona Daily Sun* (Coconino County/Flagstaff) on October 24, 2003. Copies of the notices are contained in Appendix A-18a.

18.2. Hearing Transcripts

Agendas, sign-in sheets, transcripts and hearing officer certifications for the public hearings held on November 24, 2003 in Phoenix, Arizona, and Flagstaff, Arizona, are contained in Appendix A-18b.

18.3. Written Comments Received

Several written comments were received by ADEQ before the end of the comment period (December 3, 2003). These were utilized in finalizing revisions to this SIP and are contained in Appendix A-18c.

18.4. Responsiveness Summary

Based on the oral comments received at the public hearings, and written comments received by the close of the comment period, the State of Arizona made appropriate revisions the Public Review Draft of the SIP released on October 24, 2003. Appendix A-18d contains the response to comments developed by the State of Arizona addressing the requirements under 40 CFR 51.102.

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REGIONAL HAZE STATE IMPLEMENTATION PLAN FOR THE STATE OF ARIZONA

APPENDICES - VOLUME I

Appendix A-1 through Appendix A-9

Air Quality Division
Arizona Department of Environmental Quality

LIST OF APPENDICES

APPENDIX VOLUME I

LIST OF APPENDICES (Cont.)

APPENDIX VOLUME II

LIST OF APPENDICES (Cont.)

APPENDIX VOLUME III

APPENDIX A-1. BACKGROUND

This appendix contains work products and references relied upon by Arizona in the development of Chapter 1 of the Regional Haze SIP.

Appendix A-1a. Definitions

<u>Applicable definitions from 40 CFR 51.301:</u>

BART-eligible source means an existing stationary facility as defined in this section.

Best Available Retrofit Technology (BART) means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant, which is emitted by an existing stationary facility. The emission limitation must be established, on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

Deciview means a measurement of visibility impairment. A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions, from pristine to highly impaired. The deciview haze index is calculated based on the following equation (for the purposes of calculating deciview, the atmospheric light extinction coefficient must be calculated from aerosol measurements):

Deciview haze index = $10 \quad 1n_e \quad (b_{ext}/10\ Mm^{-1})$.
Where b_{ext} = the atmospheric light extinction coefficient, expressed in inverse megameters (Mm^{-1}).

Existing stationary facility means any of the following stationary sources of air pollutants, including any reconstructed source, which was not in operation prior to August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit 250 tons per year or more of any air pollutant. In determining potential to emit, fugitive emissions, to the extent quantifiable, must be counted.

Fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour heat input,
Coal cleaning plants (thermal dryers),
Kraft pulp mills,
Portland cement plants,
Primary zinc smelters,
Iron and steel mill plants,
Primary aluminum ore reduction plants,
Primary copper smelters,
Municipal incinerators capable of charging more than 250 tons of refuse per day,
Hydrofluoric, sulfuric, and nitric acid plants,
Petroleum refineries,
Lime plants,
Phosphate rock processing plants,
Coke oven batteries,

Sulfur recovery plants,
Carbon black plants (furnace process),
Primary lead smelters,
Fuel conversion plants,
Sintering plants,
Secondary metal production facilities,
Chemical process plants,
Fossil-fuel boilers of more than 250 million British thermal units per hour heat input,
Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels,
Taconite ore processing facilities,
Glass fiber processing plants, and
Charcoal production facilities.

Federal Class I area means any Federal land that is classified or reclassified Class I.

Federal Land Manager means the Secretary of the department with authority over the Federal Class I area (or the Secretary's designee) or, with respect to Roosevelt-Campobello International Park, the Chairman of the Roosevelt-Campobello International Park Commission.

Federally enforceable means all limitations and conditions which are enforceable by the Administrator under the Clean Air Act including those requirements developed pursuant to parts 60 and 61 of this title, requirements within any applicable State Implementation Plan, and any permit requirements established pursuant to Sec. 52.21 of this chapter or under regulations approved pursuant to part 51, 52, or 60 of this title.

Implementation plan means, for the purposes of this part, any State Implementation Plan, Federal Implementation Plan, or Tribal Implementation Plan.

Indian tribe or tribe means any Indian tribe, band, nation, or other organized group or community, including any Alaska Native village, which is federally recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians.

In existence means that the owner or operator has obtained all necessary preconstruction approvals or permits required by Federal, State, or local air pollution emissions and air quality laws or regulations and either has (1) begun, or caused to begin, a continuous program of physical on-site construction of the facility or (2) entered into binding agreements or contractual obligations, which cannot be cancelled or modified without substantial loss to the owner or operator, to undertake a program of construction of the facility to be completed in a reasonable time.

Least impaired days means the average visibility impairment (measured in deciviews) for the twenty percent of monitored days in a calendar year with the lowest amount of visibility impairment.

Major stationary source and major modification mean major stationary source and major modification, respectively, as defined in Sec. 51.166.

Mandatory Class I Federal Area means any area identified in part 81, subpart D of this title.

Most impaired days means the average visibility impairment (measured in deciviews) for the twenty percent of monitored days in a calendar year with the highest amount of visibility impairment.

Natural conditions includes naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.

Potential to emit means the maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the source to emit a pollutant including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation or the effect it would have on emissions is federally enforceable. Secondary emissions do not count in determining the potential to emit of a stationary source.

Reasonably attributable means attributable by visual observation or any other technique the State deems appropriate.

Reasonably attributable visibility impairment means visibility impairment that is caused by the emission of air pollutants from one, or a small number of sources.

Regional haze means visibility impairment that is caused by the emission of air pollutants from numerous sources located over a wide geographic area. Such sources include, but are not limited to, major and minor stationary sources, mobile sources, and area sources.

State means ``State'' as defined in section 302(d) of the CAA.

Stationary Source means any building, structure, facility, or installation, which emits or may emit any air pollutant.

Visibility impairment means any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions.

Applicable Definitions from 40 CFR 51.309:

16 Class I areas means the following mandatory Class I Federal areas on the Colorado Plateau: Grand Canyon National Park, Sycamore Canyon Wilderness, Petrified Forest National Park, Mount Baldy Wilderness, San Pedro Parks Wilderness, Mesa Verde National Park, Weminuche Wilderness, Black Canyon of the Gunnison Wilderness, West Elk Wilderness, Maroon Bells Wilderness, Flat Tops Wilderness, Arches National Park, Canyonlands National Park, Capital Reef National Park, Bryce Canyon National Park, and Zion National Park.

Transport Region State means one of the States that is included within the Transport Region addressed by the Grand Canyon Visibility Transport Commission (Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Wyoming).

Commission Report means the report of the Grand Canyon Visibility Transport Commission entitled *Recommendations for Improving Western Vistas*, dated June 10, 1996.

Fire means wildfire, wildland fire (including prescribed natural fire), prescribed fire, and agricultural burning conducted and occurring on Federal, State, and private wildlands and farmlands.

Milestone means the maximum level of annual regional sulfur dioxide emissions for a given year, assessed annually consistent with paragraph (h)(2) of this section beginning in the year 2003.

Mobile Source Emission Budget means the lowest level of VOC, NOx, SO_2, elemental and organic carbon, and fine particles which are projected to occur in any area within the transport region from which mobile source emissions are determined to contribute significantly to visibility impairment in any of the 16 Class I areas.

Geographic enhancement means a method, procedure, or process to allow a broad regional strategy, such as a milestone or backstop market trading program designed to achieve greater reasonable progress than BART for regional haze, to accommodate BART for reasonably attributable impairment.

BHP San Manuel means: (i) The copper smelter located in San Manuel, Arizona which operated during 1990, but whose operations were suspended during the year 2000, (ii) The same smelter in the event of a change of name or ownership.

Phelps Dodge Hidalgo means: (i) The copper smelter located in Hidalgo, New Mexico which operated during 1990, but whose operations were suspended during the year 2000, (ii) The same smelter in the event of a change of name or ownership.

Definitions for the Fire Programs

Land Manager means any federal, state, local, or private entity that owns, administers, directs, oversees or controls the use of public or private land, including the application of fire to the land.

Prescribed fire or ***prescribed burn*** means any fire ignited by management actions to meet specific objectives, such as achieving resource benefits.

Wildland Fire Used for Resource Benefits means naturally ignited wildland fire that is managed to accomplish specific prestated resource management objectives in predefined geographic areas.

<u>Definitions for the Western Emission Backstop Trading Program Applicable to Sections 7 and 8 of Implementation Plan</u>

EPA Administrator means the Administrator of the United States Environmental Protection Agency or the Administrator's duly authorized representative.

Floor allocation means the amount of allowances set by the Director in accordance with this Plan that represents the minimum necessary for a source to operate under stringent control assumptions.

Reducible allocation means the amount of allowances set by the Director in accordance with this Plan that represents, for each source, emissions in excess of the floor allocation that shall be reduced over time as the regional milestone is decreased.

Tribal Set-Aside means a 20,000-ton SO_2 WEB allowance allocated to tribes on an annual basis. The tribes will decide how to distribute the allowances in the set-aside among tribes in the region. The set-side is intended to ensure equitable treatment for tribal economies and to prevent barriers to economic development.

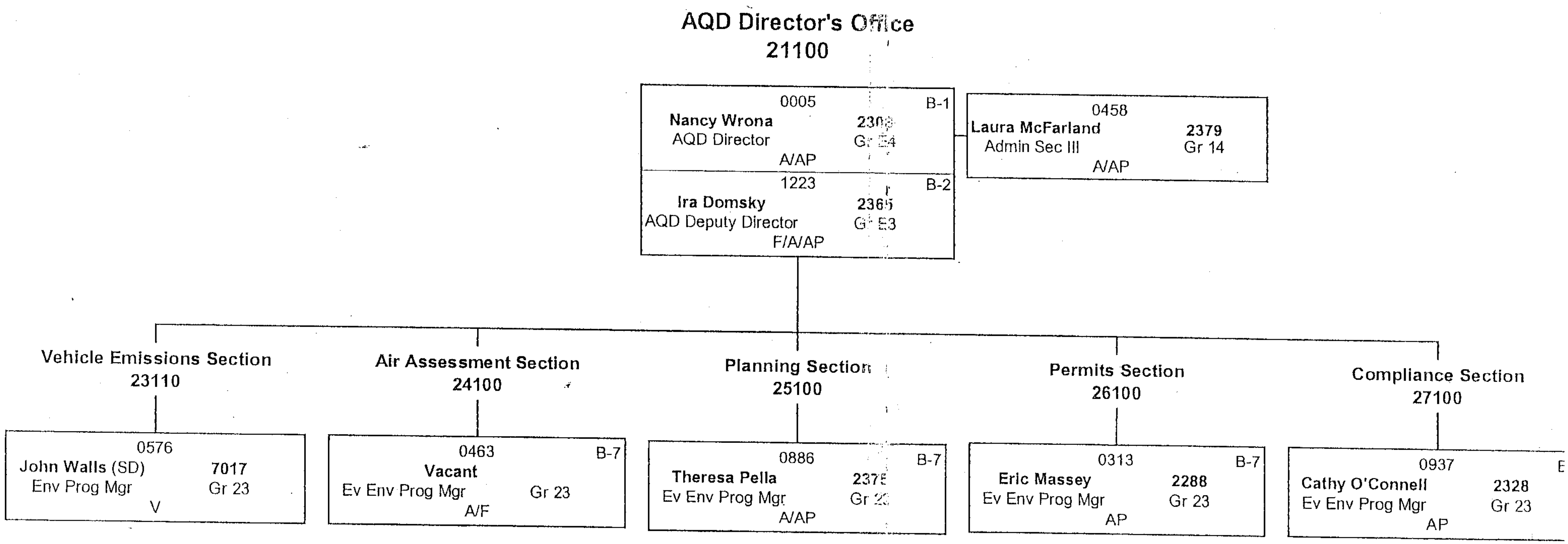
Trigger refers to the activation of the WEB Trading Program for SO_2 in accordance with this Plan.

WEB Trading Program refers to the Western Backstop (WEB) Trading Program Rule that shall be triggered as a backstop in accordance the provisions of this Plan to ensure that regional SO_2 emissions are reduced.

Western Regional Air Partnership (WRAP) means the collaborative effort of tribal governments, state governments, and federal agencies to promote and monitor implementation of recommendations from the Grand Canyon Visibility Transport Commission authorized under Section 169B(f) of the Clean Air Act, and to address other common Western regional air quality issues.

Appendix A-1b. Arizona Department of Environmental Quality – Air Quality Division Organization Charts

Arizona Department of Environmental Quality
Air Quality Division



JULY 2003

Arizona Department of Environmental Quality
Air Quality Division

Compliance Section
27100

0937 B-7
Cathy O'Connell 2328
Ev Env Prog Mgr Gr 23
AP

Section Support

0885
Mary Canez 4332
Admin Asst I Gr 13
AP

0914
Vacant
Env Prog Spec Gr 20
AP/F

0622
Rosita Slider 2301
Admin Sec II Gr 13
AP

0910
Sandra Olding 4330
Admin Sec I Gr 12
AP

Inspections & Field Services Unit
27210

0610 B-7
Lynn Ogata 2286
Ev Env Prog Spvr Gr 22
F/AP

CRO Inspection Team
27220

0660
Lucinda Chavez 4553
Env Prog Spec Gr 20
F

0615
Steve Rose 2280
Env Eng Spec Gr 21
AP

0919
Fred Ellis 4851
Env Eng Spec Gr 21
AP

1071
Emily Bonanni 2324
Env Eng Spec Gr 21
AP

0933
Vacant
Env Eng Assoc Gr 18
AP

1166
Tracy Neal 2333
Env Prog Spec Gr 20
F

0389
Frank Keene 4493
Env Eng Spec Gr 21
AP

0915
Martin Landis 4537
Env Eng Spec Gr 21
AP

0913
Galileo Gutierrez 4495
Env Eng Spec Gr 21
AP

Performance/Test CEM Team
27250

0392
Wayne Hunt 2327
Env Eng Spec Gr 21
AP

0924
Raza Abbas 4485
EHS II Gr 19
AP

0922
Lynn Ott 4494
EHS II Gr 19
AP

Technical Services Unit
27310

0932 B-7
Vacant
Ev Env Prog Spvr Gr 22
F/AP

Technical Review Team
27320

0613
Joanie Wadas 4489
Env Eng Spec Gr 21
AP

0912
Karla Copeland 2282
Env Eng Spec Gr 21
AP

1072
Leonard Ishihara 2343
Env Eng Spec Gr 21
AP

1073
Weiwen Daly 2281
Env Eng Spec Gr 21
AP

1074
Tarun Sinha 4488
Env Eng Spec Gr 21
AP

1141
Richard Baker 2325
Env Eng Spec Gr 21
AP

Information Management Team
27330

0379
Latha Toopal 2273
Env Eng Spec Gr 21
AP

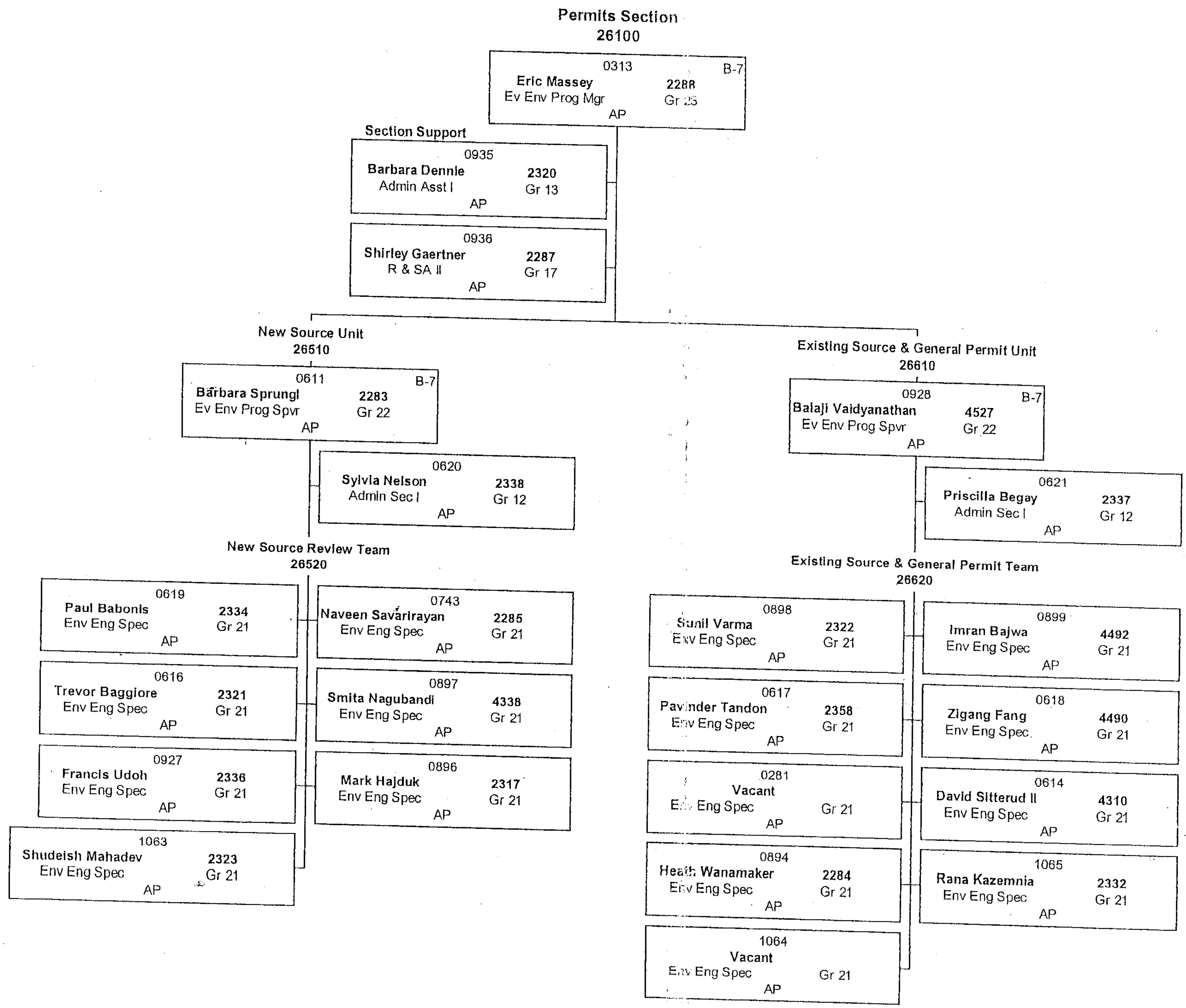
0923
Carol Tuttle 2344
Info Tech Spec III Gr C3
AP

1070
Darlene Celaya 7662
EHS II Gr 19
AP

AQD (7)

JULY 2003

Arizona Department of Environmental Quality
Air Quality Division



JULY 2003

Arizona Department of Environmental Quality
Air Quality Division

Planning Section
25100

- **Theresa Pella** — 0886 — B-7
  Ev Env Prog Mgr — **2375** Gr 23 — A/AP
- **Mollie Lemoine** — 0672
  Admin Sec II — **2373** Gr 13 — A/AP/F
- **Mohan Toopal** — 1363
  Exec Consultant II — **2335** Gr 22 — A
- **David Lillie** — 0684
  Economist III — **4461** Gr 22 — A

SIP & Program Development Unit
25210

- **Mark Lewandowski** — 0890 — B-7
  Ev Env Prog Spvr — **2230** Gr 22 — F

SIP Team
25220

- **Deborrah Martinkovic** — 0705
  Env Prog Spec — **2372** Gr 20 — A
- **Catherine Jordan** — 0676
  Planner II — **2371** Gr 19 — A
- **Andra Juniel** — 0674
  Planner II — **4417** Gr 19 — F
- **Vacant** — 0891
  EHS II — Gr 19 — F

Rules Team
25230

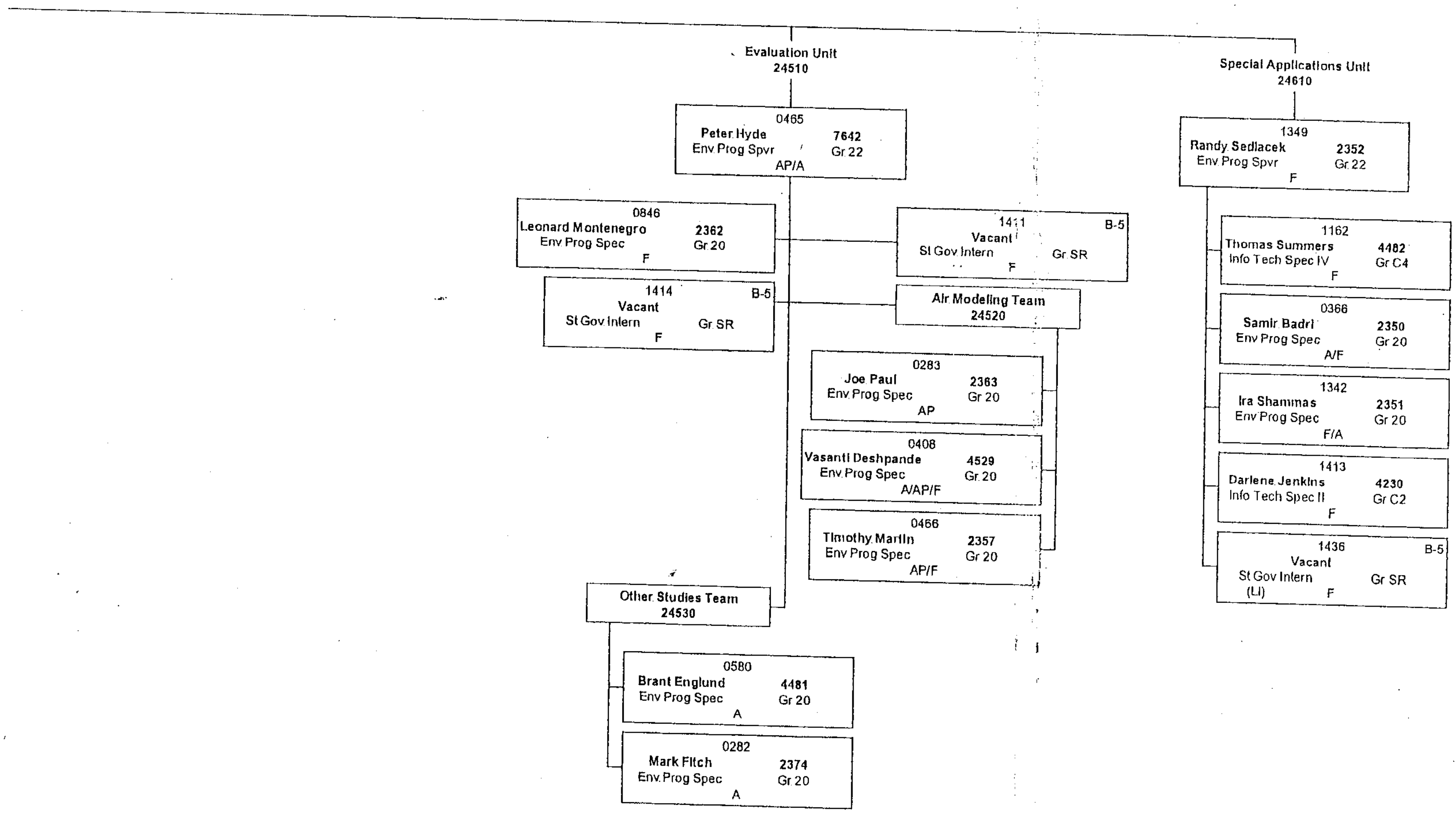
- **Dena Konopka** — 0889
  Env Prog Spec — **2378** Gr 20 — F/AP
- **Vacant** — 0892
  EHS II — Gr 19 — AP/A
- **Bruce Friedl** — 1302 — B-5
  Ev Env Prog Spec — **2259** Gr 20 — F
- **Kevin Force** — 1179 — B-7
  Ev Env Rules Spec — **4480** Gr 21 — A

Fund & Project Management Unit
25300

- **David Biddle** — 0853
  Env Prog Spec — **2376** Gr 20 — A
  - **Sondra Francis** — 1169
    P & PS II — **2370** Gr 19 — F/A
  - **Sherri Zendri** — 0887 — B-2
    Ev P & PS II (PT) — **4775** Gr 19 — A

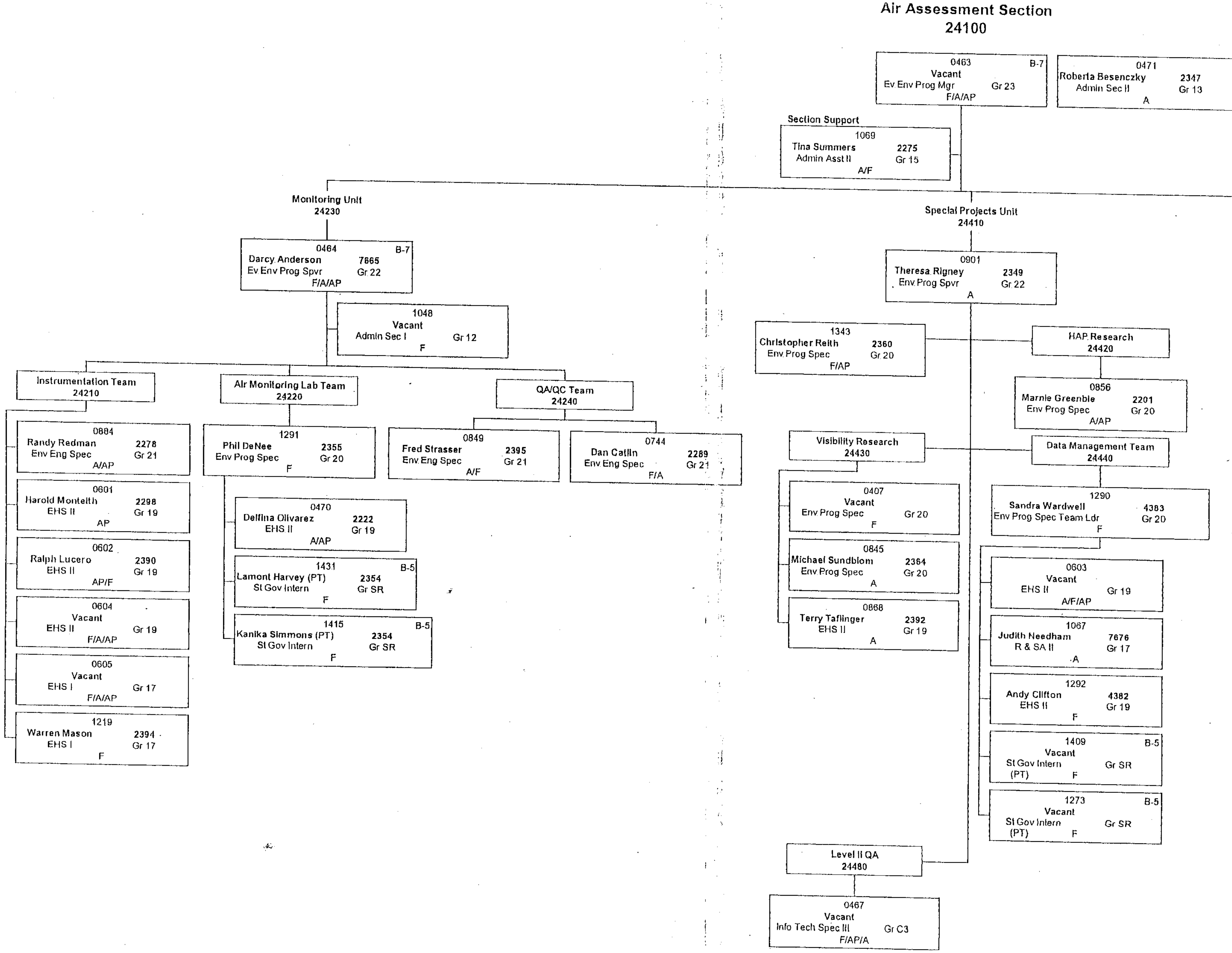
JULY 2003

Arizona Department of Environmental Quality
Air Quality Division
Air Assessment Section (continued)



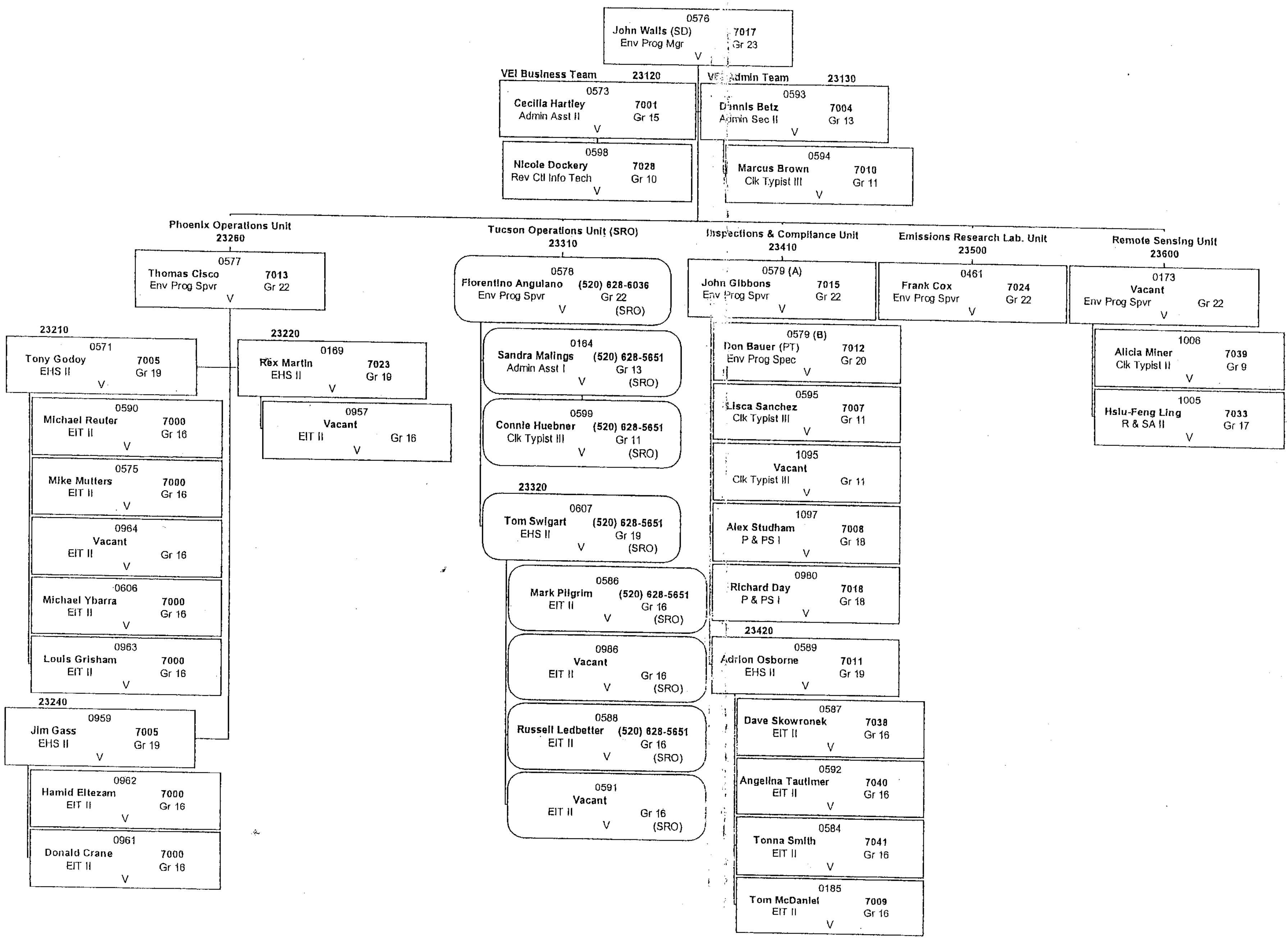
JULY 2003

Arizona Department of Environmental Quality
Air Quality Division



Arizona Department of Environmental Quality
Air Quality Division

Vehicle Emission Section
23110



AQD (3)

JULY 2003

Arizona Department of Environmental Quality
Air Quality Division

AQD Deputy Director
22110

1223 B-2
Ira Domsky **2365**
AQD Deputy Director Gr E3
F/A/AP

1304 B-7
Betty Doyle **4211**
Ev Exec Consultant II Gr 22
Ev ASO II U/F Gr 21
A

Administration Team **22130**

0458
Laura McFarland **2379**
Admin Sec III Gr 14
A/AP

1101
Virgina Cook **2316**
Clk Typist III Gr 11
F/AP

JULY 2003

APPENDIX A-2. DESCRIPTIONS OF ARIZONA

This appendix contains work products and references relied upon by Arizona in the development of Chapter 2 of the Regional Haze SIP.

Appendix A-2a. Bibliography for Chapter 2

Appendix A-2a.   Bibliography for Chapter 2

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Appendix A-2a.   Bibliography for Chapter 2 (Continued)

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APPENDIX A-5. ATTRIBUTABLE IMPAIRMENT

This appendix contains work products and references relied upon by Arizona in the development of Chapter 5 of the Regional Haze SIP.

<u>Appendix A-5a. Arizona's RAVI rule</u>

NOTICES OF FINAL RULEMAKING

The Administrative Procedure Act requires the publication of the final rules of the state's agencies. Final rules are those which have appeared in the *Register* first as proposed rules and have been through the formal rulemaking process including approval by the Governor's Regulatory Review Council or the Attorney General. The Secretary of State shall publish the notice along with the Preamble and the full text in the next available issue of the *Register* after the final rules have been submitted for filing and publication.

NOTICE OF FINAL RULEMAKING

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY AIR POLLUTION CONTROL

PREAMBLE

1. Sections Affected / **Rulemaking Action**

Sections Affected	Rulemaking Action
R18-2-101	Amend
Article 16	New Article
R18-2-1601	New Section
R18-2-1602	New Section
R18-2-1603	New Section
R18-2-1604	New Section
R18-2-1605	New Section
R18-2-1606	New Section

2. The statutory authority for the rulemaking, including both the authorizing statute (general) and the statutes the rules are implementing (specific):

Authorizing statutes: A.R.S. §§ 49-104(A)(11) and 49-425

Implementing statutes: A.R.S. §§ 49-414 and 49-414.01

3. The effective date of the rules:

December 2, 2003

4. A list of all previous notices appearing in the Register addressing the final rules:

Notice of Rulemaking Docket Opening: 9 A.A.R. 390, February 7, 2003

Notice of Proposed Rulemaking: 9 A.A.R. 763, March 7, 2003

5. The name and address of agency personnel with whom persons may communicate regarding the rulemaking:

Name: Deborrah "Corky" Martinkovic

Address: ADEQ, Air Quality Planning Section
1110 W. Washington
Phoenix, AZ 85007

Telephone: (602) 771-2372 (Any extension may be reached in-state by dialing 1-800-234-5677, and asking for a specific number.)

Fax: (602) 771-2366

E-mail: martinkovic.deborrah@ev.state.az.us

6. An explanation of the rules, including the agency's reasons for initiating the rules:

Summary. This rule sets forth the process Arizona Department of Environmental Quality (ADEQ) will use to determine whether Best Available Retrofit Technology (BART) will be required for sources determined to be contributing to visibility impairment in a mandatory Federal Class I area. Federal regulations allow Federal Land Managers (FLMs) to certify sources defined in 40 CFR 51.301 as potential contributors to visibility impairment in any of the Arizona mandatory Federal Class I areas under Section 169A of the Clean Air Act (CAA).

Background. In 1977 Congress added a new section to the Clean Air Act - Section 169A, Visibility Protection for Federal Class I Areas - which established a national goal for, "the prevention of any future, and the remedying of any existing impairment of visibility in mandatory class I Federal areas which impairment results from man-made air pollution." In addition, the section required states to submit state implementation plans (SIPs) requiring best available retrofit technology (BART) for certain existing stationary sources found to cause or contribute to visibility impairment. On November 30, 1979, EPA promulgated a list of mandatory Federal Class I Areas (Class I areas) where visibility is an important value (44 FR 69122). There are 12 Class I areas identified in Arizona: Chiricahua National Monument Wilderness, Chiricahua Wilderness, Galiuro Wilderness, Grand Canyon National Park, Mazatzal Wilderness, Mount Baldy Wilderness, Petrified Forest National Park, Pine Mountain Wilderness, Saguaro Wilderness, Sierra Ancha Wilderness, Superstition Wilderness, and Sycamore Canyon Wilderness (40 CFR 81.403).

On December 2, 1980 (45 FR 80084), EPA defined the role of the FLMs in certifying visibility impairment in the mandatory Federal Class I areas. On November 24, 1987 (52 FR 45132), FLMs identified Petrified Forest National Park, Saguaro Wilderness, and Grand Canyon National Park, as having visibility impairment possibly attributable to stationary sources. Under the 1980 rule, if found to cause or contribute to the impairment, certain existing stationary sources operating in or near the identified Class I areas could be subject to BART (A list of sources eligible for the possible application of BART can be found at 40 CFR 51.301). On October 3, 1991, the Navajo Generating Station (NGS) was found by EPA to be causing or contributing to visibility impairment for the Grand Canyon National Park and eligible for BART (56 FR 50172). BART control analyses were subsequently performed by EPA, and other parties through related court actions. Under the 1980 rule, the federal expectation is that actions for determination of possible source attribution will be performed by the states. Therefore, Arizona needs to be prepared to proceed with an attribution analysis and assessment for the application of controls upon any determination of a BART eligible source being the possible cause or contributor to visibility impairment in a Class I area. This rule addresses that need.

Current Conditions. ADEQ has determined that this rule applies to any source in existing stationary source categories identified in 40 CFR 51.301 that are operating in or near the mandatory federal Class I areas in Arizona. The source is an existing stationary facility that includes any reconstructed source that was not in operation prior to August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit 250 tons per year of any regulated pollutant. ADEQ estimates that there are potentially 10 such sources within Arizona. “In existence” is interpreted by EPA to be consistent with the term, “commence construction” found in Prevention of Serious Deterioration (PSD) regulations (40 CFR 51.165(a)(1)(xvi) and 40 CFR 52.21(b)(9)). If construction commenced after August 7, 1977, the source would be subject to the PSD/NSR (new source review) program (the state regulations are found at 18 A.C.C. 2, Article 4). However, EPA also notes “that sources, are not BART eligible if the only change at the plant was the addition of pollution controls. For example, if the only change at a copper smelter during the 1962 through 1977 time period was the addition of acid plants for the reduction of SO_2 emissions, these emission controls would not themselves trigger a BART review.”[1]

[[1]EPA proposed rule, 66 Federal Register 38119, July 20, 2001.]

Under this rule, ADEQ, when analyzing an attributable source for BART controls, must consider several factors including, for example, costs, remaining useful life of the source, and degree of improvement anticipated to result from the application of the controls (the factors are detailed in R18-2-1605). Sources required by ADEQ to install and operate BART controls have a final opportunity to request exemption from the requirement prior to the application of controls. This opportunity for a federal exemption from BART, is contained in R18-2-1606, and 40 CFR 51.303.

Summary. This rule outlines the process through which sources eligible for the application of BART will proceed if certified by the state of Arizona or an FLM as possibly causing or contributing to visibility impairment due to attribution. If found to be attributable for the impairment, a BART analysis will be performed to determine the level of controls necessary to remedy the impairment. This rule enables Arizona to fulfill the requirements of the Clean Air Act and the goal of section 169A of the Act to return the Nation’s federal parks and wilderness areas to natural conditions.

Section-by-Section Explanation for the Rules

R18-2-1601	This Section lists the definitions that apply to this rule.
R18-2-1602	This Section lists the Class I areas addressed by this rule for the applicable existing stationary facilities, as defined in R18-2-1601(2).
R18-2-1603	This Section establishes the procedure for certification of impairment by either a Federal Land Manager with authority over a mandatory Federal Class I area, or the Director, should either believe there exists reasonably attributable visibility impairment in a Federal Class I area as listed in R18-2-1602.
R18-2-1604	This Section establishes the procedure for an attribution analysis after certification of a source or group of sources as outlined in R18-2-1603. Upon completion of the attribution analysis, the procedure for the Director to issue draft and final attribution findings is outlined in R18-2-1604(C).
R18-2-1605	This Section establishes the best available retrofit technology (BART) analysis procedure after a source is identified under R18-2-1604. Upon completion of the BART analysis, the procedure for the Director to issue draft and final BART findings, including alternatives to emission standards, is outlined in R18-2-1605(B) and (C), respectively. The specific conditions where BART would be satisfied due to past or planned actions by the facility are outlined in R18-2-1605(D). EPA determinations regarding new technology that might require a BART analysis

for an applicable source, regardless of a source or small group of sources previously being certified and found attributable, are covered in R18-2-1605(E).

R18-2-1606 This Section establishes the procedures for obtaining a federal exemption from a BART requirement.

7. A reference to any study relevant to the rules that the agency reviewed and either relied on in its evaluation of or justification for the rules or did not rely on in its evaluation of or justification for the rules, where the public may obtain or review each study, all data underlying each study, and any analysis of each study and other supporting material:

None

8. A showing of good cause why the rules are necessary to promote a statewide interest if the rules will diminish a previous grant of authority of a political subdivision of this state:

Not applicable

9. The summary of the economic, small business, and consumer impact:

A. Rule Identification

These rules amend R18-2-101 ("visibility impairment" definition) and add new Sections R18-2-1601 through R18-2-1606. For sources under ADEQ jurisdiction, the rules take the place of federal regulations that currently govern this area.

B. Entities Directly Impacted

1. Federal Land Managers. R18-2-1603 allows Federal Land Managers (FLMs) to certify visibility impairment in mandatory Class I areas. This was already allowed by federal rule. Under R18-2-1601 of the rule, the FLMs able to certify impairment in Arizona are with the United States Forest Service and the National Park Service. There are no FLMs in Arizona from the United States Fish and Wildlife Service, because this agency does not have jurisdiction over any of Arizona's mandatory federal Class I areas.

2. ADEQ. R18-2-1604 requires ADEQ to identify stationary sources that could cause or contribute to the certified visibility impairment. Prior to this rule, this function was carried out by EPA. R18-2-1605 would require ADEQ to analyze for BART (best available retrofit technology) controls those sources identified as causing or contributing to visibility impairment. Prior to this rule, this function was carried out by EPA. The impact of this rule on ADEQ will primarily be on the Air Quality Division, Permits and Assessment sections, with a corresponding reduction of impact on EPA.

3. Stationary sources. R18-2-1605 also requires stationary sources identified in #2 to install or operate the BART as determined by the Director. Prior to this rule, only EPA determined and required BART. To determine impacted stationary sources, ADEQ staff reviewed Title V permits from ADEQ's Air Permit files. Of the 26 industry categories listed in 40 CFR 51.301, only five categories were found to exist under ADEQ's jurisdiction: steam electric plants, cement plants, primary copper smelters, lime plants, and industries using non-utility boilers. As a result, potentially 10 sources, representing 16 BART eligible units (boilers and kilns), could be affected by this rule. The combined potential to emit from these sources totaled 94,287 tons per year for NO_x, 141,036 tons per year for SO_2, and 12,146 tons per year for PM. The combined potential to emit for all pollutants for these 10 sources total approximately 250,000 tons per year.

C. Probable Costs and Benefits Associated with the BART/Visibility Impairment Process

1. Direct Costs - FLMs: FLM activities to certify visibility impairment in mandatory Class I areas may involve preparation and analysis of monitoring data, emission inventories, meteorological records, etc. ADEQ estimates that this cost per certification could be as much as $50,000 if extensive analysis is conducted. These costs exist whether or not these rules became final.

2. Direct Costs - ADEQ: ADEQ costs related to identifying whether a BART eligible stationary source causes or contributes to visibility impairment in Class I areas are based on the activities identified in R18-2-1604(A). ADEQ estimates that these costs could range from $100,000 – 200,000 per attribution analysis, and be primarily borne by the ADEQ's Air Quality Assessment Section. Costs related to analyzing identified sources for BART are based on the activities identified in R18-2-1605(A) and will be moderate, but less expensive than the attribution analysis. These costs will be primarily borne by ADEQ's Permits Section. These costs will accrue to the state. Finally, incorporating BART into an existing state air quality permit may require additional resources from the Permits Section. However, these costs, unlike costs for the attribution and BART analysis, would be covered by permit revision fees paid by the source, and would have existed whether or not these rules became final.

3. Direct Costs - Stationary sources: If a source or small group of sources is found to cause or contribute to visibility impairment, and the BART determination requires installation of retrofit controls, the costs to sources required to install BART will be substantial. The total cost to install a technology similar to BART at the Navajo Generating Station was estimated by SRP to be in the hundreds of millions of dollars (51 Federal Register 50172, October 3, 1991). However, the example of the Navajo Generating Station shows costs to install technology similar to BART can result even where there is no state rule. According to EPA, "Where a State defaults on its obligations under the visibility

regulations, EPA may act in place of the State pursuant to a FIP under section 110(c) of the Act, 42 U.S.C. 7410(c)[2], and promulgate such limitation and measures as are required to achieve reasonable progress." (Ibid. at 50173, footnote not included). Although ADEQ is listing these costs for information purposes, ADEQ is not attributing any costs to install and operate BART to this rule because such requirements can be imposed by the federal government without any state rule.

Benefits. Two kinds of benefits are associated with this rule. The first benefit is derived from reduced emissions. Although, BART could be required to be installed on sources even without this state rule, it is helpful to list the emission benefits. When BART is installed, visibility is improved. Over four million recreation visits were made to Grand Canyon National Park in FY 2001. These visits generate substantial revenue in and for the state of Arizona. Other scenic resources could also be improved with the installation of BART, and, though less significant than the Grand Canyon, would enhance the tourism resources of Arizona, as well as the quality of life for Arizona citizens. In addition, reduction of visibility-impairing emissions also has health benefits.

The second benefit is through the replacement of federal regulation with state regulation. The lack of state regulations implementing BART results in Arizona sources being subject to federal regulation implemented by EPA from Washington and San Francisco, headquarters for EPA's Region IX. These rules place the identification and analysis of BART sources with ADEQ rather than with EPA. Arizona is currently under a visibility Federal Implementation Plan (FIP), and one or two Arizona sources have considered or implemented technology similar to BART under federal rules. Because ADEQ already permits many of these sources, ADEQ will be more familiar with the various factors that go into the BART analysis. This would be a benefit to sources being regulated. ADEQ would be implementing the same BART rules that EPA does, with a resulting increase in costs for ADEQ and a decrease in costs for EPA.

This final rule further allows ADEQ to proceed with the implementation of the entire federal rule for visibility improvement. The rule addresses the requirements of 40 C.F.R. §§ 51.302 – 51.307. These sections must be satisfied before ADEQ can implement the requirements of 40 C.F.R. §§ 51.308 and 51.309. The plan to implement Section 309 must be submitted to EPA by December 31, 2003.

D. Small Business Analysis

A.R.S. § 41-1055(B)(5) requires agencies to state the probable impact of a rulemaking on small businesses. A.R.S. § 41-1035 requires agencies to reduce the impact of a rule on small businesses by using certain methods when they are legal and feasible in meeting the statutory objectives for the rulemaking. These methods include: (1) exempting them from any or all rule requirements, (2) establishing performance standards which would replace any design or operational standards, or (3) instituting reduced compliance or reporting requirements. An agency may accomplish the third method by establishing less stringent requirements, consolidating or simplifying requirements, or setting less stringent schedules or deadlines.

"Small business" is defined in A.R.S. § 41-1001 as "a concern, including its affiliates, which is independently owned and operated, which is not dominant in its field and which employs fewer than one hundred full-time employees or which had gross annual receipts of less than four million dollars in its last fiscal year." Interpreting this definition means that if a concern has annual gross receipts of more than four million dollars, but fewer than 100 employees, it would not be classified as a small business.

ADEQ expects that none of the potential BART eligible sources will be classified as a small business. ADEQ's conclusion is that this rule will not impact small business sources. However, if a BART eligible source would qualify as a small business, under federal rule, ADEQ could not establish different requirements for these small business sources. If there are any small businesses that sell, install, or maintain BART-related technology, they will benefit from this rule.

In the preliminary EIS, ADEQ requested comment and additional information relating to any of the conclusions reached above and did not receive any.

10. A description of the changes between the proposed rules, including supplemental notices, and final rules (if applicable):

Changes were made with the cooperation of G.R.R.C. Staff to improve the clarity, conciseness and understandability of the rule. The changes are shown below:

A new definition was placed at R18-2-101(71), to clarify a term used in the proposed definition of "visibility impairment" at R18-2-101(123):

71. "Natural conditions" includes naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.

In addition, the word "and" was removed from the definition of "visibility impairment," as shown:

~~123.~~124."Visibility impairment" means any humanly perceptible change in visibility (light extinction, visual range, contrast, ~~and~~ coloration) from that which would have existed under natural conditions.

Both definitions are copied exactly from federal regulations at 40 CFR 51.308.

In addition, new Article 16 was amended as follows:

ARTICLE 16. VISIBILITY; REGIONAL HAZE

R18-2-1601. Definitions

In addition to the definitions contained in Articles 1 and 4 of this Chapter and A.R.S. § 49-401.01, the following definitions apply to this Article:

1. "Best available retrofit technology (BART)" means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant ~~that is~~ emitted by an existing stationary facility. The emission limitation is established on a case-by-case basis ~~in accordance with~~ under R18-2-1605.
2. "Existing stationary facility" means any of the following stationary sources of air pollutants, including any reconstructed source, which was not in operation ~~prior to~~ before August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit 250 tons per year or more of any air pollutant. ~~In determining~~ A person who determines potential to emit~~,~~ shall count fugitive emissions~~,~~ to the extent quantifiable~~, must be counted~~.
   a. Fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour heat input~~,~~;
   b. Coal cleaning plants (thermal dryers)~~,~~;
   c. Kraft pulp mills~~,~~;
   d. Portland cement plants~~,~~;
   e. Primary zinc smelters~~,~~;
   f. Iron and steel mill plants~~,~~;
   g. Primary aluminum ore reduction plants~~,~~;
   h. Primary copper smelters~~,~~;
   i. Municipal incinerators capable of charging more than 250 tons of refuse per day~~,~~;
   j. Hydrofluoric, sulfuric, and nitric acid plants~~,~~;
   k. Petroleum refineries~~,~~;
   l. Lime plants~~,~~;
   m. Phosphate rock processing plants~~,~~;
   n. Coke oven batteries~~,~~;
   o. Sulfur recovery plants~~,~~;
   p. Carbon black plants (furnace process)~~,~~;
   q. Primary lead smelters~~,~~;
   r. Fuel conversion plants~~,~~;
   s. Sintering plants~~,~~;
   t. Secondary metal production facilities~~,~~;
   u. Chemical process plants~~,~~;
   v. Fossil-fuel boilers of more than 250 million British thermal units per hour heat input~~,~~;
   w. Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels~~,~~;
   x. Taconite ore processing facilities~~,~~;
   y. Glass fiber processing plants~~,~~; and
   z. Charcoal production facilities.
3. "Federal Land Manager" means the Secretary of the department, or the Secretary's designee, with authority over the Federal Class I area.
4. "Mandatory Federal Class I Area" means any area identified in 40 CFR §§ 81.400-81.436.
5. "Reasonably attributable" means ascribable by visual observation or other techniques ~~the Director deems appropriate~~ described in R18-2-1604.
6. "Reasonably attributable visibility impairment" means visibility impairment that is caused by the emission of air pollutants from one source, or a small group of sources.

R18-2-1602. Applicability

This Article applies to any existing stationary source located in the state that may reasonably be anticipated to cause or contribute to visibility impairment in any mandatory Federal Class I area identified in 40 CFR §§ 81.401-81.436. Mandatory Federal Class I areas within Arizona are: Chiricahua National Monument Wilderness, Chiricahua Wilderness, Galiuro Wilderness, Grand Canyon National Park, Mazatzal Wilderness, Mount Baldy Wilderness, Petrified Forest National Park, Pine Mountain Wilderness, Saguaro Wilderness, Sierra Ancha Wilderness, Superstition Wilderness, and Sycamore Canyon Wilderness.

R18-2-1603. Certification of Impairment

A. A Federal Land Manager with authority over a mandatory Federal Class I area may certify to the Director, at any time, that ~~there exists~~ a reasonably attributable visibility impairment exists in ~~the~~ a mandatory Federal Class I area. The Director may also certify that ~~there exists~~ reasonably attributable visibility impairment exists in any mandatory Federal Class I area ~~as necessary~~ to assure reasonable progress under section 169A(b)(2) of the Clean Air Act.

B. Documentation ~~from the affected Federal Land Manager or Director~~ that supports the Federal Land Manager or Director's certification shall include:
1. The mandatory Federal Class I area for which visibility impairment is being certified,
2. Any information documenting the basis for the certification of impairment.

R18-2-1604. Attribution Analysis; Finding

A. ~~Upon certification of reasonably attributable visibility impairment in any mandatory Federal Class I area~~ If a mandatory Federal Class I area is certified as having reasonably attributable visibility impairment, the Director shall conduct an attribution analysis to identify each existing stationary source that may be reasonably anticipated to cause or contribute to visibility impairment. The Director shall notify the Federal Land Manager, affected source or small group of sources, and local air pollution control officer of the intent to conduct an attribution analysis. The attribution analysis shall be based on the following:
1. Monitoring information obtained through the Arizona Class I Visibility Monitoring Network or special studies approved by ADEQ to ascertain:
   a. The times visibility impairment occurred, and
   b. The pollutants contributing to the visibility impairment~~.~~;
2. Transport analysis or air quality modeling based upon meteorological records to ascertain whether the pollutants were transported to the mandatory Federal Class I area~~.~~;
3. Other available studies, modeling analyses, and emissions inventories of point, area, and mobile source emissions to ascertain:
   a. The pollutant ~~or pollutants~~ causing the impairment, and
   b. The source, or a small group of sources, emitting the ~~impairing~~ pollutant; ~~or pollutants.~~
4. Other relevant supporting documentation provided by the Federal Land Manager or Director used to make the draft attribution analysis finding~~.~~; and
5. Consideration of any documentation provided by the source, ~~or~~ a small group of sources~~.~~, or other interested parties.

B. In conducting the attribution analysis, the Director shall use monitoring information, meteorological records, and emissions inventories that represent times and locations reasonably concurrent with the visibility impairment.

C. The Director shall issue a draft attribution finding that impairment has or has not occurred, and provide public notice of the draft attribution finding. The Director shall publish notice of the draft attribution finding in a newspaper of general circulation in each county containing the mandatory Federal Class I area and the affected source. The Director shall provide at least 30 days from the date of the notice for public comment. Written comments to the Director shall include the name of the person and the person's agent or attorney, if any, and shall clearly set forth reasons why the Director should review the draft attribution finding ~~should be reviewed~~. The Director shall issue ~~A~~ a final attribution finding ~~shall be issued~~ after the public comment period. If the Director finds existing stationary sources ~~found to~~ cause or contribute to visibility impairment in a mandatory Federal Class I area, the source shall be subject to a BART Control Analysis under R18-2-1605.

R18-2-1605. BART Control Analysis; Finding

A. The Director shall analyze for BART controls each existing stationary source for which a final attribution finding is made under R18-2-1604(C). The Director shall consider the following factors:
1. Available control technology;
2. New source performance standards (NSPS) ~~as adopted~~ in Article 9;
3. Alternative control systems if retrofitting to comply with applicable NSPS standards ~~adopted~~ in Article 9 is ~~found~~ infeasible~~.~~;
4. Cost of compliance;
5. Energy and non-air quality environmental impacts of compliance;
6. Existing pollution control technology in use at the source or small group of sources;
7. Remaining useful life of the source or small group of sources;
8. Net environmental impact associated with the proposed emission control system;
9. Economic impacts associated with installing and operating the proposed emission control system; and
10. Degree of improvement in visibility anticipated to result from application of the proposed emission control system.

B. The Director shall issue a draft BART finding, and provide public notice of the draft BART finding. The Director shall publish notice of the draft BART finding in a newspaper of general circulation in each county containing the mandatory Federal Class I area and the affected source. The Director shall provide at least 30 days from the date of the notice for public comment. Written comments to the Director shall include the name of the person and the person's agent or attorney, and shall clearly set forth reasons why the Director should review the draft BART ~~finding should be reviewed~~. The Director shall issue a final BART finding after the public comment period.
1. The Director shall submit each final BART finding ~~that an existing stationary source is required to meet BART~~ to the Administrator as a revision to the ~~state implementation plan (~~SIP~~)~~.

2. The Director shall require that each existing stationary source meet BART as expeditiously as practicable but in no case later than five years after EPA approval of the~~ revision to Arizona's State Implementation Plan~~ SIP revision.

C. If the Director determines that technological or economic limitations on the applicability of measurement methodology to a particular existing stationary source would make the imposition of an emission standard infeasible, the Director may, as part of the finding under subsection (B), ~~instead~~ prescribe a design, equipment, work practice, ~~or other~~ operational standard, or combination ~~thereof~~ of design, equipment, work practice, or operational standard. ~~Such~~ The standard, to the degree possible, ~~is to~~ shall set forth the emission reduction to be achieved by implementation of ~~such~~ the design, equipment, work practice, or operation, and ~~must~~ shall provide for compliance by means ~~which~~ that achieve equivalent results.

D. The Director shall make a finding that the attributable source ~~has satisfied~~ satisfies the BART requirement if the attributable source ~~has~~:

1. Voluntarily ~~applied~~ applies best available retrofit technology;
2. Previously applied emission control standards equivalent to BART; or
3. ~~Agreed~~ Agrees to shutdown or curtail operations at the attributable source within ~~5~~ five years of the finding. An attributable source that does not shutdown or curtail operations shall ~~proceed to~~ meet BART as expeditiously as practicable, but in no case later than five years after EPA's approval of the revision to ~~Arizona's State Implementation Plan~~ the SIP.

E. If the Director determines that the imposition of BART or a standard ~~pursuant to~~ under subsection (C) ~~of this section~~ is ~~not feasible~~ infeasible at the time of the finding, the Director shall require the attributable source ~~shall be required~~ to install and operate BART ~~upon a determination by the Director~~ at a later date when the Director determines that BART or equivalent controls are ~~now~~ feasible.

F. The Director shall provide for a BART control analysis of any existing stationary source that might cause or contribute to impairment of visibility in any mandatory Federal Class I area identified under this Article at such times~~,~~ as ~~determined by~~ the Administrator~~,~~ determines new control technology for ~~control of~~ the pollutant becomes reasonably available if:

1. The pollutant is emitted by that existing stationary source,
2. Controls representing BART for the pollutant have not previously been required under this Article, and
3. The impairment of visibility in any mandatory Federal Class I area is reasonably attributable to the emissions of that pollutant.

R18-2-1606. Exemption from BART

Any existing stationary source required to install, operate, and maintain BART ~~pursuant to~~ under this Article, may apply to the Administrator for an exemption from that requirement according to 40 CFR 51.303. ~~by obtaining prior written concurrence from the Director according to 40 CFR 51.303.~~ The existing stationary source shall obtain the Director's written concurrence before sending the application for exemption to the Administrator.

11. A summary of the comments made regarding the rules and the agency response to them:

ADEQ received one written comment. It expressed general support for the rules and for protecting visibility in Arizona's Class I parks and wilderness areas.

Comment: ADEQ received an oral comment that the word "facility" should be replaced by "source" in the definitions of "best available retrofit technology" and "existing stationary facility" to be consistent with the rest of the rule.

Response: ADEQ has kept these definitions the same as the federal definitions to ensure consistency. The definitions use the term "source" to define the terms, and "source" is used thereafter in the rules. ADEQ is not aware of any inconsistency.

12. Any other matters prescribed by statute that are applicable to the specific agency or to any specific rule or class of rules:

Not applicable

13. Incorporations by reference and their location in the rules:

Not applicable

14. Were these rules previously adopted as emergency rules?

No

15. The full text of the rules follows:

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY AIR POLLUTION CONTROL

ARTICLE 1. GENERAL

ARTICLE 16. VISIBILITY; REGIONAL HAZE

ARTICLE 1. GENERAL

R18-2-101. Definitions

In addition to the definitions prescribed in A.R.S. §§ 49-101, 49-401.01, 49-421, 49-471, and 49-541, in this Chapter, unless otherwise specified:

1. No change
2. No change
   a. No change
   b. No change
   c. No change
   d. No change
   e. No change
3. No change
4. No change
5. No change
6. No change
7. No change
8. No change
9. No change
10. No change
    a. No change
    b. No change
    c. No change
    d. No change
    e. No change
    f. No change
11. No change
    a. No change
    b. No change
    c. No change
12. No change
13. No change
14. No change
    a. No change
    b. No change
15. No change
16. No change
17. No change
18. No change
19. No change
20. No change
21. No change
22. No change
23. No change
24. No change
25. No change
26. No change

27. No change
    a. No change
    b. No change
28. No change
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31. No change
32. No change
33. No change
34. No change
35. No change
36. No change
37. No change
38. No change
39. No change
40. No change
41. No change
42. No change
    a. No change
    b. No change
    c. No change
    d. No change
    e. No change
    f. No change
    g. No change
    h. No change
    i. No change
    j. No change
    k. No change
    l. No change
43. No change
44. No change
    a. No change
    b. No change
    c. No change
    d. No change
45. No change
46. No change
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48. No change
49. No change
50. No change
51. No change
52. No change
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54. No change
55. No change
56. No change
57. No change
    a. No change
    b. No change
    c. No change
    d. No change
    e. No change
    f. No change
    g. No change
    h. No change
    i. No change
    j. No change

58. No change
59. No change
60. No change
61. No change
62. No change
63. No change
    a. No change
    b. No change
    c. No change
        i. No change
        ii. No change
        iii. No change
        iv. No change
        v. No change
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            (2) No change
        vi. No change
        vii. No change
        viii. No change
            (1) No change
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        ix. No change
            (1) No change
            (2) No change
        x. No change
        xi. No change
64. No change
    a. No change
    b. No change
        i. No change
        ii. No change
    c. No change
        i. No change
        ii. No change
        iii. No change
        iv. No change
        v. No change
        vi. No change
        vii. No change
        viii. No change
        ix. No change
        x. No change
        xi. No change
        xii. No change
        xiii. No change
        xiv. No change
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        xx. No change
        xxi. No change
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        xxiii. No change
        xxiv. No change
        xxv. No change
        xxvi. No change
        xxvii. No change

65. No change
66. No change
67. No change
68. No change
69. No change
70. No change
<u>71.</u> <u>"Natural conditions" includes naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.</u>

~~71.~~<u>72.</u>No change
~~72.~~<u>73.</u>No change
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~~122.~~123. No change
~~123.~~124. "Visibility impairment" means any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions.
~~124.~~125. No change
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ARTICLE 16. VISIBILITY; REGIONAL HAZE

R18-2-1601. Definitions

In addition to the definitions contained in Articles 1 and 4 of this Chapter and A.R.S. § 49-401.01, the following definitions apply to this Article:

1. "Best available retrofit technology (BART)" means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant emitted by an existing stationary facility. The emission limitation is established on a case-by-case basis under R18-2-1605.
2. "Existing stationary facility" means any of the following stationary sources of air pollutants, including any reconstructed source, which was not in operation before August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit 250 tons per year or more of any air pollutant. A person who determines potential to emit shall count fugitive emissions to the extent quantifiable.
   a. Fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour heat input;
   b. Coal cleaning plants (thermal dryers);
   c. Kraft pulp mills;
   d. Portland cement plants;
   e. Primary zinc smelters;
   f. Iron and steel mill plants;
   g. Primary aluminum ore reduction plants;
   h. Primary copper smelters;
   i. Municipal incinerators capable of charging more than 250 tons of refuse per day;
   j. Hydrofluoric, sulfuric, and nitric acid plants;
   k. Petroleum refineries;
   l. Lime plants;
   m. Phosphate rock processing plants;
   n. Coke oven batteries;

o. Sulfur recovery plants;
p. Carbon black plants (furnace process);
q. Primary lead smelters;
r. Fuel conversion plants;
s. Sintering plants;
t. Secondary metal production facilities;
u. Chemical process plants;
v. Fossil-fuel boilers of more than 250 million British thermal units per hour heat input;
w. Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels;
x. Taconite ore processing facilities;
y. Glass fiber processing plants; and
z. Charcoal production facilities.

3. "Federal Land Manager" means the secretary of the department, or the secretary's designee, with authority over the Federal Class I area.
4. "Mandatory Federal Class I Area" means any area identified in 40 CFR 81.400 through 81.436.
5. "Reasonably attributable" means ascribable by visual observation or other techniques described in R18-2-1604.
6. "Reasonably attributable visibility impairment" means visibility impairment that is caused by the emission of air pollutants from one source, or a small group of sources.

R18-2-1602. Applicability

This Article applies to any existing stationary source located in the state that may reasonably be anticipated to cause or contribute to visibility impairment in any mandatory Federal Class I area identified in 40 CFR 81.401 through 81.436. Mandatory Federal Class I areas within Arizona are: Chiricahua National Monument Wilderness, Chiricahua Wilderness, Galiuro Wilderness, Grand Canyon National Park, Mazatzal Wilderness, Mount Baldy Wilderness, Petrified Forest National Park, Pine Mountain Wilderness, Saguaro Wilderness, Sierra Ancha Wilderness, Superstition Wilderness, and Sycamore Canyon Wilderness.

R18-2-1603. Certification of Impairment

A. A Federal Land Manager with authority over a mandatory Federal Class I area may certify to the Director, at any time, that a reasonably attributable visibility impairment exists in a mandatory Federal Class I area. The Director may also certify that reasonably attributable visibility impairment exists in any mandatory Federal Class I area to assure reasonable progress under section 169A(b)(2) of the Clean Air Act.

B. Documentation that supports the Federal Land Manager or Director's certification shall include:
1. The mandatory Federal Class I area for which visibility impairment is being certified,
2. Any information documenting the basis for the certification of impairment.

R18-2-1604. Attribution Analysis; Finding

A. If a mandatory Federal Class I area is certified as having reasonably attributable visibility impairment, the Director shall conduct an attribution analysis to identify each existing stationary source that may be reasonably anticipated to cause or contribute to visibility impairment. The Director shall notify the Federal Land Manager, affected source or small group of sources, and local air pollution control officer of the intent to conduct an attribution analysis. The attribution analysis shall be based on the following:
1. Monitoring information obtained through the Arizona Class I Visibility Monitoring Network or special studies approved by ADEQ to ascertain:
   a. The times visibility impairment occurred, and
   b. The pollutants contributing to the visibility impairment;
2. Transport analysis or air quality modeling based upon meteorological records to ascertain whether the pollutants were transported to the mandatory Federal Class I area;
3. Other available studies, modeling analyses, and emissions inventories of point, area, and mobile source emissions to ascertain:
   a. The pollutant causing the impairment, and
   b. The source, or a small group of sources, emitting the pollutant;
4. Other relevant supporting documentation provided by the Federal Land Manager or Director used to make the draft attribution analysis finding; and
5. Consideration of any documentation provided by the source, a small group of sources, or other interested parties.

B. In conducting the attribution analysis, the Director shall use monitoring information, meteorological records, and emissions inventories that represent times and locations reasonably concurrent with the visibility impairment.

C. The Director shall issue a draft attribution finding that impairment has or has not occurred, and provide public notice of the draft attribution finding. The Director shall publish notice of the draft attribution finding in a newspaper of general circulation in each county containing the mandatory Federal Class I area and the affected source. The Director shall provide at least 30 days from the date of the notice for public comment. Written comments to the Director shall include the name of the person and the person's agent or attorney, if any, and shall clearly set forth reasons why the Director should review the draft attribution finding. The Director shall issue a final attribution finding after the public comment period. If the Director finds existing stationary sources cause or contribute to visibility impairment in a mandatory Federal Class I area, the source shall be subject to a BART Control Analysis under R18-2-1605.

R18-2-1605. BART Control Analysis; Finding

A. The Director shall analyze for BART controls each existing stationary source for which a final attribution finding is made under R18-2-1604(C). The Director shall consider the following factors:

1. Available control technology;
2. New source performance standards (NSPS) in Article 9;
3. Alternative control systems if retrofitting to comply with applicable NSPS standards in Article 9 is infeasible;
4. Cost of compliance;
5. Energy and non-air quality environmental impacts of compliance;
6. Existing pollution control technology in use at the source or small group of sources;
7. Remaining useful life of the source or small group of sources;
8. Net environmental impact associated with the proposed emission control system;
9. Economic impacts associated with installing and operating the proposed emission control system; and
10. Degree of improvement in visibility anticipated to result from application of the proposed emission control system.

B. The Director shall issue a draft BART finding, and provide public notice of the draft BART finding. The Director shall publish notice of the draft BART finding in a newspaper of general circulation in each county containing the mandatory Federal Class I area and the affected source. The Director shall provide at least 30 days from the date of the notice for public comment. Written comments to the Director shall include the name of the person and the person's agent or attorney, and shall clearly set forth reasons why the Director should review the draft BART finding. The Director shall issue a final BART finding after the public comment period.

1. The Director shall submit each final BART finding to the Administrator as a revision to the SIP.
2. The Director shall require that each existing stationary source meet BART as expeditiously as practicable but in no case later than five years after EPA approval of the SIP revision.

C. If the Director determines that technological or economic limitations on the applicability of measurement methodology to a particular existing stationary source would make the imposition of an emission standard infeasible, the Director may, as part of the finding under subsection (B), prescribe a design, equipment, work practice, operational standard, or combination of design, equipment, work practice, or operational standard. The standard, to the degree possible, shall set forth the emission reduction to be achieved by implementation of the design, equipment, work practice, or operation, and shall provide for compliance by means that achieve equivalent results.

D. The Director shall make a finding that the attributable source satisfies the BART requirement if the attributable source:

1. Voluntarily applies best available retrofit technology;
2. Previously applied emission control standards equivalent to BART; or
3. Agrees to shutdown or curtail operations at the attributable source within five years of the finding. An attributable source that does not shutdown or curtail operations shall meet BART as expeditiously as practicable, but in no case later than five years after EPA's approval of the revision to the SIP.

E. If the Director determines that the imposition of BART or a standard under subsection (C) is infeasible at the time of the finding, the Director shall require the attributable source to install and operate BART at a later date when the Director determines that BART or equivalent controls are feasible.

F. The Director shall provide for a BART control analysis of any existing stationary source that might cause or contribute to impairment of visibility in any mandatory Federal Class I area identified under this Article at such time as the Administrator determines new control technology for the pollutant becomes reasonably available:

1. The pollutant is emitted by that existing stationary source,
2. Controls representing BART for the pollutant have not previously been required under this Article, and
3. The impairment of visibility in any mandatory Federal Class I area is reasonably attributable to the emissions of that pollutant.

R18-2-1606. Exemption from BART

Any existing stationary source required to install, operate, and maintain BART under this Article, may apply to the Administrator for an exemption from that requirement according to 40 CFR 51.303. The existing stationary source shall obtain the Director's written concurrence before sending the application for exemption to the Administrator.

Appendix A-5b. Notification letters to FLMS on contact person, and Public Comment Period

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Governor Jane Dee Hull   Jacqueline E. Schafer, Director

April 13, 2000

Eleanor Townes
US Forest Services
517 Gold Avenue SW Region
Albuquerque, New Mexico 87105

Dear Ms. Townes:

I am writing to welcome your participation in the Arizona Department of Environmental Quality's (ADEQ) efforts to improve visibility in our Class I areas. One of our duties under the EPA Regional Haze Regulations (64 Fed. Reg. 35,714, July 1, 1999) is to notify you of our state contact person for regional haze issues. Mike George, Assessment Section Manager, Air Quality Division, has been assigned this responsibility. He can be reached at (602)207-2274. General inquiries may also be directed to Corky Martinkovic of the Air Quality Planning Section at (602)207-2372.

ADEQ will also send written notices to all affected federal land managers of public hearings to be held prior to submittal of a related State Implementation Plan (SIP) to EPA. Arizona is presently under a Federal Implementation Plan (FIP) for reasonably attributable visibility impairment, but is developing a SIP revision to replace the FIP. You will receive an official notice when the public hearing date is finalized, which is expected to be later this year. A draft SIP will be included with the notice of public hearing date for review and comment. Further, affected federal land managers will be notified of applicable rulemaking activities.

ADEQ looks forward to working with you to protect our clean air resource. If you have questions or comments, you may contact me at (602)207-2308, or Mike and Corky at the above phone numbers.

Sincerely,

Nancy C. Wrona, Director
Air Quality Division

cc: Mike George, ADEQ
Theresa Pella, ADEQ
Pete Lahm, ADEQ

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Janet Napolitano
Governor

Stephen A. Owens
Director

August 22, 2003

Mr. Joseph Alston, Federal Land Manager
Grand Canyon National Park
P.O. Box 129
Grand Canyon, AZ 86023

Re: Arizona's Regional Haze State Implementation Plan

Dear Mr. Alston:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

Consultation with the federal land managers is an integral part of the regional haze regulations, and we invite you to participate in the review of the proposed SIP during the upcoming 30-day public comment period. The proposed SIP will be posted to the ADEQ Website at www.adeq.state.az.us/environ/air/plan/haze. It is ADEQ's intent to have the Regional Haze SIP available for public comment in mid-September of this year, culminating with public hearings held throughout the state during the middle or end of October. A notice regarding the commencement of the public comment period and dates/locations of the public hearings will be sent separately. The SIP must be submitted to EPA by December 31, 2003, to meet the requirements of 40 CFR 51.309.

Until further notice, I will be the contact person for regional haze at ADEQ. General inquiries may still be directed to Corky Martinkovic of the Air Quality Planning Section at (602) 771-2372 or dam@ev.state.az.us. ADEQ looks forward to working with you to protect our national parks and wilderness areas.

Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Joseph Alston

cc: Lee Baiza
Carl Bowman
Sarah Craighead
Harv Forsgren
Michael King
Pete Lahm
Neil Mangum
Colleen McKaughan
John McGee
Joseph Mikitish
Bruce Polkowsky
Nora Rasure
Chris Shaver
Karl Siderits
Mike Williams
Elaine Zieroth

ARIZONA DEPARTMENT
OF
ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Janet Napolitano
Governor

Stephen A. Owens
Director

August 22, 2003

Mr. Lee Baiza, Federal Land Manager
Petrified Forest National Park
P.O. Box 2217
Petrified Forest, AZ 86028

Re: Arizona's Regional Haze State Implementation Plan

Dear Mr. Baiza:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division

cc: Joseph Alston
Carl Bowman
Sarah Craighead
Harv Forsgren
Michael King
Pete Lahm
Neil Mangum
Colleen McKaughan
John McGee
Joseph Mikitish
Bruce Polkowsky
Nora Rasure
Chris Shaver
Karl Siderits
Mike Williams

ARIZONA DEPARTMENT
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Janet Napolitano
Governor

1110 West Washington Street • Phoenix, Arizona 85007
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Stephen A. Owens
Director

August 22, 2003

Mr. Carl Bowman, Federal Land Manager
Grand Canyon National Park
P.O. Box 129
Grand Canyon, AZ 86023

Re: Arizona's Regional Haze State Implementation Plan

Dear Mr. Bowman:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Carl Bowman

Northern Regional Office
1515 East Cedar Avenue • Suite F • Flagstaff, AZ 86004

Southern Regional Office
400 West Congress Street • Suite 433 • Tucson, AZ 85701

cc: Joseph Alston
Lee Baiza
Sarah Craighead
Harv Forsgren
Michael King
Pete Lahm
Neil Mangum
Colleen McKaughan
John McGee
Joseph Mikitish
Bruce Polkowsky
Nora Rasure
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Janet Napolitano
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

August 22, 2003

Ms. Sarah Craighead, Federal Land Manager
Saguaro National Monument
3693 S. Old Spanish Trail
Tucson, AZ 85730

Re: Arizona's Regional Haze State Implementation Plan

Dear Ms. Craighead:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Sarah Craighead

cc: Joseph Alston
Lee Baiza
Carl Bowman
Harv Forsgren
Michael King
Pete Lahm
Neil Mangum
Colleen McKaughan
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Joseph Mikitish
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Janet Napolitano
Governor

Stephen A. Owens
Director

August 22, 2003

Mr. Harv Forsgren, Federal Land Manager
U.S. Forest Service – Southwest Region
333 Broadway SE
Albuquerque, NM 87102

Re: Arizona's Regional Haze State Implementation Plan

Dear Mr. Forsgren:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Harv Forsgren

cc: Joseph Alston
Lee Baiza
Carl Bowman
Sarah Craighead
Michael King
Pete Lahm
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Janet Napolitano
Governor

Stephen A. Owens
Director

August 22, 2003

Mr. Michael King, Federal Land Manager
Pine Mountain Wilderness
344 S. Cortez Street
Prescott, AZ 86303

Re: Arizona's Regional Haze State Implementation Plan

Dear Mr. Siderits:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

Consultation with the federal land managers is an integral part of the regional haze regulations, and we invite you to participate in the review of the proposed SIP during the upcoming 30-day public comment period. The proposed SIP will be posted to the ADEQ Website at www.adeq.state.az.us/environ/air/plan/haze. It is ADEQ's intent to have the Regional Haze SIP available for public comment in mid-September of this year, culminating with public hearings held throughout the state during the middle or end of October. A notice regarding the commencement of the public comment period and dates/locations of the public hearings will be sent separately. The SIP must be submitted to EPA by December 31, 2003, to meet the requirements of 40 CFR 51.309.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Michael King

cc: Joseph Alston
Lee Baiza
Carl Bowman
Sarah Craighead
Harv Forsgren
Pete Lahm
Neil Mangum
Colleen McKaughan
John McGee
Joseph Mikitish
Bruce Polkowsky
Nora Rasure
Chris Shaver
Karl Sideritz
Mike Williams
Elaine Zieroth

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Janet Napolitano
Governor

Stephen A. Owens
Director

August 22, 2003

Mr. Pete Lahm, Federal Land Manager
U.S. Forest Service
c/o Arizona Department of Environmental Quality
1110 W. Washington Street, 3415A-3
Phoenix, AZ 85007

Re: Arizona's Regional Haze State Implementation Plan

Dear Mr. Lahm:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Pete Lahm

cc: Joseph Alston
Lee Baiza
Carl Bowman
Sarah Craighead
Harv Forsgren
Michael King
Neil Mangum
John McGee
Colleen McKaughan
Joseph Mikitish
Bruce Polkowsky
Nora Rasure
Chris Shaver
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Janet Napolitano
Governor

Stephen A. Owens
Director

August 22, 2003

Mr. Neil Mangum, Federal Land Manager
Chiricuahua National Park
13063 E. Boenito Canyon
Wilcox, AZ 85643

Re: Arizona's Regional Haze State Implementation Plan

Dear Mr. Mangum:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Neil Mangum

cc: Joseph Alston
Lee Baiza
Carl Bowman
Sarah Craighead
Harv Forsgren
Michael King
Pete Lahm
Colleen McKaughan
John McGee
Joseph Mikitish
Bruce Polkowsky
Nora Rasure
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(602) 771-2300 • www.adeq.state.az.us

Janet Napolitano
Governor

Stephen A. Owens
Director

August 22, 2003

Mr. John McGee, Federal Land Manager
Galiuro Wilderness
300 W. Congress
Tucson, AZ 85701

Re: Arizona's Regional Haze State Implementation Plan

Dear Mr. McGee:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
John McGee

cc: Joseph Alston
Lee Baiza
Carl Bowman
Sarah Craighead
Harv Forsgren
Michael King
Pete Lahm
Neil Mangum
Colleen McKaughan
Joseph Mikitish
Bruce Polkowsky
Nora Rasure
Chris Shaver
Karl Siderits
Mike Williams
Elaine Zieroth

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(602) 771-2300 • www.adeq.state.az.us

Janet Napolitano
Governor

Stephen A. Owens
Director

August 22, 2003

Mr. Bruce Polkowsky, Federal Land Manager
National Park Service
P.O. Box 25287
Denver, CO 80225

Re: Arizona's Regional Haze State Implementation Plan

Dear Mr. Polkowsky:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Bruce Polkowsky

cc: Joseph Alston
Lee Baiza
Carl Bowman
Sarah Craighead
Harv Forsgren
Michael King
Pete Lahm
Neil Mangum
John McGee
Colleen McKaughan
Joseph Mikitish
Nora Rasure
Chris Shaver
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Governor

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(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

August 22, 2003

Ms. Nora Rasure, Federal Land Manager
Sycamore Canyon Wilderness
2323 E. Greenlaw Lane
Flagstaff, AZ 86004

Re: Arizona's Regional Haze State Implementation Plan

Dear Ms. Rasure:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Nora Rasure

cc: Joseph Alston
Lee Baiza
Carl Bowman
Sarah Craighead
Harv Forsgren
Michael King
Pete Lahm
Neil Mangum
Colleen McKaughan
John McGee
Joseph Mikitish
Bruce Polkowsky
Chris Shaver
Karl Siderits
Mike Williams
Elaine Zieroth

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(602) 771-2300 • www.adeq.state.az.us

Janet Napolitano
Governor

Stephen A. Owens
Director

August 22, 2003

Ms. Chris Shaver, Federal Land Manager
National Park Service
P.O. Box 25287
Denver, CO 80225

Re: Arizona's Regional Haze State Implementation Plan

Dear Ms. Shaver:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Chris Shaver

cc: Joseph Alston
Lee Baiza
Carl Bowman
Sarah Craighead
Harv Forsgren
Michael King
Pete Lahm
Neil Mangum
John McGee
Colleen McKaughan
Joseph Mikitish
Bruce Polkowsky
Nora Rasure
Karl Siderits
Mike Williams
Elaine Zieroth

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Janet Napolitano
Governor

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

August 22, 2003

Mr. Karl Siderits, Federal Land Manager
Sierra Ancha/Superstition/Mazatzal Wildernesses
2324 E. McDowell Road
Phoenix, AZ 85006

Re: Arizona's Regional Haze State Implementation Plan

Dear Mr. Siderits:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Karl Siderits

Northern Regional Office
1515 East Cedar Avenue • Suite F • Flagstaff, AZ 86004

Southern Regional Office
400 West Congress Street • Suite 433 • Tucson, AZ 85701

cc: Joseph Alston
Lee Baiza
Carl Bowman
Sarah Craighead
Harv Forsgren
Michael King
Pete Lahm
Neil Mangum
Colleen McKaughan
John McGee
Joseph Mikitish
Bruce Polkowsky
Nora Rasure
Chris Shaver
Mike Williams
Elaine Zieroth

Janet Napolitano
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

August 22, 2003

Mr. Mike Williams, Federal Land Manager
Sycamore Canyon Wilderness
800 S. 6th Street
Williams, AZ 86046

Re: Arizona's Regional Haze State Implementation Plan

Dear Mr. Williams:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Mike Williams

cc: Joseph Alston
Lee Baiza
Carl Bowman
Sarah Craighead
Harv Forsgren
Michael King
Pete Lahm
Neil Mangum
Colleen McKaughan
John McGee
Joseph Mikitish
Bruce Polkowsky
Nora Rasure
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Elaine Zieroth

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1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Janet Napolitano
Governor

Stephen A. Owens
Director

August 22, 2003

Ms. Elaine Zieroth, Federal Land Manager
Mt. Baldy Wilderness
P.O. Box 640
Springerville, AZ 85938

Re: Arizona's Regional Haze State Implementation Plan

Dear Ms. Zieroth:

The purpose of this letter is to provide notice to you in accordance with 40 CFR 51.302(a)(2)(ii), regarding the availability of a draft Regional Haze State Implementation Plan (SIP) for Arizona. In April 2000, I sent notices to the federal land managers that Arizona was beginning to develop a state implementation plan to address visibility impairment in the Class I areas. Arizona's Regional Haze SIP will address visibility impairment for the four mandatory Federal Class I areas in Arizona that are part of the Grand Canyon Visibility Transport Commission's Colorado Plateau: Grand Canyon National Park, Petrified Forest National Park, Sycamore Canyon Wilderness, and Mount Baldy Wilderness.

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Sincerely,

Nancy C. Wrona, Director
Air Quality Division
Elaine Zieroth

cc: Joseph Alston
Lee Baiza
Carl Bowman
Sarah Craighead
Harv Forsgren
Michael King
Pete Lahm
Neil Mangum
Colleen McKaughan
John McGee
Joseph Mikitish
Bruce Polkowsky
Nora Rasure
Chris Shaver
Karl Siderits
Mike Williams

<u>Appendix A-5c. Supporting Documents Related To The Promulgation Of Arizona's RAVI Rule</u>

Janet Napolitano
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

MEMORANDUM

DATE: January 7, 2003

TO: Visibility Rule Stakeholders

FROM: Nancy C. Wrona, Director
Air Quality Division

SUBJECT: Preliminary Draft Notice of Proposed Rulemaking for
Reasonably Attributable Visibility Impairment (RAVI) Rule

You are invited to a stakeholder meeting on **Tuesday, January 14, 2003, 1:30 p.m., Room 145, ADEQ, 1110 W. Washington, Phoenix, Arizona**. The purpose of this meeting is to review a draft Notice of Proposed Rulemaking (NPRM) for the Reasonably Attributable Visibility Impairment (RAVI) rule. The RAVI rule, formerly known as the "visibility rule," has had numerous stakeholder reviews, but now contains the preamble portion required for submission to the Secretary of State. Once the RAVI rule is submitted to the Secretary of State for publication in the *Arizona Administrative Register*, the rule will have a 30 day public review period, culminating in a public hearing in mid March 2003.

The proposed rule deals with state requirements within the federal visibility/regional haze rule 40 CFR §§51.302 - 307. Sections 302 through 307 deal with a specific type of visibility impairment caused by certain categories of exiting stationary sources operating in and near national parks and wilderness areas (federal Class I areas).

Due to the length of the draft NPRM, we will not be faxing the document with this notice. However, you can access the RAVI rule via the ADEQ Web page at www.adeq.state.az.us/environ/air/plan/haze.html. You can also receive a copy of the draft NPRM by contacting Corky Martinkovic at the number or e-mail shown below.

I look forward to seeing you on January 14th. If you have any questions regarding the meeting, please call me at (602) 771-2308 or Corky Martinkovic at (602) 771-2372, or by e-mail at martinkovic.deborrah@ev.state.az.us. If you are in Arizona, but outside of the Phoenix area, call 1-800-234-5677, then dial extension 771-2372. Copies of the draft NPRM will also be available at the January 14th meeting.

PUBLIC NOTICE

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
PUBLIC HEARING
ON NOTICE OF PROPOSED RULEMAKING
REASONABLY ATTRIBUTABLE VISIBILITY IMPAIRMENT RULE

The Arizona Department of Environmental Quality (ADEQ) will hold a public hearing to receive comments on the Notice of Proposed Rulemaking for Reasonably Attributable Visibility Impairment (RAVI) rule. This rule impacts specific stationary sources emitting 250 tons per year or more of visibility impairing air pollutants in or near Arizona's 12 mandatory federal class I areas (national parks and wilderness areas). The rule directs the state of Arizona and the stationary sources on the actions necessary should a source or small group of sources be certified by a Federal Land Manager as possibly causing or contributing to visibility problems in any of the 12 national parks and wilderness areas.

A public hearing on the Notice of Proposed Rulemaking will be held on Wednesday, April 7, 2003, at the Coconino Library, 300 W. Aspen, Flagstaff, Arizona. All interested parties will be given an opportunity at the public hearing to submit relevant comments, data, and views, orally and in writing. Written comments must be received at ADEQ by 5:00 p.m. on Friday, April 11, 2003. ADEQ anticipates sending the proposed rule and any comments received to the Governor's Regulatory Review Council on or after April 21, 2003.

All written comments should be addressed, faxed, or e-mailed to:

Deborrah "Corky" Martinkovic
Air Quality Planning Section
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85012-2905
FAX: (602) 771-2366
E-Mail: martinkovic.deborrah@ev.state.az.us

Copies of the proposal are available for review beginning Thursday, March 13 (ADEQ) and March 17 (Flagstaff), 2003, at the following locations:

Arizona Department of Environmental Quality
First Floor Library
1110 W. Washington Street
Phoenix, Arizona 85012
Lorraine Akey, (602) 771-4335

<u>Locally</u>:
Coconino Library
300 W. Aspen
Flagstaff, Arizona
Dawn Gardner, (928) 779-7670

PUBLIC NOTICE

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
PUBLIC HEARING
ON NOTICE OF PROPOSED RULEMAKING
REASONABLY ATTRIBUTABLE VISIBILITY IMPAIRMENT RULE

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A public hearing on the Notice of Proposed Rulemaking will be held on Wednesday, April 8, 2003, at the Arizona Department of Environmental Quality, 1110 W. Washington Street, Room 145, Phoenix, Arizona. All interested parties will be given an opportunity at the public hearing to submit relevant comments, data, and views, orally and in writing. Written comments must be received at ADEQ by 5:00 p.m. on Friday, April 11, 2003. ADEQ anticipates sending the proposed rule and any comments received to the Governor's Regulatory Review Council on or after April 21, 2003.

All written comments should be addressed, faxed, or e-mailed to:

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Air Quality Planning Section
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85012-2905
FAX: (602) 771-2366
E-Mail: martinkovic.deborrah@ev.state.az.us

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Arizona Department of Environmental Quality
First Floor Library
1110 W. Washington Street
Phoenix, Arizona 85012
Lorraine Akey, (602) 771-4335

Other Hearing Locations:

Flagstaff - April 7, 2003
Tucson - April 9, 2003

PUBLIC NOTICE

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
PUBLIC HEARING
ON NOTICE OF PROPOSED RULEMAKING
REASONABLY ATTRIBUTABLE VISIBILITY IMPAIRMENT RULE

The Arizona Department of Environmental Quality (ADEQ) will hold a public hearing to receive comments on the Notice of Proposed Rulemaking for Reasonably Attributable Visibility Impairment (RAVI) rule. This rule impacts specific stationary sources emitting 250 tons per year or more of visibility impairing air pollutants in or near Arizona's 12 mandatory federal class I areas (national parks and wilderness areas). The rule directs the state of Arizona and the stationary sources on the actions necessary should a source or small group of sources be certified by a Federal Land Manager as possibly causing or contributing to visibility problems in any of the 12 national parks and wilderness areas.

A public hearing on the Notice of Proposed Rulemaking will be held on Wednesday, April 9, 2003, at the State Office Building, 400 W. Congress, Room 158, Tucson, Arizona. All interested parties will be given an opportunity at the public hearing to submit relevant comments, data, and views, orally and in writing. Written comments must be received at ADEQ by 5:00 p.m. on Friday, April 11, 2003. ADEQ anticipates sending the proposed rule and any comments received to the Governor's Regulatory Review Council on or after April 21, 2003.

All written comments should be addressed, faxed, or e-mailed to:

Deborrah "Corky" Martinkovic
Air Quality Planning Section
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85012-2905
FAX: (602) 771-2366
E-Mail: martinkovic.deborrah@ev.state.az.us

Copies of the proposal are available for review beginning Thursday, March 13 (ADEQ) and March 17 (Tucson), 2003, at the following locations:

Arizona Department of Environmental Quality
First Floor Library
1110 W. Washington Street
Phoenix, Arizona 85012
Lorraine Akey, (602) 771-4335

Locally:
State Office Building
400 W. Congress, Room 158
Tucson, Arizona
Julie Benner, (520) 628-6902

NOTICE OF PROPOSED RULEMAKING

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY

AIR POLLUTION CONTROL

ARTICLE 16. VISIBILITY; REGIONAL HAZE

PREAMBLE

1. Sections Affected — **Rulemaking Action**

Sections Affected	Rulemaking Action
R18-2-101	Amend
R18-2-1601	New Section
R18-2-1602	New Section
R18-2-1603	New Section
R18-2-1604	New Section
R18-2-1605	New Section
R18-2-1606	New Section

2. The statutory authority for the rulemaking, including both the authorizing statute (general) and the statutes the rules are implementing (specific):

General Authority: A.R.S. §§ 49-104(A)(11) and 49-425

Specific Authority: A.R.S. §§ 49-414 and 414.01

3. A list of all previous notices appearing in the Register addressing the proposed rule:

Notice of Docket Opening: 9 A.A.R. 390, February 7, 2003

4. The name and address of agency personnel with whom persons may communicate regarding the rulemaking.

Name: Deborrah "Corky" Martinkovic

Address: ADEQ, Air Quality Planning Section, 1110 West Washington Street, Phoenix, AZ 85007

Telephone: (602) 771-2372 (Any extension may be reached in-state by dialing 1-800-234-5677, and asking for a specific number.)

Fax: (602) 771-2366

E-mail: martinkovic.deborrah@ev.state.az.us

5. <u>An explanation of the rule, including the agency's reasons for initiating the rule</u>:

Summary. This rule sets forth the process Arizona Department of Environmental Quality (ADEQ) will use to determine whether Best Available Retrofit Technology (BART) will be required for sources determined to be contributing to visibility impairment in a mandatory Federal Class I area. Federal regulations allow Federal Land Managers (FLMs) to certify sources defined in 40 CFR 51.301 as potential contributors to visibility impairment in any of the Arizona mandatory Federal Class I areas under Section 169A of the Clean Air Act (CAA).

Background. In 1977 Congress added a new section to the Clean Air Act - Section 169A, Visibility Protection for Federal Class I Areas - which established a national goal for, "the prevention of any future, and the remedying of any existing impairment of visibility in mandatory class I Federal areas which impairment results from man-made air pollution." In addition, the section required states to submit state implementation plans (SIPs) requiring best available retrofit technology (BART) for certain existing stationary sources found to cause or contribute to visibility impairment. On November 30, 1979, EPA promulgated a list of mandatory Federal Class I Areas (Class I areas) where visibility is an important value (44 FR 69122). There are 12 Class I areas identified in Arizona: Chiricahua National Monument Wilderness, Chiricahua Wilderness, Galiuro Wilderness, Grand Canyon National Park, Mazatzal Wilderness, Mount Baldy Wilderness, Petrified Forest National Park, Pine Mountain Wilderness, Saguaro Wilderness, Sierra Ancha Wilderness, Superstition Wilderness, and Sycamore Canyon Wilderness (40 CFR 81.403).

On December 2, 1980 (45 FR 80084), EPA defined the role of the FLMs in certifying visibility impairment in the mandatory Federal Class I areas. On November 24, 1987 (52 FR 45132), FLMs identified Petrified Forest National Park, Saguaro Wilderness, and Grand Canyon National Park, as having visibility impairment possibly attributable to stationary sources. Under the 1980 rule, if found to cause or contribute to the impairment, certain existing stationary sources operating in or near the identified Class I areas could be subject to BART (A list of sources eligible for the possible application of BART can be found at 40 CFR 51.301). On October 3, 1991, the Navajo Generating Station (NGS) was found by EPA to be causing or contributing to visibility impairment for the Grand Canyon National Park and eligible for BART (56 FR 50172). BART control analyses were subsequently performed by EPA, and other parties through related court actions. Under the 1980 rule, the federal expectation is that actions for determination of possible source attribution will be performed by the states. Therefore, Arizona needs to be prepared to proceed with an attribution analysis and assessment for the application of controls upon any determination of a BART eligible source being the possible cause or contributor to visibility impairment in a Class I area. This rule addresses that need.

Current Conditions. ADEQ is proposing that this rule apply to any source in existing stationary source categories identified in 40 CFR 51.301 that are operating in or near the mandatory federal Class I areas in Arizona. The source is an existing stationary facility that includes any reconstructed source that was not in operation prior to August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit 250 tons per year of any regulated pollutant. ADEQ estimates that there are potentially 10 such sources within Arizona. "In existence" is interpreted by EPA to be consistent with the term, "commence construction" found in Prevention of Serious Deterioration (PSD) regulations (40 CFR 51.165(a)(1)(xvi) and 40 CFR 52.21 (b)(9)). If construction commenced after August 7, 1977, the source would be subject to the PSD/NSR (new source review) program (the state regulations are found at 18 A.C.C. 2, Article 4). However, EPA also notes "that sources, are not BART eligible if the only change at the plant was the addition of pollution controls. For example, if the only change at a copper smelter during the 1962 through 1977 time period was the addition of acid plants for the reduction of SO_2 emissions, these emission controls would not themselves trigger a BART review."[1]

Under this proposed rule, ADEQ, when analyzing an attributable source for BART controls, must consider several factors including, for example, costs, remaining useful life of the source, and degree of improvement anticipated to result from the application of the controls (the factors are detailed in R18-2-1605). Sources required by ADEQ to install and operate BART controls have a final opportunity to request exemption from the requirement prior to the application of controls. This opportunity for a federal exemption from BART, is contained in R18-2-1606, and 40 CFR 51.303.

Summary. This rule outlines the process through which sources eligible for the application of BART will proceed if certified by the state of Arizona or an FLM as possibly causing or contributing to visibility impairment due to attribution. If found to be attributable for the impairment, a BART analysis will be performed to determine the level of controls necessary to remedy the impairment. This rule enables Arizona to fulfill the requirements of the Clean Air Act and the goal of section 169A of the Act to return the Nation's federal parks and wilderness areas to natural conditions.

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[1] EPA proposed rule, 66 Federal Register 38119, July 20, 2001.

Section-by-section Explanation for the Proposed Rule

R18-2-1601	This section lists the definitions that apply to this rule.
R18-2-1602	This section lists the Class I areas addressed by this rule for the applicable existing stationary facilities, as defined in R18-2-1601(2).
R18-2-1603	This section establishes the procedure for certification of impairment by either a Federal Land Manager with authority over a mandatory Federal Class I area, or the Director, should either believe there exists reasonably attributable visibility impairment in a Federal Class I area as listed in R18-2-1602.
R18-2-1604	This section establishes the procedure for an attribution analysis after certification of a source or group of sources as outlined in R18-2-1603. Upon completion of the attribution analysis, the procedure for the Director to issue draft and final attribution findings is outlined in R18-2-1604(C).
R18-2-1605	This section establishes the best available retrofit technology (BART) analysis procedure after a source is identified under R18-2-1604. Upon completion of the BART analysis, the procedure for the Director to issue draft and final BART findings, including alternatives to emission standards, is outlined in R18-2-1605(B) and (C), respectively. The specific conditions where BART would be satisfied due to past or planned actions by the facility are outlined in R18-2-1605(D). EPA determinations regarding new technology that might require a BART analysis for an applicable source, regardless of a source or small group of sources previously being certified and found attributable, are covered in R18-2-1605(E).
R18-2-1606	This section establishes the procedures for obtaining a federal exemption from a BART requirement.

6. **A reference to any study relevant to the rule that the agency proposes to rely on in its evaluation of or justification for the proposed rule or proposes not to rely on in its evaluation of or justification for the rule, where the public may obtain or review each study, all data underlying each study, and any analysis of each study and other supporting material:**

Not Applicable

7. **A showing of good cause why the rule is necessary to promote a statewide interest if the rule will diminish a previous grant of authority of a political subdivision of this state:**

Not applicable

8. **The preliminary summary of the economic, small business, and consumer impact:**

A. Rule Identification

These rules would amend R18-2-101 ("visibility impairment" definition) and add new sections R18-2-1601 through R18-2-1606. For sources under ADEQ jurisdiction, the rules would take the place of federal regulations that currently govern this area.

B. Entities Directly Impacted

1. Federal Land Managers. Proposed R18-2-1603 would allow Federal Land Managers (FLMs) to certify visibility impairment in mandatory Class I areas. This is already allowed by federal rule. Under R18-2-1601 of the proposed rule, the FLMs able to certify impairment in Arizona are with the United States Forest Service and the National Park Service. There are no FLMs in Arizona from the United States Fish and Wildlife Service, because this agency does not have jurisdiction over any of Arizona's mandatory federal Class I areas.

2. ADEQ. Proposed R18-2-1604 would require ADEQ to identify stationary sources that could cause or contribute to the certified visibility impairment. This function is currently carried out by EPA. Proposed R18-2-1605 would require ADEQ to analyze for BART (best available retrofit technology) controls those sources identified as causing or contributing to visibility impairment. This function is currently carried out by EPA. The impact of this rule on ADEQ would primarily be on the Air Quality Division, Permits and Assessment sections.

3. Stationary sources. Proposed R18-2-1605 would also require stationary sources identified in #2 to install or operate the BART as determined by the Director. Currently, EPA determines and requires BART. To determine impacted stationary sources, ADEQ staff reviewed Title V permits from ADEQ's Air Permit files. Of the 26 industry categories listed in 40 CFR 51.301, only five categories were found to exist under ADEQ's jurisdiction: steam electric plants, cement plants, primary copper smelters, lime plants, and industries using non-utility boilers. As a result, potentially 10 sources, representing 16 BART eligible units (boilers and kilns), could be affected by this proposed rule. The combined potential to emit

from these sources totaled 94,287 tons per year for NO_x, 141,036 tons per year for SO_2, and 12,146 tons per year for PM. The combined potential to emit for all pollutants for these 10 sources total approximately 250,000 tons per year.

C. Probable Costs and Benefits Associated with the BART/Visibility Impairment Process

1. Direct Costs - FLMs: FLM activities to certify visibility impairment in mandatory Class I areas may involve preparation and analysis of monitoring data, emission inventories, meteorological records, etc. ADEQ estimates that this cost per certification could be as much as $50,000 if extensive analysis is conducted. These costs exist whether or not these proposed rules become final.

2. Direct Costs - ADEQ: ADEQ costs related to identifying whether a BART eligible stationary source causes or contributes to visibility impairment in Class I areas are based on the activities identified in R18-2-1604(A). ADEQ estimates that these costs could range from $100,000 – 200,000 per attribution analysis, and be primarily borne by the ADEQ's Air Quality Assessment Section. Costs related to analyzing identified sources for BART are based on the activities identified in proposed R18-2-1605(A) and will be moderate, but less expensive than the attribution analysis. These costs will be primarily born by the Permits Section. These costs would not accrue to the State unless the proposed rule becomes final. Finally, incorporating BART into an existing State air quality permit may require additional resources from the Permits Section. However, these costs, unlike costs for the attribution and BART analysis, would be covered by permit revision fees paid by the source, and would exist whether or not these proposed rules become final.

3. Direct Costs - Stationary sources: If a source or small group of sources is found to cause or contribute to visibility impairment, and the BART determination requires installation of retrofit controls, costs to sources required to install BART would be substantial. The total cost to install a technology similar to BART at the Navajo Generating Station was estimated by SRP to be in the hundreds of millions of dollars (51 Federal Register 50172, October 3, 1991). However, the example of the Navajo Generating Station shows costs to install technology similar to BART can result even where there is no state rule. According to EPA, "Where a State defaults on its obligations under the visibility regulations, EPA may act in place of the State pursuant to a FIP under section 110(c) of the Act, 42 U.S.C. 7410(c)[2], and promulgate such limitation and measures as are required to achieve reasonable progress."(Ibid. at 50173, footnote not included). Although ADEQ is listing these costs for information purposes, ADEQ is not attributing any costs to install and operate BART to this rule because such requirements can be imposed by the federal government without any State rule.

Benefits. Two kinds of benefits are associated with this proposed rule. The first is reduced emissions. Although, BART could be required to be installed on sources even without this state rule, it is helpful to list the emission benefits. When BART is installed, visibility is improved. Over 4 million recreation visits were made to Grand Canyon National Park in FY 2001. These visits generate substantial revenue in and for the state of Arizona. Other scenic resources that could also be improved with the installation of BART, and, though less significant than the Grand Canyon, would enhance the tourism resources of Arizona, as well as the quality of life for Arizona citizens. In addition, reduction of visibility-impairing emissions also has health benefits.

The second benefit is replacement of federal regulation with state regulation. The lack of state regulations implementing BART results in Arizona sources being subject to federal regulation implemented by EPA from Washington and San Francisco. These proposed rules would place the identification and analysis of BART sources at ADEQ rather than with EPA. Arizona is currently under a visibility Federal Implementation Plan (FIP), and one or two sources have considered or implemented technology similar to BART under federal rules. Because ADEQ already permits many of these sources, ADEQ is more familiar with the various factors that go into the BART analysis. This would be a benefit to sources being regulated. ADEQ would be implementing the same BART rules that EPA does.

The rule further allows ADEQ to proceed with the implementation of the entire federal rule for visibility improvement. The proposed rule addresses the requirements of 40 C.F.R. §§51.302 – 307. These sections must be satisfied before ADEQ can implement the requirements of 40 C.F.R. §§51-308 and 309. The plan to implement Section 309 must be submitted to EPA by December 31, 2003.

D. Small Business Analysis

A.R.S. §41-1055(B)(5) requires agencies to state the probable impact of a rulemaking on small businesses. A.R.S. §41-1035 requires agencies to reduce the impact of a rule on small businesses by using certain methods when they are legal and feasible in meeting the statutory objectives for the rule making. These methods include: (1) exempting them from any or all rule requirements, (2) establishing performance standards which would replace any design or operational standards, or (3) instituting reduced compliance or reporting requirements. An agency may accomplish the third method by establishing less stringent requirements, consolidating or simplifying requirements, or setting less stringent schedules or deadlines.

"Small business" is defined in A.R.S. §41-1001 as "a concern, including its affiliates, which is independently owned and operated, which is not dominant in its field and which employs fewer than one hundred full-time employees or which had gross annual receipts of less than four million dollars in its last fiscal year." Interpreting this definition means that if a concern has annual gross receipts of more than four million dollars, but fewer than 100 employees, it would not be classified as a small business.

ADEQ expects that none of the potential BART eligible sources would be classified as a small business. A preliminary conclusion is that this proposed rule will not impact other small businesses. However, if a BART eligible source would qualify as a small business, ADEQ is unable to establish different requirements for small businesses. Except for applying for an exemption, as mentioned under "Alternative Methods," ADEQ cannot establish less stringent requirements or exemptions for small businesses, or any BART eligible source.

ADEQ requests comment and additional information relating to any of the conclusions reached in this preliminary EIS.

9. The name and address of agency personnel with whom persons may communicate regarding the accuracy of the economic, small business, and consumer impact statement:

Name: David Lillie

Address: ADEQ, Air Quality Planning Section, 1110 West Washington, Phoenix, AZ 85007

Telephone: (602) 771-4461 (Any extension may be reached in-state by dialing 1-800-234-5677, and asking for a specific number.)

Fax: (602) 771-2366

E-mail: Lillie.David@ev.state.az.us

10. The time, place, and nature of the proceedings for the making, amendment, or repeal of the rule or, if no proceeding is scheduled, where, when and how persons may request an oral proceeding on the proposed rule:

Date: April 7, 2003

Time: 4:30 p.m.

Location: Coconino Library, 300 W. Aspen, Flagstaff, AZ

Date: April 8, 2003

Time: 4:30 p.m.

Location: ADEQ, 1110 W. Washington St, Rm 145, Phoenix, AZ

Date: April 9, 2003

Time: 4:30 p.m.

Location: State Office Building, 400 W. Congress, Rm 158, Tucson, AZ

Nature: Oral Proceedings with opportunity for formal comments on the record

Close of Comment: 5:00 p.m., April 11, 2003

11. <u>Any other matters prescribed by statute that are applicable to the specific agency or to any specific rule or class of rules</u>:

Not applicable

12. <u>Incorporation by reference and their location in the rule</u>:

Not applicable

13. <u>The full text of the rule follows:</u>

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY

AIR POLLUTION CONTROL

ARTICLE 1. GENERAL

Section

ARTICLE 16. VISIBILITY; REGIONAL HAZE

Section

ARTICLE 1. GENERAL

R18-2-101. Definitions

In addition to the definitions prescribed in A.R.S. §§ 49-101, 49-401.01, 49-421, 49-471, and 49-541, in this Chapter, unless otherwise specified:

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123. "Visibility impairment" means any humanly perceptible change in visibility (light extinction, visual range, contrast, and coloration) from that which would have existed under natural conditions.

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ARTICLE 16. VISIBILITY; REGIONAL HAZE

R18-2-1601. Definitions

In addition to the definitions contained in Articles 1 and 4 of this Chapter and A.R.S. § 49-401.01, the following definitions apply to this Article:

1. "Best available retrofit technology (BART)" means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant that is emitted by an existing stationary facility. The emission limitation is established on a case-by-case basis in accordance with R18-2-1605.
2. "Existing stationary facility" means any of the following stationary sources of air pollutants, including any reconstructed source, which was not in operation prior to August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit 250 tons per year or more of any air pollutant. In determining potential to emit, fugitive emissions, to the extent quantifiable, must be counted.
   a. Fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour heat input,
   b. Coal cleaning plants (thermal dryers),
   c. Kraft pulp mills,
   d. Portland cement plants,
   e. Primary zinc smelters,
   f. Iron and steel mill plants,
   g. Primary aluminum ore reduction plants,
   h. Primary copper smelters,
   i. Municipal incinerators capable of charging more than 250 tons of refuse per day,
   j. Hydrofluoric, sulfuric, and nitric acid plants,
   k. Petroleum refineries,
   l. Lime plants,
   m. Phosphate rock processing plants,
   n. Coke oven batteries,
   o. Sulfur recovery plants,
   p. Carbon black plants (furnace process),
   q. Primary lead smelters,
   r. Fuel conversion plants,
   s. Sintering plants,
   t. Secondary metal production facilities,
   u. Chemical process plants,
   v. Fossil-fuel boilers of more than 250 million British thermal units per hour heat input,

w. Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels,

x. Taconite ore processing facilities,

y. Glass fiber processing plants, and

z. Charcoal production facilities.

3. "Federal Land Manager" means the Secretary of the department, or the Secretary's designee, with authority over the Federal Class I area.

4. "Mandatory Federal Class I Area" means any area identified in 40 CFR §§81.400-81.436.

5. "Reasonably attributable" means ascribable by visual observation or other techniques the Director deems appropriate.

6. "Reasonably attributable visibility impairment" means visibility impairment that is caused by the emission of air pollutants from one source, or a small group of sources.

R18-2-1602. Applicability

This Article applies to any existing stationary source located in the state that may reasonably be anticipated to cause or contribute to visibility impairment in any mandatory Federal Class I area identified in 40 CFR §§81.401-81.436. Mandatory Federal Class I areas within Arizona are: Chiricahua National Monument Wilderness, Chiricahua Wilderness, Galiuro Wilderness, Grand Canyon National Park, Mazatzal Wilderness, Mount Baldy Wilderness, Petrified Forest National Park, Pine Mountain Wilderness, Saguaro Wilderness, Sierra Ancha Wilderness, Superstition Wilderness, and Sycamore Canyon Wilderness.

R18-2-1603. Certification of Impairment

A. A Federal Land Manager with authority over a mandatory Federal Class I area may certify to the Director, at any time, that there exists reasonably attributable visibility impairment in the mandatory Federal Class I area. The Director may also certify that there exists reasonably attributable visibility impairment in any mandatory Federal Class I area as necessary to assure reasonable progress under section 169A(b)(2) of the Clean Air Act.

B. Documentation from the affected Federal Land Manager or Director shall include:

1. The mandatory Federal Class I area for which visibility impairment is being certified,
2. Any information documenting the basis for the certification of impairment.

R18-2-1604. Attribution Analysis; Finding

A. Upon certification of reasonably attributable visibility impairment in any mandatory Federal

Class I area, the Director shall conduct an attribution analysis to identify each existing stationary source that may be reasonably anticipated to cause or contribute to visibility impairment. The Director shall notify the Federal Land Manager, affected source or small group of sources, and local air pollution control officer of the intent to conduct an attribution analysis. The attribution analysis shall be based on the following:

1. Monitoring information obtained through the Arizona Class I Visibility Monitoring Network or special studies approved by ADEQ to ascertain:
    a. The times visibility impairment occurred, and
    b. The pollutants contributing to the visibility impairment.
2. Transport analysis or air quality modeling based upon meteorological records to ascertain whether the pollutants were transported to the mandatory Federal Class I area.
3. Other available studies, modeling analysis, and emissions inventories of point, area and mobile source emissions to ascertain:
    a. The pollutant or pollutants causing the impairment, and
    b. The source, or small group of sources, emitting the impairing pollutant or pollutants.
4. Other relevant supporting documentation provided by the Federal Land Manager or Director used to make the draft attribution analysis finding.
5. Consideration of any documentation provided by the source or small group of sources.

B. In conducting the attribution analysis, the Director shall use monitoring information, meteorological records, and emissions inventories that represent times and locations reasonably concurrent with the visibility impairment.

C. The Director shall issue a draft attribution finding that impairment has or has not occurred, and provide public notice of the draft attribution finding. The Director shall publish notice of the draft attribution finding in a newspaper of general circulation in each county containing the mandatory Federal Class I area and the affected source. The Director shall provide at least 30 days from the date of the notice for public comment. Written comments to the Director shall include the name of the person and the person's agent or attorney, if any, and shall clearly set forth reasons why the draft attribution finding should be reviewed. A final attribution finding shall be issued after the public comment period. Existing stationary sources found to cause or contribute to visibility impairment in a mandatory Federal Class I area shall be subject to a BART Control Analysis under R18-2-1605.

R18-2-1605. BART Control Analysis; Finding

A. The Director shall analyze for BART controls each existing stationary source for which a final attribution finding is made under R18-2-1604(C). The Director shall consider the following factors:

1. Available control technology;
2. New source performance standards (NSPS) as adopted in Article 9;
3. Alternative control systems if retrofitting to comply with applicable NSPS standards adopted in Article 9 is found infeasible.
4. Cost of compliance;
5. Energy and non-air quality environmental impacts of compliance;
6. Existing pollution control technology in use at the source or small group of sources;
7. Remaining useful life of the source or small group of sources;
8. Net environmental impact associated with the proposed emission control system;
9. Economic impacts associated with installing and operating the proposed emission control system; and
10. Degree of improvement in visibility anticipated to result from application of the proposed emission control system.

B. The Director shall issue a draft BART finding, and provide public notice of the draft BART finding. The Director shall publish notice of the draft BART finding in a newspaper of general circulation in each county containing the mandatory Federal Class I area and the affected source. The Director shall provide at least 30 days from the date of the notice for public comment. Written comments to the Director shall include the name of the person and the person's agent or attorney, and shall clearly set forth reasons why the draft BART finding should be reviewed. The Director shall issue a final BART finding after the public comment period.

1. The Director shall submit each final BART finding that an existing stationary source is required to meet BART to the Administrator as a revision to the state implementation plan (SIP).
2. The Director shall require that each existing stationary source meet BART as expeditiously as practicable but in no case later than five years after EPA approval of the revision to Arizona's State Implementation Plan.

C. If the Director determines that technological or economic limitations on the applicability of measurement methodology to a particular existing stationary source would make the imposition of an emission standard infeasible, the Director may, as part of the finding under subsection (B), instead prescribe a design, equipment, work practice, or other operational standard, or combination thereof. Such standard, to the degree possible, is to set forth the emission reduction to be achieved by implementation of such design, equipment, work practice or operation, and must provide for compliance by means which achieve equivalent results.

D. The Director shall make a finding that the attributable source has satisfied the BART requirement if the attributable source has:

1. Voluntarily applied best available retrofit technology;
2. Previously applied emission control standards equivalent to BART; or
3. Agreed to shutdown or curtail operations at the attributable source within 5 years of the finding. An attributable source that does not shutdown or curtail operations shall proceed to meet BART as expeditiously as practicable, but in no case later than five years after EPA's approval of the revision to Arizona's State Implementation Plan.

E. If the Director determines that the imposition of BART or a standard pursuant to subsection C of this section is not feasible at the time of the finding, the attributable source shall be required to install and operate BART upon a determination by the Director at a later date that BART or equivalent controls are now feasible.

F. The Director shall provide for a BART control analysis of any existing stationary source that might cause or contribute to impairment of visibility in any mandatory Federal Class I area identified under this Article at such times, as determined by the Administrator, new technology for control of the pollutant becomes reasonably available, if:

1. The pollutant is emitted by that existing stationary source,
2. Controls representing BART for the pollutant have not previously been required under this Article, and
3. The impairment of visibility in any mandatory Federal Class I area is reasonably attributable to the emissions of that pollutant.

R18-2-1606. Exemption from BART

Any existing stationary source required to install, operate, and maintain BART pursuant to this Article, may apply to the Administrator for an exemption from that requirement by obtaining prior written concurrence from the Director according to 40 CFR 51.303.

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Janet Napolitano
Governor

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

AIR QUALITY DIVISION

PUBLIC HEARING
on
PROPOSED REASONABLY ATTRIBUTABLE VISIBILITY IMPAIRMENT RULE

PLEASE NOTE THE MEETING LOCATION AND TIME:

Coconino Public Library
300 W. Aspen, Flagstaff, AZ
Monday, April 7, 2003, 4:30 p.m.

Pursuant to ARS § 49-425 for air quality rule hearings, notice is hereby given that the above referenced meeting is open to the public. Copies of the proposal are available for review locally at the Coconino Public Library and the Arizona Department of Environmental Quality Library, 1110 W. Washington Street, Phoenix, Arizona.

AGENDA

1. Welcome and Introductions
2. Purposes of the Oral Proceeding
3. Procedure for Making Public Comment
4. Brief Overview of the Proposed Reasonably Attributable Visibility Impairment Rule
5. Question and Answer Period
6. Oral Comment Period
7. Adjournment of Oral Proceeding

For additional information regarding the hearing, please call Corky Martinkovic, ADEQ Air Quality Division, at (602) 771-2372] or 1-800-234-5677, Ext. 771-2372. Persons with a disability may request a reasonable accommodation, such as a sign language interpreter, by contacting Katie Huebner at (602) 771-4794 or 1-800-234-5677, Ext. 771-4794. Requests should be made as early as possible to allow sufficient time to make the arrangements for the accommodation. This document is available in alternative formats by contacting ADEQ TDD phone number at (602) 771-4829**.**

Arizona Department of Environmental Quality
Air Quality Division

Please Sign In

PUBLIC HEARING FOR

SUBJECT REASONABLY ATTRIBUTABLE VISIBILITY IMPAIRMENT RULE DATE 4-7-03 (FLAGSTAFF)

	NAME	ORGANIZATION	PHONE	FAX	E-MAIL
1.	Carl Bowman	National Park Service	928-638-7817	928-638-7757	carl_bowman@nps.gov
2.					
3.					
4.					
5.					
6.					
7.					
8.					

P U B L I C   H E A R I N G   04 /07 /03

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALTIY

IN THE MATTER OF ARIZONA'S
PROPOSED REASONABLY ATTRIBUTABE
VISIBILITY IMPAIRMENT RULE.

PUBLIC HEARING

At: Flagstaff, Arizona

Date: April 7, 2003

NOTE: Due to circumstances beyond ADEQ's control, the official transcript for this public hearing is not available. The hearing did follow verbatim the text of the public hearing officer script; therefore, that script has been included here along with a copy of the one comment read into the record.

Proposed Reasonably Attributable Visibility Impairment Rule

Oral Proceeding
Hearing Officer Script

April 7, 2003

I now open this oral proceeding. Good afternoon, thank you for coming. This oral proceeding is on the proposed Reasonably Attributable Visibility Impairment Rule. This is a proposed rule to direct the State of Arizona and affected permitted stationary sources on the procedures should a Federal Land Manager certify that any one of these sources or small group of sources have emissions that may cause or contribute to the reduction of visibility at specific national parks or wilderness areas in Arizona or adjacent states.

It is now Monday, April 7, 2003, 4:30 [ ] p.m. The location is Coconino Library, 300 W. Aspen, Flagstaff, Arizona.

My name is Cathy O'Connell and I have been appointed by the Director of the Arizona Department of Environmental Quality to preside at this proceeding.

The purposes of this proceeding are to provide the public an opportunity:
(1) to hear about the substance of the proposed rule,
(2) to ask questions regarding the proposed rule, and
(3) to present oral argument, data and views regarding the proposed rule in the form of comments on the record.

Representing the Department are myself and Ms. Corky Martinkovic of the Air Quality Planning Section.

The procedure for making a public comment on the record is straightforward. If you wish to comment, you need to fill out a speaker slip, which is available at the sign-in table, and give it to me. Using speaker slips allows everyone an opportunity to be heard and allows us to match the name on the official record with the comments.

You may also submit written comments to me today in person or by mail, e-mail, or fax to Corky Martinkovic by the end of the comment period. The end of the comment period is 5:00 p.m. on Friday, April 11, 2003. If mailed, e-mailed, or faxed, written comments must be "postmarked" no later than April 11, 2003. Submit your written comments to:

Corky Martinkovic
Air Quality Planning Section
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, Arizona 85007
Fax: (602) 771-2366
E-Mail: martinkovic.deborrah@ev.state.az.us

Comments made during the formal comment period are required by law to be considered by the Department in the preparation of the final rulemaking. This is done through the preparation of a concise explanatory statement in which the Department responds in writing to written and oral comments made during the formal comment period.

The agenda for this hearing is simple. First, I will present a brief overview of the proposed rule.

Next, I will conduct a question and answer period. The purpose of the question and answer period is to provide information that may help you in making comments on the rule.

Thirdly, I will conduct the oral comment period. At that time, I will begin to call speakers in the order that I have received speaker slips.

Please be aware that any comments you make at today's hearing that you want the Department to formally consider must be given either in writing or on the record during the oral comment period of this proceeding.

* * * * *

At this time, I [(or)] will give a brief overview of the proposed rule.

The Reasonably Attributable Visibility Impairment Rule, or RAVI for short, will, upon approval, become a new section in the environmental chapter of the Arizona Administrative Code. States are required to adopt this rule under Federal regulations.

The rule addresses a specific type of air pollution that can reduce visibility in national parks and wilderness areas. This type of pollution is a type of air pollution that can be traced to a certain type of existing stationary source. When a source has this type of air pollution traced directly to their operations, they are said to be “reasonably attributable” for that type of pollution.

For the purposes of this rule, this type of pollution originates from a specific type of existing stationary source operating in or near federal national parks and wilderness areas, known formally as federal mandatory Class I areas. Arizona has 12 of these Class I areas. These national parks and wilderness areas are managed by Federal Land Managers. Federal Land Managers are able to “certify” for the national park or wilderness area for which they have jurisdiction that there exists a reduction in visibility. They can document the reduction in visibility they observe in the park or wilderness area, and then complete a formal report certifying impairment of visibility.

Once the State of Arizona receives a certification of visibility impairment from a Federal Land Manager, under the proposed rule, the State would determine if the source is one of the type of stationary sources covered by the rule. Then the State of Arizona would analyze if that source is in fact causing or contributing to the reduction in visibility, or in the words of the rule, is “reasonably attributable.”

If the source is eligible for emission controls and found to be attributable for the reduction in visibility, under the proposed rule, the State of Arizona would then proceed with an analysis for the application and operation of emission controls for that source’s air emissions. The emission controls applied under this rule are known as Best Available Retrofit Technology, or BART. BART is applied to existing stationary sources that are too old to operate under what is termed, New Source Performance Standards, and yet emit 250 or more tons per year of air pollutants that impair visibility.

Along with outlining the procedures for the BART control analysis of the attributable source, the proposed rule points to options for a source to pursue equivalent or better alternatives, or apply for a federal- level exemption.

This concludes the explanation period of this proceeding on the proposed rule.

* * * * *

Are there any questions before we move to the oral comment period?

[If there are questions, introduce appropriate staff as the Department's representative to respond to any questions.]

[or, "Hearing none, ..."]

This concludes the question and answer period of this proceeding on the proposed rule.

* * * * *

I now open this proceeding for oral comments.

[Call speakers in the order in which they submitted their speaker's slips; if there are many speakers present, you may limit each speaker's time to speak.]

[or, "Seeing no speaker slips, ...]

This concludes the oral comment period of this proceeding.

* * * * *

I encourage everyone to submit written comments on the proposed rule. Your participation is an essential part of the rulemaking process. Again, you may also submit written comments by mail, e-mail, or fax to Corky Martinkovic by the end of the comment period. The end of the comment period is 5:00 p.m. on Friday, April 11, 2003. If mailed, e-mailed, or faxed, written comments must be "postmarked" no later than April 11, 2003. Submit your written comments to:

Corky Martinkovic
Air Quality Planning Section
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, Arizona 85007
Fax: (602) 771-2366
E-Mail: martinkovic.deborrah@ev.state.az.us

Thank you for attending.

The time is now __________. I now close this oral proceeding.

Arizona Department of Environmental Quality
Air Quality Division

SPEAKER SLIP

Date: April 7, 2003 Speaker Slip No. 1

Name: Carl Bowman

Representing: National Park Service

Mailing Address: P.O. Box 129, Grand Canyon, AZ 86023

[X] I wish to make an oral statement.

[ ] I have submitted written comments.

[ ] I will submit written comments at a later time.

Subject: Carl B Bowman

Oral Remarks, April 7, 2003

I am Carl Bowman, Air Quality Specialist at Grand Canyon National Park, and am here representing the National Park Service. Our agency has participated in workshops to develop the proposed "Reasonably Attributable Visibility Impairment (or "RAVI") Rule since June of 2000. The rule as proposed today addresses a key resource issue by helping to protect and improve the magnificent vistas in Arizona's Class I parks and wilderness areas. There is no substitute for seeing clearly the rugged beauty of the Grand Canyon, the vibrant colors of the Painted Desert, or the beauty of the other Parks and Wilderness Areas that stand to benefit from this proposal. We believe the proposed rule not only meets the requirements of the Clean Air Act in protecting clear air from specific sources of air pollution, but will also assist the State of Arizona in evaluating and remedying specific pollution sources found to affect these areas.

As participants in the State's process to develop the proposed RAVI Rule, we also appreciate the diligence shown by the Department of Environmental Quality in reaching out to all potentially affected parties and in the open process used to develop the proposed Rule. Such stakeholder processes may take longer and be more cumbersome, but they do allow ample opportunities to gather comments, concerns and support from a wide spectrum of viewpoints, and thus, to craft a more complete and acceptable package.

The effort to preserve and restore visibility in Arizona's twelve Class I Parks and Wilderness Areas will require efforts on many fronts. We know that voluntary commitments have already been made in Arizona and other western states through the regional haze process, including the work of the Grand Canyon Visibility Transport Commission and the Western Regional Air Partnership. Once incorporated into a state regional haze rule, we can hope these commitments will be sufficient to make the goal of natural visibility conditions possible. At the same time, we realize that other tools, like the RAVI Rule, may be necessary on occasion, to address specific concerns. Together, we believe the various existing air programs, today's Proposal, and the regional haze work in progress will move us toward our clear air goal.

Thank you.

Arizona Department of Environmental Quality
Air Quality Division

Public Hearing Presiding Officer Certification

I, Cathy O'Connell, the designated Presiding Officer, do hereby certify that the public hearing held by the Arizona Department of Environmental Quality was conducted on April 7, 2003, in the Coconino Public Library, Flagstaff, Arizona, in accordance with public notice requirements by publication in Arizona Administrative Register and other locations beginning March 7, 2003. Furthermore, I do hereby certify that the public hearing was recorded from the opening of the public record through concluding remarks and adjournment, and the transcript provided contains a full, true, and correct record of the above-referenced public hearing.

Dated this 7th day of April 2003.

Cathy O'Connell
[NAME OF PRESIDING OFFICER]

State of Arizona)
) ss.
County of Maricopa)

Subscribed and sworn to before me by ________________ this 7 day of April 2003

Laura McFarland
Notary Public

Notary Public State of Arizona
Maricopa County
Laura McFarland
Expires April 02, 2004

My commission expires:

April 02, 2004

Janet Napolitano
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

AIR QUALITY DIVISION

PUBLIC HEARING
on
PROPOSED REASONABLY ATTRIBUTABLE VISIBILITY IMPAIRMENT RULE

PLEASE NOTE THE MEETING LOCATION AND TIME:
Arizona Department of Environmental Quality, Room 145
1110 W. Washington Street, Phoenix, AZ
Tuesday, April 8, 2003, 4:30 p.m.

Pursuant to ARS § 49-425 for air quality rule hearings, notice is hereby given that the above referenced meeting is open to the public. Copies of the proposal are available for review at the Arizona Department of Environmental Quality Library, 1110 W. Washington Street, Phoenix, Arizona.

AGENDA

1. Welcome and Introductions
2. Purposes of the Oral Proceeding
3. Procedure for Making Public Comment
4. Brief Overview of the Proposed Reasonably Attributable Visibility Impairment Rule
5. Question and Answer Period
6. Oral Comment Period
7. Adjournment of Oral Proceeding

For additional information regarding the hearing, please call Corky Martinkovic, ADEQ Air Quality Division, at (602) 771-2372] or 1-800-234-5677, Ext. 771-2372. Persons with a disability may request a reasonable accommodation, such as a sign language interpreter, by contacting Katie Huebner at (602) 771-4794 or 1-800-234-5677, Ext. 771-4794. Requests should be made as early as possible to allow sufficient time to make the arrangements for the accommodation. This document is available in alternative formats by contacting ADEQ TDD phone number at (602) 771-4829**.**

Arizona Department of Environmental Quality
Air Quality Division

Please Sign In

PUBLIC HEARING
RAVI RULE
PHX.

PROPOSED RULE:

SUBJECT REASONABLY ATTRIBUTABLE VISIBILITY IMPAIRMENT (RAVI) DATE 4-8-03

	NAME	ORGANIZATION	PHONE	FAX	E-MAIL
1.	Byron James	ADEQ-Community Liaison	(928) 337-3515	(928) 337-3506	bj@ev.state.az.us
2.	Jerry Geering	Thornwood Furn.	602 2440434	602 3061455	
3.					
4.					
5.					
6.					
7.					
8.					

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

PROPOSED REASONABLY ATTRIBUTABLE VISIBILITY IMPAIRMENT RULE

ORAL PROCEEDING

REPORTER'S TRANSCRIPT OF PROCEEDINGS

Phoenix, Arizona
April 8, 2003
4:45 p.m. - 4:55 p.m.

ARIZONA REPORTING SERVICE, INC.
Court Reporting
Suite Three
2627 North Third Street
Phoenix, Arizona 85004-1103

BY: DAWNA J. BOSWELL, RPR
Certified Court Reporter
Certificate No. 50326

Prepared for:

ADEQ

CERTIFIED COPY
(When in red)

PROPOSED REASONABLY ATTRIBUTABLE VISIBILITY
IMPAIRMENT RULE ORAL PROCEEDING

taken on April 8, 2003, commencing at 4:45 p.m., at the offices of the Arizona Department of Environmental Quality, 1110 West Washington Street, Room 145, Phoenix, Arizona, before DAWNA J. BOSWELL, Certified Court Reporter No. 50326 for the State of Arizona.

BEFORE: MR. SEAN P. McCABE, Hearing Officer

APPEARANCES:

For Arizona Department of Environmental Quality:

Ms. Deborrah "Corky" Martinkovic
Air Quality Division
1110 West Washington Street
Phoenix, Arizona 85007

HRG. OFF. McCABE: I now open this Oral Proceeding. Good afternoon, and thank you for coming.

This Oral Proceeding relates to the Reasonably Attributable Visibility Impairment Rule proposed by the Arizona Department of Environmental Quality and published in the Arizona Administrative Register on March 7, 2003, Volume 9, Issue 10, page 763. This rule, if it becomes effective, would direct the State of Arizona and affected permitted stationary sources on the procedures to follow in the event that a Federal Land Manager certifies that any one of these sources or a small group of sources have emissions that may cause or contribute to the reduction of visibility at specific national parks or wilderness areas in Arizona or adjacent states.

This is Tuesday, April 8th, 2003, at 4:45 p.m. We are located in Room 145, Arizona Department of Environmental Quality, 1110 West Washington Street, Phoenix, Arizona. My name is Sean McCabe, and I have been appointed by the Director of the Arizona Department of Environmental Quality to preside at this hearing.

The purposes of this proceeding are to provide the public an opportunity, one, to hear about the substance of the proposed rule; two, to ask questions regarding the proposed rule; and three, to present oral argument, data and views regarding the proposed rule in the form of comments on the record.

Representing the Department are myself, and Ms. Corky Martinkovic of the Air Planning Quality Section.

The procedure for making a public comment on the record is straightforward. If you wish to comment, you need to fill out a speaker slip which is available at the sign-in table and give it to me. Using speaker slips allows everyone an opportunity to be heard and allows us to match the name on the official record with the comments.

You may also submit written comments to me today in person or by mail, e-mail, or fax to Corky Martinkovic by the end of the comment period. The end of the comment period is 5:00 p.m. on Friday, April 11th, 2003. If mailed, e-mailed, or faxed, written comments must be postmarked no later than April 11, 2003.

Submit your written comments to Corky Martinkovic, Air Quality Planning Section, Arizona Department of Environmental Quality, 1110 West Washington Street, Phoenix, Arizona, 85007.

The fax number is (602) 771-2366, and the e-mail is martinkovic.deborrah@ev.state.az.us.

Comments made during the formal comment period are required by law to be considered by the Department in the preparation of the final rulemaking. This is done through the preparation of a concise explanatory statement in which the Department responds in writing to written and oral comments made during the formal comment period.

The agenda for this hearing is simple. First, I will present a brief overview of the proposed rule. Next, I will conduct a question and answer period, the purpose of which is to provide information that may help you in making comments on the rule. Thirdly, I will conduct the oral comment period. At that time, I will call any speakers in the order in which I have received speaker slips.

Please be aware that any comments you make at today's hearing that you want the Department to formally consider must be given either in writing or on the record during the oral comment period of this proceeding.

At this time, I will give a brief overview of the proposed rule.

The Reasonably Attributable Visibility Impairment Rule, or RAVI rule for short, will upon approval become a new section in the environmental chapter of the Arizona Administrative Code. States are required to adopt this rule under federal regulations.

The rule addresses a specific type of air pollution that can reduce visibility in national parks and wilderness areas. This type of pollution is a type of air pollution that can be traced to certain types of existing stationary sources. When a source has this type of air pollution traced directly to their operations, they are said to be "reasonably attributable" for that type of pollution.

For the purposes of this rule, this type of pollution originates from a specific type of existing stationary source operating in or near federal national parks and wilderness areas known formally as federal mandatory Class I areas. Arizona has 12 of these Class I areas. These national parks and wilderness areas are managed by Federal Land Managers. Federal Land Managers are able to certify whether the national park or wilderness area for which they have jurisdiction that there exists a reduction in visibility. They can document the reduction in visibility they observe in the park or wilderness area and then complete a formal report certifying impairment of visibility.

Once the State of Arizona receives the certification of visibility impairment from a Federal Land Manager, under the proposed rule, the State will determine if the source is one of the type of stationary sources covered by the rule. Then the State of Arizona will analyze if that source is in fact causing or contributing to the reduction of visibility, or in the words of the rule, is reasonably attributable.

If the source is eligible for emissions controls and found to be attributable for the reduction in visibility, under the proposed rule, the State of Arizona would then proceed with an analysis for the application and operation of emission controls for that source's air emissions. The emission controls applied under this rule are known as Best Available Retrofit Technology or BART. BART is applicable to existing stationary sources that are too old to operate under what is termed New Source Performance Standards and yet emit 250 or more tons per year of air pollutants that impair visibility.

Along with outlining the procedures for the BART control analysis of the attributable source, the proposed rule points to options for a source to pursue equivalent or better alternatives or apply for a federal level exemption.

This concludes the explanation period of this rulemaking, and I would like to ask if there are any questions before we move on to the oral comment period.

MR. GEERING: I just had a question about what the definition of that in or near is. Obviously in, but near --

MS. MARTINKOVIC: Generally there's a 50 kilometer, I believe that translates to 30-mile buffer that goes around each Class I area. That's considered to be a near area impact.

MR. GEERING: And then the pollutants that affect visibility being like PM-10?

MS. MARTINKOVIC: Yes, and Nox, and sulfur, SO2.

HRG. OFF. McCABE: The comment is by Jerry Geering, Thornwood Furniture, and answered by Corky Martinkovic.

Are there any other questions?

I now open -- go ahead.

MR. GEERING: We have this nonverbal communication here.

HRG. OFF. McCABE: Yes.

MR. GEERING: Record that nonverbal communication.

In reading through this, it says that you guys looked at the list of things that the EPA regulates, the industries, and then of those you found 10 and so on, and maybe 16 sources.

MS. MARTINKOVIC: Yes.

MR. GEERING: Just flat out, where is that list contained? And, you know, woodworking facilities, I know there's a few Title V permits in the State that weren't included in the list, so my assumption would be they are not on the EPA's list.

MS. MARTINKOVIC: If your source is not on the actual list that is in the rule, you're not one of those 26 categories, then you're not a BART eligible source. So if you're not --

MR. GEERING: I couldn't find it. There they are; I see it.

MS. MARTINKOVIC: Yes, it would be in the, almost the next to the last page. There's a series here under definitions in 1601, number 2, it lists all the sources there. So if you're a facility that makes 250 tons per year of those air pollutants or is one of these categorical sources, then that would put you in that group.

MR. GEERING: Thank you.

HRG. OFF. McCABE: If there are no further questions, we can proceed with the oral comment period of this proceeding. If there is anyone who has oral comments, please make them at this time.

Hearing none, I will encourage people to submit written comments on the proposed rule. Your participation is an essential part of the rulemaking process, and again, you may also submit written comments by mail, e-mail, or fax to Corky Martinkovic by the end of the comment period which is 5:00 p.m. on Friday, April 11, 2003. Your mailed, e-mailed, or faxed written comments must be postmarked no later than April 11, 2003, and submitted to Corky Martinkovic, Air Quality Planning Section, Arizona Department of Environmental Quality, 1110 West Washington Street, Phoenix, 85007, or fax, area code (602) 771-2366. E-mail is martinkovic.deborrah@ev.state.az.us.

I thank you for attending. The time is now 4:55, and I close this oral proceeding.

(The proceedings concluded at 4:55 p.m.)

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, DAWNA J. BOSWELL, Certified Court Reporter No. 50326 for the State of Arizona, do hereby certify that the foregoing printed pages constitute a full, true and accurate transcript of the proceedings had in the foregoing matter, all done to the best of my skill and ability.

WITNESS my hand this 22nd day of April, 2003.

Dawna J. Boswell

DAWNA J. BOSWELL
Certified Court Reporter
Certificate No. 50326

Arizona Department of Environmental Quality
Air Quality Division

Public Hearing Presiding Officer Certification

I, Sean McCabe, the designated Presiding Officer, do hereby certify that the public hearing held by the Arizona Department of Environmental Quality was conducted on April 8, 2003, at Arizona Department of Environmental Quality, Phoenix, Arizona, in accordance with public notice requirements by publication in Arizona Administrative Register and other locations beginning March 7, 2003. Furthermore, I do hereby certify that the public hearing was recorded from the opening of the public record through concluding remarks and adjournment, and the transcript provided contains a full, true, and correct record of the above-referenced public hearing.

Dated this 8th day of April, 2003.

[NAME OF PRESIDING OFFICER]
Sean P. McCabe

State of Arizona)
) ss.
County of Maricopa)

Subscribed and sworn to before me by ______ this ___ day of April 2003

Notary Public

My commission expires:

April 02, 2004

Notary Public State of Arizona
Maricopa County
Laura McFarland
Expires April 02, 2004

3033 North Central Avenue, Phoenix, Arizona 85012, (602) 207-2300

Janet Napolitano
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

AIR QUALITY DIVISION

PUBLIC HEARING
on
PROPOSED REASONABLY ATTRIBUTABLE VISIBILITY IMPAIRMENT RULE

PLEASE NOTE THE MEETING LOCATION AND TIME:
State Office Building, Room 158
400 W. Congress, Tucson, AZ
Wednesday, April 9, 2003, 4:30 p.m.

Pursuant to ARS § 49-425 for air quality rule hearings, notice is hereby given that the above referenced meeting is open to the public. Copies of the proposal are available for review locally at the State Office Building and the Arizona Department of Environmental Quality Library, 1110 W. Washington Street, Phoenix, Arizona.

AGENDA

1. Welcome and Introductions
2. Purposes of the Oral Proceeding
3. Procedure for Making Public Comment
4. Brief Overview of the Proposed Reasonably Attributable Visibility Impairment Rule
5. Question and Answer Period
6. Oral Comment Period
7. Adjournment of Oral Proceeding

For additional information regarding the hearing, please call Corky Martinkovic, ADEQ Air Quality Division, at (602) 771-2372] or 1-800-234-5677, Ext. 771-2372. Persons with a disability may request a reasonable accommodation, such as a sign language interpreter, by contacting Katie Huebner at (602) 771-4794 or 1-800-234-5677, Ext. 771-4794. Requests should be made as early as possible to allow sufficient time to make the arrangements for the accommodation. This document is available in alternative formats by contacting ADEQ TDD phone number at (602) 771-4829**.**

Arizona Department of Environmental Quality
Air Quality Division

Please Sign In

Public Hearing - Tucson

SUBJECT Reasonably Attributable Visibility Impairment Rule (RAVI) DATE 4-9-03

	NAME	ORGANIZATION	PHONE	FAX	E-MAIL
1.	Jeff Yockey	TEP	520-884-3692	520-884-3666	jyockey@tucsonelectric.com
2.					
3.					
4.					
5.					
6.					
7.					
8.					

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

PUBLIC MEETING and ORAL PROCEEDINGS

PROPOSED REASONABLY ATTRIBUTABLE VISIBILITY IMPAIRMENT RULE

April 9, 2003

State Office Building, 400 West Congress

Tucson, Arizona

Reported By:
Arizona Court Reporting
Tucson, AZ (520) 623-3375

ORIGINAL

MR. MASSEY: I now open this oral proceeding. Good afternoon, thank you for coming. This oral proceeding is on the proposed Reasonably Attributable Visibility Impairment Rule. This is a proposed rule to direct the State of Arizona and affected permitted stationary sources on the procedures should a Federal Land Manager certify that anyone of these sources or small group of sources have emissions that may cause or contribute to the reduction of visibility at specific national parks or wilderness areas in Arizona or adjacent states.

It is now Wednesday, April 9, 2003, 4:36 P.M. The location is Room 158, State Office Building, 400 West Congress, Tucson, Arizona.

My name is Eric Massey and I have been appointed by the Director of the Arizona Department of Environmental Quality to preside at this proceeding.

The purpose of this proceeding is to provide the public an opportunity:

1. To hear about the substance of the proposed rule.
2. To ask questions regarding the proposed rule.
3. To present oral argument, data and views regarding the proposed rule in the form of comments on the record.

Representing the Department are myself and Mr. Ira Domsky of the Air Quality Division.

The procedure for making a public comment on the record is straightforward. If you wish to comment, you need to fill out a speaker slip, which is available at the sign-in table, and give it to me. Using speakers slips allows everyone an opportunity to be heard and allows us to match the name on the official record with the comments.

You may also submit written comments to me today in person or by mail, e-mail, or fax to Corky Martinkovic by the end of the comment period. The end of the comment period is 5:00 p.m. on Friday, April 11, 2003. If mailed, e-mailed or faxed, written comments must be "postmarked" no later than April 11, 2003. Please submit your written comments to:

Corky Martinkovic
Air Quality Planning Section
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007
Fax (602) 771-2366
E-mail: martinkovic.deborrah@ev.state.az.us

Comments made during the formal comment period are required by law to be considered by the Department in the preparation of the final rule making.

This is done through the preparation of a concise explanatory statement in which the Department responds in writing to written and oral comments made during the formal comment period.

The agenda for this hearing is simple. First, I will present a brief overview of the proposed rule.

Next I will conduct a question and answer period. The purpose of the question and answer period is to provide information that may help you in making comments on the rule.

Thirdly, I will conduct the oral comment period. At that time I will begin to call speakers in the order that I have received speaker slips.

Please be aware that any comments you make at today's hearing that you want the Department to formally consider must be given either in writing or on the record during the oral comment period of this proceeding.

****

At this time I will give a brief overview of the proposed rule

The Reasonably Attributable Visibility Impairment Rule, or RAVI for short, will, upon approval, become a new section in the environmental chapter of the Arizona Administrative Code. States are required to adopt this rule under Federal regulations.

The rule addresses a specific type of air pollution that can reduce visibility in national parks and wilderness areas. This type of pollution is a type of air pollution that can be traced to a certain type of existing stationary source. When a source has this type of air pollution traced directly to their operations, they are said to be "reasonably attributable" for that type of pollution.

For the purposes of the rule, this type of pollution originates from a specific type of existing stationary source operating in or near federal national parks and wilderness areas, known formally as Federal Mandatory Class I areas. Arizona has 12 of these Class I areas. These national parks and wilderness areas are managed by Federal Land Managers. Federal Land Managers are able to "certify" for the national park or wilderness area for which they have jurisdiction that there exists a reduction in visibility. They can document the reduction in visibility they observe in the park or wilderness area and then complete a formal report certifying impairment of visibility.

Once the State of Arizona receives a

certification of visibility impairment from a Federal Land Manager, under the proposed rule, the State would determine if the source is one of the type of stationary sources covered by the rule. Then the State of Arizona would analyze if that source is in fact causing or contributing to the reduction in visibility or in the words of the rule, is reasonably attributable.

If the source is eligible for emission controls and found to be attributable for the reduction in visibility, under the proposed rule, the State of Arizona would then proceed with an analysis for the application and operation of emission controls for the source's air emissions. The emission controls applied under this rule are known as Best Available Retrofit Technology, or BART. BART is applied to existing stationary sources that are too old to operate under what is termed, New Source Performance Standards, and yet emit 250 or more tons per year of air pollutants that impair visibility.

Along with outlining the procedures for the BART control analysis of the attributable source, the proposed rule points to options for a source to pursue equivalent or better alternatives, or apply for a federal-level exemption.

This concludes the explanation period of this proceeding on the proposed rule.

Are there any questions before we move to the oral comment period?

MR. YOCKEY: So this would be just questions about specific language in the rule or anything like that?

MR. MASSEY: Yes.

MR. YOCKEY: My name is Jeff Yockey and I am with Tucson Electric Power.

I do have one comment. In the definition in 1601, it gives the definition for existing stationary facility. And then under the applicability in Section 1602, it says this article applies to any existing stationary source, and I guess what I am wondering is that -- is existing stationary source in 1602 supposed to fall in with the definition of existing stationary facility under the definition, or is that a larger group?

MR. DOMSKY: It should match up with the definition.

MR. YOCKEY: So it is intended just to include those that are included under the definition?

MR. DOMSKY: Right and I would ask you to make a comment to the affect.

MR. YOCKEY: Okay.

MR. DOMSKY: This rule has been edited

enough times based on informal comments that some of the flip-flop back and forth between facility and source, we might not have caught all of those instances.

MR. MASSEY: Are there any other questions? If there are no other questions then, this concludes the question and answer period of this proceeding on the proposed rule. I now open this proceeding for oral comments, and if I could get the speaker slips.

And this is Jeff Yockey?

MR. YOCKEY: Yes.

My name is Jeff Yockey and I am here representing Tucson Power, and my comment relates to the definitions and applicability. If primarily the applicability section relating to 1602, and it starts: "This article applies to any existing stationary source," and I believe that it is intended to refer to the definition in Section 1601, and I guess I would request that that wording be changed to "existing stationary facility" to match accurately with your definition.

MR. MASSEY: Mr. Yockey's speaker's slip is the only speaker slip I have. Are there any others that wish to submit comments this evening?

Seeing no additional speaker slips, this concludes the oral comment period at this proceeding.

I encourage everyone to submit written

comments on the proposed rule. Your participation is an essential part of the rule making process. Again, you may also submit written comments by mail, e-mail or fax to Corky Martinkovic by the end of the comment period. The end of the comment period is 5:00 on Friday April 11, 2003. If mailed, e-mailed or faxed, written comments must be postmarked no later than April 11, 2003. Again, please submit your written comments to:

Corky Martinkovic
Air Quality Planning Section
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007
Or by fax: (602) 771-2366
By e-mail, martinkovic.deborrah@ev.state.az.us

Thank you all for attending. The time is now 4:49. I now close this oral proceeding.

CERTIFICATE

STATE OF ARIZONA)
) ss.
COUNTY OF PIMA)

BE IT KNOWN that I took the foregoing Public Hearing pursuant to request; that I was then and there a Notary Public in and for the County of Pima, State of Arizona; and that the testimony of the witness was reduced to writing under my direction, all done to the best of my skill and ability.

I DO FURTHER CERTIFY that I am not a relative or attorney of either party, or otherwise interested in the events of this action.

Ronald L. Lunsford, RPR

Notary Public

My Commission Expires:
December 31, 2004

Public Hearing Presiding Officer Certification

I, Eric Massey, the designated Presiding Officer, do hereby certify that the public hearing held by the Arizona Department of Environmental Quality was conducted on April 9, 2003, at the State Capitol Building, Tucson, Arizona, in accordance with public notice requirements by publication in Arizona Administrative Register and other locations beginning March 7, 2003. Furthermore, I do hereby certify that the public hearing was recorded from the opening of the public record through concluding remarks and adjournment, and the transcript provided contains a full, true, and correct record of the above-referenced public hearing.

Dated this 9th day of April.

Eric C. Massey
[NAME OF PRESIDING OFFICER]

State of Arizona)
) ss.
County of Maricopa)

Subscribed and sworn to before me by ____________ this 9 day of April 2003

Laura McFarland
Notary Public

Notary Public State of Arizona
Maricopa County
Laura McFarland
Expires April 02, 2004

My commission expires:

April 02, 2004

NOTICE OF FINAL RULEMAKING

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY

AIR POLLUTION CONTROL

ARTICLE 16. VISIBILITY; REGIONAL HAZE

PREAMBLE

1. Sections Affected | **Rulemaking Action**

Sections Affected	Rulemaking Action
R18-2-101	Amend
Article 16	New Article
R18-2-1601	New Section
R18-2-1602	New Section
R18-2-1603	New Section
R18-2-1604	New Section
R18-2-1605	New Section
R18-2-1606	New Section

2. The statutory authority for the rulemaking, including both the authorizing statute (general) and the statutes the rules are implementing (specific):

General Authority: A.R.S. §§ 49-104(A)(11) and 49-425

Specific Authority: A.R.S. §§ 49-414 and 414.01

3. The effective date of the rules:

60 days after filing with the Secretary of State

4. A list of all previous notices appearing in the Register addressing the final rules:

Notice of Docket Opening: 9 A.A.R. 390, February 7, 2003

Notice of Proposed Rulemaking: 9 A.A.R. 763, March 7, 2003

5. The name and address of agency personnel with whom persons may communicate regarding the rulemaking.

Name: Deborrah "Corky" Martinkovic

Address: ADEQ, Air Quality Planning Section, 1110 West Washington Street, Phoenix, AZ 85007

Telephone: (602) 771-2372 (Any extension may be reached in-state by dialing 1-800-234-5677, and asking for a specific number.)

Fax: (602) 771-2366

E-mail: martinkovic.deborrah@ev.state.az.us

6. An explanation of the rules, including the agency's reasons for initiating the rules:

Summary. This rule sets forth the process Arizona Department of Environmental Quality (ADEQ) will use to determine whether Best Available Retrofit Technology (BART) will be required for sources determined to be contributing to visibility impairment in a mandatory Federal Class I area. Federal regulations allow Federal Land Managers (FLMs) to certify sources defined in 40 CFR 51.301 as potential contributors to visibility impairment in any of the Arizona mandatory Federal Class I areas under Section 169A of the Clean Air Act (CAA).

Background. In 1977 Congress added a new section to the Clean Air Act - Section 169A, Visibility Protection for Federal Class I Areas - which established a national goal for, "the prevention of any future, and the remedying of any existing impairment of visibility in mandatory class I Federal areas which impairment results from man-made air pollution." In addition, the section required states to submit state implementation plans (SIPs) requiring best available retrofit technology (BART) for certain existing stationary sources found to cause or contribute to visibility impairment. On November 30, 1979, EPA promulgated a list of mandatory Federal Class I Areas (Class I areas) where visibility is an important value (44 FR 69122). There are 12 Class I areas identified in Arizona: Chiricahua National Monument Wilderness, Chiricahua Wilderness, Galiuro Wilderness, Grand Canyon National Park, Mazatzal Wilderness, Mount Baldy Wilderness, Petrified Forest National Park, Pine Mountain Wilderness, Saguaro Wilderness, Sierra Ancha Wilderness, Superstition Wilderness, and Sycamore Canyon Wilderness (40 CFR 81.403).

On December 2, 1980 (45 FR 80084), EPA defined the role of the FLMs in certifying visibility impairment in the mandatory Federal Class I areas. On November 24, 1987 (52 FR 45132), FLMs identified Petrified Forest National Park, Saguaro Wilderness, and Grand Canyon National Park, as having visibility impairment possibly attributable to stationary sources. Under the 1980 rule, if found to cause or contribute to the impairment, certain existing stationary sources operating in or near the identified Class I areas could be subject to BART (A list of sources eligible for the possible application of

BART can be found at 40 CFR 51.301). On October 3, 1991, the Navajo Generating Station (NGS) was found by EPA to be causing or contributing to visibility impairment for the Grand Canyon National Park and eligible for BART (56 FR 50172). BART control analyses were subsequently performed by EPA, and other parties through related court actions. Under the 1980 rule, the federal expectation is that actions for determination of possible source attribution will be performed by the states. Therefore, Arizona needs to be prepared to proceed with an attribution analysis and assessment for the application of controls upon any determination of a BART eligible source being the possible cause or contributor to visibility impairment in a Class I area. This rule addresses that need.

Current Conditions. ADEQ has determined that this rule applies to any source in existing stationary source categories identified in 40 CFR 51.301 that are operating in or near the mandatory federal Class I areas in Arizona. The source is an existing stationary facility that includes any reconstructed source that was not in operation prior to August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit 250 tons per year of any regulated pollutant. ADEQ estimates that there are potentially 10 such sources within Arizona. "In existence" is interpreted by EPA to be consistent with the term, "commence construction" found in Prevention of Serious Deterioration (PSD) regulations (40 CFR 51.165(a)(1)(xvi) and 40 CFR 52.21(b)(9)). If construction commenced after August 7, 1977, the source would be subject to the PSD/NSR (new source review) program (the state regulations are found at 18 A.C.C. 2, Article 4). However, EPA also notes "that sources, are not BART eligible if the only change at the plant was the addition of pollution controls. For example, if the only change at a copper smelter during the 1962 through 1977 time period was the addition of acid plants for the reduction of SO_2 emissions, these emission controls would not themselves trigger a BART review."[1]

Under this rule, ADEQ, when analyzing an attributable source for BART controls, must consider several factors including, for example, costs, remaining useful life of the source, and degree of improvement anticipated to result from the application of the controls (the factors are detailed in R18-2-1605). Sources required by ADEQ to install and operate BART controls have a final opportunity to request exemption from the requirement prior to the application of controls. This opportunity for a federal exemption from BART, is contained in R18-2-1606, and 40 CFR 51.303.

Summary. This rule outlines the process through which sources eligible for the application of BART will

[1] EPA proposed rule, 66 Federal Register 38119, July 20, 2001.

proceed if certified by the state of Arizona or an FLM as possibly causing or contributing to visibility impairment due to attribution. If found to be attributable for the impairment, a BART analysis will be performed to determine the level of controls necessary to remedy the impairment. This rule enables Arizona to fulfill the requirements of the Clean Air Act and the goal of section 169A of the Act to return the Nation's federal parks and wilderness areas to natural conditions.

Section-by-section Explanation for the Rule

R18-2-1601	This section lists the definitions that apply to this rule.
R18-2-1602	This section lists the Class I areas addressed by this rule for the applicable existing stationary facilities, as defined in R18-2-1601(2).
R18-2-1603	This section establishes the procedure for certification of impairment by either a Federal Land Manager with authority over a mandatory Federal Class I area, or the Director, should either believe there exists reasonably attributable visibility impairment in a Federal Class I area as listed in R18-2-1602.
R18-2-1604	This section establishes the procedure for an attribution analysis after certification of a source or group of sources as outlined in R18-2-1603. Upon completion of the attribution analysis, the procedure for the Director to issue draft and final attribution findings is outlined in R18-2-1604(C).
R18-2-1605	This section establishes the best available retrofit technology (BART) analysis procedure after a source is identified under R18-2-1604. Upon completion of the BART analysis, the procedure for the Director to issue draft and final BART findings, including alternatives to emission standards, is outlined in R18-2-1605(B) and (C), respectively. The specific conditions where BART would be satisfied due to past or planned actions by the facility are outlined in R18-2-1605(D). EPA determinations regarding new technology that might require a BART analysis for an applicable source, regardless of a source or small group of sources previously being certified and found attributable, are covered in R18-2-1605(E).
R18-2-1606	This section establishes the procedures for obtaining a federal exemption from a BART requirement.

7. <u>A reference to any study relevant to the rule that the agency reviewed and either relied on in its evaluation of or justification for the rule or did not rely on in its evaluation of or</u>

justification for the rule, where the public may obtain or review each study, all data underlying each study, and any analysis of each study and other supporting material:

None

8. **A showing of good cause why the rules are necessary to promote a statewide interest if the rules will diminish a previous grant of authority of a political subdivision of this state:**

Not applicable

9. **The summary of the economic, small business, and consumer impact:**

A. Rule Identification

These rules amend R18-2-101 ("visibility impairment" definition) and add new sections R18-2-1601 through R18-2-1606. For sources under ADEQ jurisdiction, the rules take the place of federal regulations that currently govern this area.

B. Entities Directly Impacted

1. Federal Land Managers. R18-2-1603 allows Federal Land Managers (FLMs) to certify visibility impairment in mandatory Class I areas. This was already allowed by federal rule. Under R18-2-1601 of the rule, the FLMs able to certify impairment in Arizona are with the United States Forest Service and the National Park Service. There are no FLMs in Arizona from the United States Fish and Wildlife Service, because this agency does not have jurisdiction over any of Arizona's mandatory federal Class I areas.

2. ADEQ. R18-2-1604 requires ADEQ to identify stationary sources that could cause or contribute to the certified visibility impairment. Prior to this rule, this function was carried out by EPA. R18-2-1605 would require ADEQ to analyze for BART (best available retrofit technology) controls those sources identified as causing or contributing to visibility impairment. Prior to this rule, this function was carried out by EPA. The impact of this rule on ADEQ will primarily be on the Air Quality Division, Permits and Assessment sections, with a corresponding reduction of impact on EPA.

3. Stationary sources. R18-2-1605 also requires stationary sources identified in #2 to install or operate the BART as determined by the Director. Prior to this rule, only EPA determined and required BART. To determine impacted stationary sources, ADEQ staff reviewed Title V permits from ADEQ's Air Permit files. Of the 26 industry categories listed in 40 CFR 51.301, only five categories were found to

exist under ADEQ's jurisdiction: steam electric plants, cement plants, primary copper smelters, lime plants, and industries using non-utility boilers. As a result, potentially 10 sources, representing 16 BART eligible units (boilers and kilns), could be affected by this rule. The combined potential to emit from these sources totaled 94,287 tons per year for NO_x, 141,036 tons per year for SO_2, and 12,146 tons per year for PM. The combined potential to emit for all pollutants for these 10 sources total approximately 250,000 tons per year.

C. Probable Costs and Benefits Associated with the BART/Visibility Impairment Process

1. Direct Costs - FLMs: FLM activities to certify visibility impairment in mandatory Class I areas may involve preparation and analysis of monitoring data, emission inventories, meteorological records, etc. ADEQ estimates that this cost per certification could be as much as $50,000 if extensive analysis is conducted. These costs exist whether or not these rules became final.

2. Direct Costs - ADEQ: ADEQ costs related to identifying whether a BART eligible stationary source causes or contributes to visibility impairment in Class I areas are based on the activities identified in R18-2-1604(A). ADEQ estimates that these costs could range from $100,000 – 200,000 per attribution analysis, and be primarily borne by the ADEQ's Air Quality Assessment Section. Costs related to analyzing identified sources for BART are based on the activities identified in R18-2-1605(A) and will be moderate, but less expensive than the attribution analysis. These costs will be primarily borne by ADEQ's Permits Section. These costs will accrue to the State. Finally, incorporating BART into an existing State air quality permit may require additional resources from the Permits Section. However, these costs, unlike costs for the attribution and BART analysis, would be covered by permit revision fees paid by the source, and would have existed whether or not these rules became final.

3. Direct Costs - Stationary sources: If a source or small group of sources is found to cause or contribute to visibility impairment, and the BART determination requires installation of retrofit controls, the costs to sources required to install BART will be substantial. The total cost to install a technology similar to BART at the Navajo Generating Station was estimated by SRP to be in the hundreds of millions of dollars (51 Federal Register 50172, October 3, 1991). However, the example of the Navajo Generating Station shows costs to install technology similar to BART can result even where there is no state rule. According to EPA, "Where a State defaults on its obligations under the visibility regulations, EPA may act in place of the State pursuant to a FIP under section 110(c) of the Act, 42 U.S.C. 7410(c)[2], and promulgate such limitation and measures as are required to achieve reasonable progress." (Ibid. at 50173, footnote not

included). Although ADEQ is listing these costs for information purposes, ADEQ is not attributing any costs to install and operate BART to this rule because such requirements can be imposed by the federal government without any State rule.

Benefits. Two kinds of benefits are associated with this rule. The first benefit is derived from reduced emissions. Although, BART could be required to be installed on sources even without this state rule, it is helpful to list the emission benefits. When BART is installed, visibility is improved. Over 4 million recreation visits were made to Grand Canyon National Park in FY 2001. These visits generate substantial revenue in and for the state of Arizona. Other scenic resources could also be improved with the installation of BART, and, though less significant than the Grand Canyon, would enhance the tourism resources of Arizona, as well as the quality of life for Arizona citizens. In addition, reduction of visibility-impairing emissions also has health benefits.

The second benefit is through the replacement of federal regulation with state regulation. The lack of state regulations implementing BART results in Arizona sources being subject to federal regulation implemented by EPA from Washington and San Francisco, headquarters for EPA's Region IX. These rules place the identification and analysis of BART sources with ADEQ rather than with EPA. Arizona is currently under a visibility Federal Implementation Plan (FIP), and one or two Arizona sources have considered or implemented technology similar to BART under federal rules. Because ADEQ already permits many of these sources, ADEQ will be more familiar with the various factors that go into the BART analysis. This would be a benefit to sources being regulated. ADEQ would be implementing the same BART rules that EPA does, with a resulting increase in costs for ADEQ and a decrease in costs for EPA.

This final rule further allows ADEQ to proceed with the implementation of the entire federal rule for visibility improvement. The rule addresses the requirements of 40 C.F.R. §§51.302 – 51.307. These sections must be satisfied before ADEQ can implement the requirements of 40 C.F.R. §§51.308 and 51.309. The plan to implement Section 309 must be submitted to EPA by December 31, 2003.

D. Small Business Analysis

A.R.S. § 41-1055(B)(5) requires agencies to state the probable impact of a rulemaking on small businesses. A.R.S. § 41-1035 requires agencies to reduce the impact of a rule on small businesses by using certain methods when they are legal and feasible in meeting the statutory objectives for the rule making. These methods include: (1) exempting them from any or all rule requirements, (2) establishing performance standards which would replace any design or operational standards, or (3) instituting reduced compliance or reporting requirements. An agency may accomplish the third method by establishing less stringent requirements, consolidating or simplifying requirements, or setting less stringent schedules or deadlines.

"Small business" is defined in A.R.S. §41-1001 as "a concern, including its affiliates, which is independently owned and operated, which is not dominant in its field and which employs fewer than one hundred full-time employees or which had gross annual receipts of less than four million dollars in its last fiscal year." Interpreting this definition means that if a concern has annual gross receipts of more than four million dollars, but fewer than 100 employees, it would not be classified as a small business.

ADEQ expects that none of the potential BART eligible sources will be classified as a small business. ADEQ's conclusion is that this rule will not impact small business sources. However, if a BART eligible source would qualify as a small business, under federal rule, ADEQ could not establish different requirements for these small business sources. If there are any small businesses that sell, install, or maintain BART-related technology, they will benefit from this rule.

In the preliminary EIS, ADEQ requested comment and additional information relating to any of the conclusions reached above and did not receive any.

10. <u>A description of the changes between the proposed rules, including supplemental notices, and final rules (if applicable):</u>

Changes were made with the cooperation of GRRC Staff to improve the clarity, conciseness and understandability of the rule. The changes are shown below:

A new definition was placed at R18-2-101(71), to clarify a term used in the proposed definition of "visibility impairment" at R18-2-101(123):

<u>71.</u> <u>"Natural conditions" includes naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.</u>

In addition, the word "and" was removed from the definition of "visibility impairment", as shown:

~~123~~124. "Visibility impairment" means any humanly perceptible change in visibility (light extinction, visual range, contrast, ~~and~~ coloration) from that which would have existed under natural conditions.

Both definitions are copied exactly from federal regulations at 40 CFR 51.308.

In addition, new Article 16 was amended as follows:

ARTICLE 16. VISIBILITY; REGIONAL HAZE

R18-2-1601. Definitions

In addition to the definitions contained in Articles 1 and 4 of this Chapter and A.R.S. § 49-401.01, the following definitions apply to this Article:

1. "Best available retrofit technology (BART)" means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant ~~that is~~ emitted by an existing stationary facility. The emission limitation is established on a case-by-case basis ~~in accordance with~~ under R18-2-1605.
2. "Existing stationary facility" means any of the following stationary sources of air pollutants, including any reconstructed source, which was not in operation ~~prior to~~ before August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit 250 tons per year or more of any air pollutant. ~~In determining~~ A person who determines potential to emit~~,~~ shall count fugitive emissions~~,~~ to the extent quantifiable~~, must be counted~~.
   a. Fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour heat input~~,~~;
   b. Coal cleaning plants (thermal dryers)~~,~~;
   c. Kraft pulp mills~~,~~;
   d. Portland cement plants~~,~~;
   e. Primary zinc smelters~~,~~;
   f. Iron and steel mill plants~~,~~;
   g. Primary aluminum ore reduction plants~~,~~;
   h. Primary copper smelters~~,~~;
   i. Municipal incinerators capable of charging more than 250 tons of refuse per day~~,~~;
   j. Hydrofluoric, sulfuric, and nitric acid plants~~,~~;
   k. Petroleum refineries~~,~~;
   l. Lime plants~~,~~;

m. Phosphate rock processing plants~~,~~;

n. Coke oven batteries~~,~~;

o. Sulfur recovery plants~~,~~;

p. Carbon black plants (furnace process)~~,~~;

q. Primary lead smelters~~,~~;

r. Fuel conversion plants~~,~~;

s. Sintering plants~~,~~;

t. Secondary metal production facilities~~,~~;

u. Chemical process plants~~,~~;

v. Fossil-fuel boilers of more than 250 million British thermal units per hour heat input~~,~~;

w. Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels~~,~~;

x. Taconite ore processing facilities~~,~~;

y. Glass fiber processing plants~~,~~; and

z. Charcoal production facilities.

3. "Federal Land Manager" means the Secretary of the department, or the Secretary's designee, with authority over the Federal Class I area.

4. "Mandatory Federal Class I Area" means any area identified in 40 CFR §§81.400-81.436.

5. "Reasonably attributable" means ascribable by visual observation or other techniques ~~the Director deems appropriate~~ described in R18-2-1604.

6. "Reasonably attributable visibility impairment" means visibility impairment that is caused by the emission of air pollutants from one source, or a small group of sources.

R18-2-1602. Applicability

This Article applies to any existing stationary source located in the state that may reasonably be anticipated to cause or contribute to visibility impairment in any mandatory Federal Class I area identified in 40 CFR §§81.401-81.436. Mandatory Federal Class I areas within Arizona are: Chiricahua National Monument Wilderness, Chiricahua Wilderness, Galiuro Wilderness, Grand Canyon National Park, Mazatzal Wilderness, Mount Baldy Wilderness, Petrified Forest National Park, Pine Mountain Wilderness, Saguaro Wilderness, Sierra Ancha Wilderness, Superstition Wilderness, and Sycamore Canyon Wilderness.

R18-2-1603. Certification of Impairment

A. A Federal Land Manager with authority over a mandatory Federal Class I area may certify to the

Director, at any time, that ~~there exists~~ a reasonably attributable visibility impairment exists in ~~the~~ a mandatory Federal Class I area. The Director may also certify that ~~there exists~~ reasonably attributable visibility impairment exists in any mandatory Federal Class I area ~~as necessary~~ to assure reasonable progress under section 169A(b)(2) of the Clean Air Act.

B. Documentation ~~from the affected Federal Land Manager or Director~~ that supports the Federal Land Manager or Director's certification shall include:

1. The mandatory Federal Class I area for which visibility impairment is being certified,
2. Any information documenting the basis for the certification of impairment.

R18-2-1604. Attribution Analysis; Finding

A. ~~Upon certification of reasonably attributable visibility impairment in any mandatory Federal Class I area~~ If a mandatory Federal Class I area is certified as having reasonably attributable visibility impairment, the Director shall conduct an attribution analysis to identify each existing stationary source that may be reasonably anticipated to cause or contribute to visibility impairment. The Director shall notify the Federal Land Manager, affected source or small group of sources, and local air pollution control officer of the intent to conduct an attribution analysis. The attribution analysis shall be based on the following:

1. Monitoring information obtained through the Arizona Class I Visibility Monitoring Network or special studies approved by ADEQ to ascertain:
   a. The times visibility impairment occurred, and
   b. The pollutants contributing to the visibility impairment~~.~~;
2. Transport analysis or air quality modeling based upon meteorological records to ascertain whether the pollutants were transported to the mandatory Federal Class I area~~.~~;
3. Other available studies, modeling analyses, and emissions inventories of point, area, and mobile source emissions to ascertain:
   a. The pollutant ~~or pollutants~~ causing the impairment, and
   b. The source, or a small group of sources, emitting the ~~impairing~~ pollutant; ~~or pollutants.~~
4. Other relevant supporting documentation provided by the Federal Land Manager or Director used to make the draft attribution analysis finding~~.~~; and
5. Consideration of any documentation provided by the source, ~~or~~ a small group of sources~~.~~, or other interested parties.

B. In conducting the attribution analysis, the Director shall use monitoring information, meteorological records, and emissions inventories that represent times and locations reasonably concurrent with the visibility impairment.

C. The Director shall issue a draft attribution finding that impairment has or has not occurred, and provide public notice of the draft attribution finding. The Director shall publish notice of the draft attribution finding in a newspaper of general circulation in each county containing the mandatory Federal Class I area and the affected source. The Director shall provide at least 30 days from the date of the notice for public comment. Written comments to the Director shall include the name of the person and the person's agent or attorney, if any, and shall clearly set forth reasons why the Director should review the draft attribution finding ~~should be reviewed~~. The Director shall issue ~~A~~ a final attribution finding ~~shall be issued~~ after the public comment period. If the Director finds existing stationary sources ~~found to~~ cause or contribute to visibility impairment in a mandatory Federal Class I area, the source shall be subject to a BART Control Analysis under R18-2-1605.

R18-2-1605. BART Control Analysis; Finding

A. The Director shall analyze for BART controls each existing stationary source for which a final attribution finding is made under R18-2-1604(C). The Director shall consider the following factors:

1. Available control technology;
2. New source performance standards (NSPS) ~~as adopted~~ in Article 9;
3. Alternative control systems if retrofitting to comply with applicable NSPS standards ~~adopted~~ in Article 9 is ~~found~~ infeasible~~.~~;
4. Cost of compliance;
5. Energy and non-air quality environmental impacts of compliance;
6. Existing pollution control technology in use at the source or small group of sources;
7. Remaining useful life of the source or small group of sources;
8. Net environmental impact associated with the proposed emission control system;
9. Economic impacts associated with installing and operating the proposed emission control system; and
10. Degree of improvement in visibility anticipated to result from application of the proposed emission control system.

B. The Director shall issue a draft BART finding, and provide public notice of the draft BART finding. The Director shall publish notice of the draft BART finding in a newspaper of general circulation in each county containing the mandatory Federal Class I area and the affected source.

The Director shall provide at least 30 days from the date of the notice for public comment. Written comments to the Director shall include the name of the person and the person's agent or attorney, and shall clearly set forth reasons why the Director should review the draft BART ~~finding should be reviewed~~. The Director shall issue a final BART finding after the public comment period.

1. The Director shall submit each final BART finding ~~that an existing stationary source is required to meet BART~~ to the Administrator as a revision to the ~~state implementation plan (~~SIP~~)~~.
2. The Director shall require that each existing stationary source meet BART as expeditiously as practicable but in no case later than five years after EPA approval of the ~~revision to Arizona's State Implementation Plan~~ SIP revision.

C. If the Director determines that technological or economic limitations on the applicability of measurement methodology to a particular existing stationary source would make the imposition of an emission standard infeasible, the Director may, as part of the finding under subsection (B), ~~instead~~ prescribe a design, equipment, work practice, ~~or other~~ operational standard, or combination ~~thereof~~ of design, equipment, work practice, or operational standard. ~~Such~~ The standard, to the degree possible, ~~is to~~ shall set forth the emission reduction to be achieved by implementation of ~~such~~ the design, equipment, work practice, or operation, and ~~must~~ shall provide for compliance by means ~~which~~ that achieve equivalent results.

D. The Director shall make a finding that the attributable source ~~has satisfied~~ satisfies the BART requirement if the attributable source ~~has~~:

1. Voluntarily ~~applied~~ applies best available retrofit technology;
2. Previously applied emission control standards equivalent to BART; or
3. ~~Agreed~~ Agrees to shutdown or curtail operations at the attributable source within ~~5~~ five years of the finding. An attributable source that does not shutdown or curtail operations shall ~~proceed to~~ meet BART as expeditiously as practicable, but in no case later than five years after EPA's approval of the revision to ~~Arizona's State Implementation Plan~~ the SIP.

E. If the Director determines that the imposition of BART or a standard ~~pursuant to~~ under subsection (C) ~~of this section~~ is ~~not feasible~~ infeasible at the time of the finding, the Director shall require the attributable source ~~shall be required~~ to install and operate BART ~~upon a determination by the Director~~ at a later date when the Director determines that BART or equivalent controls are ~~now~~

feasible.

F. The Director shall provide for a BART control analysis of any existing stationary source that might cause or contribute to impairment of visibility in any mandatory Federal Class I area identified under this Article at such time~~s,~~ as ~~determined by~~ the Administrator~~,~~ determines new control technology for ~~control of~~ the pollutant becomes reasonably available if:

1. The pollutant is emitted by that existing stationary source,
2. Controls representing BART for the pollutant have not previously been required under this Article, and
3. The impairment of visibility in any mandatory Federal Class I area is reasonably attributable to the emissions of that pollutant.

R18-2-1606. Exemption from BART

Any existing stationary source required to install, operate, and maintain BART ~~pursuant to~~ under this Article, may apply to the Administrator for an exemption from that requirement according to 40 CFR 51.303. ~~by obtaining prior written concurrence from the Director according to 40 CFR 51.303.~~ The existing stationary source shall obtain the Director's written concurrence before sending the application for exemption to the Administrator.

11. A summary of the comments made regarding the rule and the agency response to them:

ADEQ received one written comment. It expressed general support for the rule and for protecting visibility in Arizona's Class I parks and wilderness areas.

Comment: ADEQ received an oral comment that the word "facility" should be replaced by "source" in the definitions of "best available retrofit technology" and "existing stationary facility" to be consistent with the rest of the rule.

Response: ADEQ has kept these definitions the same as the federal definitions to ensure consistency. The definitions use the term "source" to define the terms, and "source" is used thereafter in the rules. ADEQ is not aware of any inconsistency.

12. Any other matters prescribed by statute that are applicable to the specific agency or to any specific rule or class of rules:

Not applicable

13. Incorporation by reference and their location in the rule:

Not applicable

14. Were these rules previously adopted as emergency rules?

No

15. The full text of the rule follows:

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY

AIR POLLUTION CONTROL

ARTICLE 1. GENERAL

ARTICLE 16. VISIBILITY; REGIONAL HAZE

ARTICLE 1. GENERAL

R18-2-101. Definitions

In addition to the definitions prescribed in A.R.S. §§ 49-101, 49-401.01, 49-421, 49-471, and 49-541, in this Chapter, unless otherwise specified:

1. No change
2. No change
   a. No change
   b. No change
   c. No change
   d. No change
   e. No change
3. No change
4. No change
5. No change
6. No change
7. No change
8. No change
9. No change
10. No change
    a. No change
    b. No change
    c. No change
    d. No change
    e. No change
    f. No change
11. No change
    a. No change
    b. No change
    c. No change
12. No change
13. No change
14. No change

a. No change

b. No change

15. No change

16. No change

17. No change

18. No change

19. No change

20. No change

21. No change

22. No change

23. No change

24. No change

25. No change

26. No change

27. No change

a. No change

b. No change

28. No change

29. No change

30. No change

31. No change

32. No change

33. No change

34. No change

35. No change

36. No change

37. No change

38. No change

39. No change

40. No change.

41 No change

42. No change

a. No change

b. No change

c. No change

d. No change

e. No change

f. No change

g. No change

h. No change

i. No change

j. No change

k. No change

l. No change

43. No change

44. No change

a. No change

b. No change

c. No change

d. No change

45. No change

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57. No change

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58. No change

59. No change

60. No change

61. No change

62. No change

63. No change

a. No change

b. No change

c. No change

i. No change

ii. No change

iii. No change

iv. No change

v. No change

(1) No change

(2) No change

vi. No change

vii. No change

viii. No change

(1) No change

(2) No change

ix. No change

(1) No change

(2) No change

x. No change

xi. No change

64. No change

a. No change

b. No change

i. No change

ii. No change

c. No change

i. No change

ii. No change

iii. No change

iv. No change

v. No change

vi. No change

vii. No change

viii. No change

ix. No change

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xi. No change

xii. No change

xiii. No change

xiv. No change

xv. No change

xvi. No change

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xviii. No change

xix. No change

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xxi. No change

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xxiv. No change

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xxvi. No change

xxvii. No change

65. No change

66. No change

67. No change

68. No change

69. No change

70. No change

71. “Natural conditions” includes naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.

~~71.~~72. No change

~~72.~~73. No change

    a. No change

        i. No change

        ii. No change

    b. No change

        i. No change

        ii. No change

    c. No change

    d. No change

    e. No change

    f. No change

        i. No change

        ii. No change

        iii. No change

        iv. No change

    g. No change

~~73.~~74. No change

~~74.~~75. No change

~~75.~~76. No change

~~76.~~77. No change

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~~78.~~79. No change

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~~80.~~81. No change

~~81.~~82. No change

~~82.~~83. No change

~~83.~~84. No change

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b. No change

c. No change

d. No change

~~84.~~85. No change

~~85.~~86. No change

~~86.~~87. No change

~~87.~~88. No change

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~~89.~~90. No change

~~90.~~91. No change

~~91.~~92. No change

~~92.~~93. No change

~~93.~~94. No change

~~94.~~95. No change

a. No change

b. No change

c. No change

d. No change

~~95.~~96. No change

~~96.~~97. No change

~~97.~~98. No change

a. No change

b. No change

c. No change

d. No change

e. No change

~~98.~~99. No change

a. No change

i. No change

ii. No change

iii. No change

iv. No change

v. No change

vi. No change

vii. No change

b. No change

c. No change

~~99.~~100. No change

a. No change

b. No change

~~100.~~101. No change

~~101.~~102. No change

~~102.~~103. No change

~~103.~~104. No change

~~104.~~105. No change

a. No change

b. No change

c. No change

d. No change

~~105.~~106. No change

~~106.~~107. No change

~~107.~~108. No change

a. No change

b. No change

~~108.~~109. No change

~~109.~~110. No change

~~110.~~111. No change

~~111.~~112. No change

~~112.~~113. No change

~~113.~~114. No change

~~114.~~115. No change

~~115.~~116. No change

~~116.~~117. No change

~~117.~~118. No change

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v. No change

w. No change

x. No change

y. No change

z. No change

aa. No change

bb. No change

cc. No change

dd. No change

ee. No change

ff. No change

gg. No change

hh. No change

ii. No change

jj. No change

kk. No change

ll. No change

mm. No change

nn. No change

oo. No change

pp. No change

qq. No change

rr. No change

ss. No change

tt. No change

uu. No change

vv. No change

ww. No change

xx. No change

~~118.~~119. No change

~~119.~~120. No change

~~120.~~121. No change

~~121.~~122. No change

~~122.~~123. No change

~~123.~~124. "Visibility impairment" means any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions.

~~124.~~125. No change

~~125.~~126. No change

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b. No change

c. No change

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~~126.~~127. No change

ARTICLE 16. VISIBILITY; REGIONAL HAZE

R18-2-1601. Definitions

In addition to the definitions contained in Articles 1 and 4 of this Chapter and A.R.S. § 49-401.01, the following definitions apply to this Article:

1. "Best available retrofit technology (BART)" means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant emitted by an existing stationary facility. The emission limitation is established on a case-by-case basis under R18-2-1605.
2. "Existing stationary facility" means any of the following stationary sources of air pollutants, including any reconstructed source, which was not in operation before August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit 250 tons per year or more of any air pollutant. A person who determines potential to emit shall count fugitive emissions to the extent quantifiable.
   a. Fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour heat input;
   b. Coal cleaning plants (thermal dryers);
   c. Kraft pulp mills;
   d. Portland cement plants;

e. Primary zinc smelters;

f. Iron and steel mill plants;

g. Primary aluminum ore reduction plants;

h. Primary copper smelters;

i. Municipal incinerators capable of charging more than 250 tons of refuse per day;

j. Hydrofluoric, sulfuric, and nitric acid plants;

k. Petroleum refineries;

l. Lime plants;

m. Phosphate rock processing plants;

n. Coke oven batteries;

o. Sulfur recovery plants;

p. Carbon black plants (furnace process);

q. Primary lead smelters;

r. Fuel conversion plants;

s. Sintering plants;

t. Secondary metal production facilities;

u. Chemical process plants;

v. Fossil-fuel boilers of more than 250 million British thermal units per hour heat input;

w. Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels;

x. Taconite ore processing facilities;

y. Glass fiber processing plants; and

z. Charcoal production facilities.

3. "Federal Land Manager" means the Secretary of the department, or the Secretary's designee, with authority over the Federal Class I area.

4. "Mandatory Federal Class I Area" means any area identified in 40 CFR §§81.400-81.436.

5. "Reasonably attributable" means ascribable by visual observation or other techniques described in R18-2-1604.

6. "Reasonably attributable visibility impairment" means visibility impairment that is caused by the emission of air pollutants from one source, or a small group of sources.

R18-2-1602. Applicability

This Article applies to any existing stationary source located in the state that may reasonably be anticipated to cause or contribute to visibility impairment in any mandatory Federal Class I area identified in 40 CFR §§81.401-81.436. Mandatory Federal Class I areas within Arizona are: Chiricahua National Monument Wilderness, Chiricahua Wilderness, Galiuro Wilderness, Grand Canyon National Park, Mazatzal Wilderness, Mount Baldy Wilderness, Petrified Forest National Park, Pine Mountain Wilderness, Saguaro Wilderness, Sierra Ancha Wilderness, Superstition Wilderness, and Sycamore Canyon Wilderness.

R18-2-1603. Certification of Impairment

A. A Federal Land Manager with authority over a mandatory Federal Class I area may certify to the Director, at any time, that a reasonably attributable visibility impairment exists in a mandatory Federal Class I area. The Director may also certify that reasonably attributable visibility impairment exists in any mandatory Federal Class I area to assure reasonable progress under section 169A(b)(2) of the Clean Air Act.

B. Documentation that supports the Federal Land Manager or Director's certification shall include:

1. The mandatory Federal Class I area for which visibility impairment is being certified,
2. Any information documenting the basis for the certification of impairment.

R18-2-1604. Attribution Analysis; Finding

A. If a mandatory Federal Class I area is certified as having reasonably attributable visibility impairment, the Director shall conduct an attribution analysis to identify each existing stationary source that may be reasonably anticipated to cause or contribute to visibility impairment. The Director shall notify the Federal Land Manager, affected source or small group of sources, and local air pollution control officer of the intent to conduct an attribution analysis. The attribution analysis shall be based on the following:

1. Monitoring information obtained through the Arizona Class I Visibility Monitoring Network or special studies approved by ADEQ to ascertain:
   a. The times visibility impairment occurred, and
   b. The pollutants contributing to the visibility impairment;
2. Transport analysis or air quality modeling based upon meteorological records to ascertain whether the pollutants were transported to the mandatory Federal Class I area;
3. Other available studies, modeling analyses, and emissions inventories of point, area, and mobile source emissions to ascertain:
   a. The pollutant causing the impairment, and
   b. The source, or a small group of sources, emitting the pollutant;

4. Other relevant supporting documentation provided by the Federal Land Manager or Director used to make the draft attribution analysis finding; and
5. Consideration of any documentation provided by the source, a small group of sources; or other interested parties.

B. In conducting the attribution analysis, the Director shall use monitoring information, meteorological records, and emissions inventories that represent times and locations reasonably concurrent with the visibility impairment.

C. The Director shall issue a draft attribution finding that impairment has or has not occurred, and provide public notice of the draft attribution finding. The Director shall publish notice of the draft attribution finding in a newspaper of general circulation in each county containing the mandatory Federal Class I area and the affected source. The Director shall provide at least 30 days from the date of the notice for public comment. Written comments to the Director shall include the name of the person and the person's agent or attorney, if any, and shall clearly set forth reasons why the Director should review the draft attribution finding. The Director shall issue a final attribution finding after the public comment period. If the Director finds existing stationary sources cause or contribute to visibility impairment in a mandatory Federal Class I area, the source shall be subject to a BART Control Analysis under R18-2-1605.

R18-2-1605. BART Control Analysis; Finding

A. The Director shall analyze for BART controls each existing stationary source for which a final attribution finding is made under R18-2-1604(C). The Director shall consider the following factors:

1. Available control technology;
2. New source performance standards (NSPS) in Article 9;
3. Alternative control systems if retrofitting to comply with applicable NSPS standards in Article 9 is infeasible;
4. Cost of compliance;
5. Energy and non-air quality environmental impacts of compliance;
6. Existing pollution control technology in use at the source or small group of sources;
7. Remaining useful life of the source or small group of sources;
8. Net environmental impact associated with the proposed emission control system;
9. Economic impacts associated with installing and operating the proposed emission control system; and

10. Degree of improvement in visibility anticipated to result from application of the proposed emission control system.

B. The Director shall issue a draft BART finding, and provide public notice of the draft BART finding. The Director shall publish notice of the draft BART finding in a newspaper of general circulation in each county containing the mandatory Federal Class I area and the affected source. The Director shall provide at least 30 days from the date of the notice for public comment. Written comments to the Director shall include the name of the person and the person's agent or attorney, and shall clearly set forth reasons why the Director should review the draft BART finding. The Director shall issue a final BART finding after the public comment period.

1. The Director shall submit each final BART finding to the Administrator as a revision to the SIP.
2. The Director shall require that each existing stationary source meet BART as expeditiously as practicable but in no case later than five years after EPA approval of the SIP revision.

C. If the Director determines that technological or economic limitations on the applicability of measurement methodology to a particular existing stationary source would make the imposition of an emission standard infeasible, the Director may, as part of the finding under subsection (B), prescribe a design, equipment, work practice, operational standard, or combination of design, equipment, work practice, or operational standard. The standard, to the degree possible, shall set forth the emission reduction to be achieved by implementation of the design, equipment, work practice, or operation, and shall provide for compliance by means that achieve equivalent results.

D. The Director shall make a finding that the attributable source satisfies the BART requirement if the attributable source:

1. Voluntarily applies best available retrofit technology;
2. Previously applied emission control standards equivalent to BART; or
3. Agrees to shutdown or curtail operations at the attributable source within five years of the finding. An attributable source that does not shutdown or curtail operations shall meet BART as expeditiously as practicable, but in no case later than five years after EPA's approval of the revision to the SIP.

E. If the Director determines that the imposition of BART or a standard under subsection (C) is infeasible at the time of the finding, the Director shall require the attributable source to install and operate BART at a later date when the Director determines that BART or equivalent controls are feasible.

F. The Director shall provide for a BART control analysis of any existing stationary source that might cause or contribute to impairment of visibility in any mandatory Federal Class I area identified under this Article at such time as the Administrator determines new control technology for the pollutant becomes reasonably available:

1. The pollutant is emitted by that existing stationary source,
2. Controls representing BART for the pollutant have not previously been required under this Article, and
3. The impairment of visibility in any mandatory Federal Class I area is reasonably attributable to the emissions of that pollutant.

R18-2-1606. Exemption from BART

Any existing stationary source required to install, operate, and maintain BART under this Article, may apply to the Administrator for an exemption from that requirement according to 40 CFR 51.303. The existing stationary source shall obtain the Director's written concurrence before sending the application for exemption to the Administrator.

<u>Appendix A-5d. New source review rule - R18-2-410</u>

R18-2-410. Visibility Protection

A. For any new major source or major modification subject to the provisions of this Chapter, no permit or permit revision under this Article shall be issued to a person proposing to construct or modify the source unless the applicant has provided:
   1. An analysis of the anticipated impacts of the proposed source on visibility in any Class I areas which may be affected by the emissions from that source; and
   2. Results of monitoring of visibility in any area near the proposed source for such purposes and by such means as the Director determines is necessary and appropriate.

B. A determination of an adverse impact on visibility shall be made based on consideration of all of the following factors:
   1. The times of visitor use of the area;
   2. The frequency and timing of natural conditions in the area that reduce visibility;
   3. All of the following visibility impairment characteristics:
      a. Geographic extent,
      b. Intensity,
      c. Duration,
      d. Frequency,
      e. Time of day;
   4. The correlation between the characteristics listed in subsection (B)(3) and the factors described in subsections (B)(1) and (2).

C. The Director shall not issue a permit or permit revision pursuant to this Article or Article 3 of this Chapter for any new major source or major modification subject to this Chapter unless the following requirements have been met:
   1. The Director shall notify the individuals identified in subsection (C)(2) within 30 days of receipt of any advance notification of any such permit or permit revision under this Article.
   2. Within 30 days of receipt of an application for a permit or permit revision under this Article for a source whose emissions may affect a Class I area, the Director shall provide written notification of the application to the Federal Land Manager and the federal official charged with direct responsibility for management of any lands within any such area. The notice shall:
      a. Include a copy of all information relevant to the permit or permit revision under this Article,
      b. Include an analysis of the anticipated impacts of the proposed source on visibility in any area which may be affected by emissions from the source, and
      c. Provide for no less than a 30-day period within which written comments may be submitted.
   3. The Director shall consider any analysis provided by the Federal Land Manager that is received within the comment period provided in subsection (C)(2).
      a. Where the Director finds that the analysis provided by the Federal Land Manager does not demonstrate to the satisfaction of the Director that an adverse impact on visibility will result in the area, the Director shall, within the public notice required under R18-2-330, either explain the decision or specify where the explanation can be obtained.
      b. When the Director finds that the analysis provided by the Federal Land Manager demonstrates to the satisfaction of the Director that an adverse impact on visibility will result in the area, the Director shall not issue a permit or permit revision under this Article for the proposed major new source or major modification.
   4. When the proposed permit decision is made, pursuant to R18-2-304(J), and available for public review, the Director shall provide the individuals identified in subsection (C)(2) with a copy of the proposed permit decision and shall make available to them any materials used in making that determination.

Historical Note

Adopted effective May 14, 1979 (Supp. 79-1). Former Section R9-3-410 renumbered without change as Section R18-2-410 (Supp. 87-3). Section R18-2-410 renumbered to R18-2-610, new Section R18-2-410 adopted effective November 15, 1993 (Supp. 93-4).

<u>APPENDIX A-6. CLEAN AIR CORRIDOR</u>

This appendix contains work products and references relied upon by Arizona in the development of Chapter 6 of the Regional Haze SIP.

<u>Appendix A-6a. WRAP Policy on Clean Air Corridors</u>

WRAP Policy on Clean Air Corridors

Approved by WRAP Board
November 13, 2002

I. Summary of WRAP Policy

1. *Pursuant to 40 CFR 51.309(d)(3), the WRAP directs its Technical Oversight Committee (TOC) to track emissions and to describe the tracking process in such a way that can be included in state and tribal implementation plans. At a minimum, using the most recent state emission inventories available, the TOC should produce a report for each five-year implementation plan revision on the current and projected emissions in the clean air corridor and in areas outside the corridor and compare these emissions to a 1996 baseline for purposes of this section.*

2. *Pursuant to 40 CFR 51.309(d)(3)(i), the WRAP identifies one clean air corridor as shown in* ***Figure 1***. *The counties within the corridor are listed in* ***Table 1***. *For ease of administration, the corridor's boundary follows county lines.*

3. *Pursuant to 40 CFR 51.309(d)(3)(ii), the WRAP has examined patterns of growth in the corridor and finds that they are not causing significant emission increases that could have or are having visibility impacts at one or more of the 16 Class I areas. Nor, at this time, are such emission increases expected during the first planning period (2003-2018). Analyses performed by the Grand Canyon Visibility Transport Commission found that an increase of 25% in weighted emissions would result in a 0.7 dv reduction in visibility, whereas the weighted emission increase expected by 2018 is only 4%.*

4. *Pursuant to 40 CFR 51.309(d)(3)(iii), the WRAP has examined emissions growth in areas outside the corridor and finds that significant emissions growth is not occurring that could begin or is beginning to impair the quality of the air in the corridor and thereby lead to visibility degradation for the least impaired days in one or more of the 16 Class I areas.*

5. *Since impairment of air quality in clean air corridors has not been identified pursuant to 40 CFR 51.309(d)(3)(ii) and (iii), the WRAP finds no requirement under 40 CFR 51.309(d)(3)(iv) for further visibility impact analysis or additional emission reduction measures until at least the next SIP revision (2008). However, the WRAP encourages its appropriate technical activities – such as the Causes of Haze report – to take into account the assessment and protection of clean air corridors.*

6. *Pursuant to 40 CFR 51.309(d)(3)(v), the WRAP finds no other clean air corridors beyond the corridor identified in* ***Figure 1***.

II. Clean Air Corridors, The Clean Air Act, And The Regional Haze Rule

The Clean Air Act Amendments of 1990 specifically require that visibility transport commissions, including the Grand Canyon Visibility Transport Commission ("Commission"), address "the establishment of clean air corridors, in which additional restrictions on increases in emissions may be appropriate to protect visibility in affected class I areas."[1] The Clean Air Act also requires protection of clean air corridors in a less direct way. The Act establishes as a national goal the prevention of any future impairment of visibility in mandatory Class I areas. As a measure of progress towards this goal, the U.S. Environmental Protection Agency (EPA) has established a criteria of no degradation on the 20% cleanest days. Such days on the Colorado Plateau are usually dominated by northwest winds, hence defining a corridor to the northwest that must be protected to meet the broader visibility goal of the Clean Air Act.

In its regional haze rule, the EPA provides more specificity on the requirements to protect clean air corridors, based largely on the recommendations of the Commission. The preamble of the rule defines a clean air corridor as "a region that generally brings clean air to a receptor region" The preamble also says, "the requirement to track emissions will enable states to quickly determine if changes in patterns of emissions will reduce the number of clean air days (defined as the average of the 20% clearest days) in any of the 16 Class I areas." The actual requirements of the rule are found in 40 CFR 51.309(d)(3):

> The [state implementation] plan must describe and provide for implementation of comprehensive emission tracking strategies for clean-air corridors to ensure that the visibility does not degrade on the least-impaired days at any of the 16 Class I areas. The strategy must include:
>
> (i) An identification of clean-air corridors. The EPA will evaluate the State's identification of such corridors based upon the reports of the Commission's Meteorology Subcommittee and any future updates by a successor organization.
>
> (ii) Within areas that are clean-air corridors, an identification of patterns of growth or specific sites of growth that could cause, or are causing, significant emissions increases that could have, or are having, visibility impairment at one or more of the 16 Class I areas.
>
> (iii) In areas outside of clean-air corridors, an identification of significant emissions growth that could begin, or is beginning, to impair the quality of air in the corridor and thereby lead to visibility degradation for the least-impaired days in one or more of the 16 Class I areas.
>
> (iv) If impairment of air quality in clean air corridors is identified pursuant to §§51.309(d)(3)(ii) and (iii), an analysis of the effects of increased emissions, including provisions for the identification of the need for additional emission reductions measures, and implementation of the additional measures where necessary.

[1] 42 U.S.C. 2169B(d)(2)(A).

(v) A determination of whether other clean air corridors exist for any of the 16 Class I areas. For any such clean air corridors, an identification of the necessary measures to protect against future degradation of air quality in any of the 16 Class I areas.

These requirements do not apply to states submitting state implementation plans (SIPs) under §308 of the rule. However, such states should provide the data necessary for other states to comply and should make a good faith effort to protect the integrity of clean air corridors.

III. The Commission's Findings and Recommendations

The Commission found that clean air corridors exist and that, generally, clean air comes to the Colorado Plateau from the northwest.[2] The Commission determined that one such corridor covers southern Utah, eastern Oregon, southwestern Idaho, and major portions of Nevada. This corridor was identified by the Commission's Meteorology Subcommittee, which examined the size and boundaries of the corridor under varying assumptions about the number of days defined as clean and the amount of protection to be afforded.[3]

Related work by Green et. al.[4] identifies three factors that explain why air from the northwest is clean when it arrives at the Colorado Plateau: low emissions of air pollutants, enhanced dispersion of the air pollutants due to higher average ventilation (wind speed multiplied by mixing depth), and increased removal of pollutants due to precipitation. Although the corridor is mostly arid, the cleanest days occur most frequently in the winter, when there is more precipitation than average. Green et al., nonetheless, conclude that the most important factor at the south rim of the Grand Canyon for most weather conditions is the low emissions of pollutants in the area to the northwest.

In addition to identifying a clean air corridor, the Commission projected emissions growth within the corridor through 2040 and found that growth is not expected to have a perceptible negative impact on the cleanest days on the Colorado Plateau. Specifically, a working group within the Meteorology Subcommittee used results from the IAS model (the model used to project visibility impacts in other Commission work) to estimate the emissions increase from 1990 that would be necessary to cause a perceptible decrease in visibility on the Plateau.[5] The working group found that increasing emissions by 25% within the corridor would result in an average change of 0.7 deciviews (dv), which would be imperceptible to most people under most conditions, while a 100% increase in emissions within the corridor would result in a change of 2.5 dv.[6] This

[2] Grand Canyon Visibility Transport Commission. Recommendations for Improving Western Vistas. Western Governors' Association. Denver, CO. June 1996.
[3] Meteorological Subcommittee, Grand Canyon Visibility Transport Commission. Clean Air Corridors: A Framework for Identifying Regions that Influence Clean Air on the Colorado Plateau. Denver, CO. August 1995.
[4] Green, M. C.; Pitchford, M. L.; and Ashbaugh, L.L. Identification of Candidate Clean Air Corridors for the Colorado Plateau. *J. Air & Waste Manage. Assoc. 1996. 46(5),* 446.
[5] Marc Pitchford. Oral communication. October 3, 2002. Participants on the working group included Dr. Pitchford, Dr. William Malm, and Dr. Ivar Tombach.
[6] BBC Research & Consulting, Inc., for the Operations Committee of the Grand Canyon Visibility Transport Commission. Clean Air Corridor: An Economic Perspective. Denver, CO. November 1995. Page III-2:6.

estimate was not based on a specific boundary for the corridor but rather on the general understanding of a corridor to the northwest of the Plateau. The implication, nonetheless, is that a 25% increase in emissions within the corridor could be considered a level of growth that would not impact visibility.

Using one of the proposed corridor alignments examined by the Meteorology Subcommittee – a corridor that would protect the 30% cleanest days on the Colorado Plateau, adjusted to account for emissions density and IAS region boundaries – BBC Research & Consulting conducted an economic and demographic assessment of the corridor to determine whether emissions would increase 25% by 2040. The assessment found that emissions are not expected to increase 25% by 2040.[7] Specifically, BBC used a weighting scheme defined in the IAS model to account for the varying effects of different pollutants on visibility. Total weighted emissions of elemental carbon, nitrogen oxides, organic carbon, particulate matter, reactive organic gases, and sulfur oxides in 1990 were 52,073 VEEU tons.[8] A 25% increase would yield 65,092 VEEU tons. BBC projected that emissions in the corridor would increase to 55,047 VEEU tons by 2040, thus leaving an ample margin of safety of 10,054 VEEU tons.[9]

As a result of these analyses, the Commission recommended that no targeted policies or regulatory programs to control emissions growth were needed at that time, but that a regional tracking and accounting system be implemented to make sure that the frequency of clear days does not decrease at the 16 Class I areas and that the Commission's assumptions about increased emissions are proven reliable. The Commission recommended that, within areas that are sources of clean air, the tracking and accounting system should identify patterns of growth that have a negative impact on visibility and that, in areas outside the clean air corridors, the tracking and accounting system should identify significant emissions growth that begins to impair the quality of air in the corridor.

IV. WRAP Policy

A. Emissions Tracking – §309(d)(3)

> *The WRAP directs its Technical Oversight Committee (TOC) to track emissions and to describe the tracking process in such a way that can be included in state and tribal implementation plans. At a minimum, using the most recent state emission inventories available, the TOC should produce a report for each five-year implementation plan revision on the current and projected emissions in the clean air corridor and in areas outside the corridor and compare these emissions to a 1996 baseline for purposes of this section.*

The tracking described above is intended to ensure that any unexpected changes are identified. This tracking would coincide with the periodic SIP revisions required in 2008, 2013, and 2018. States and tribes already prepare inventories at least every three years to meet federal

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[7] BBC report, page III-5
[8] Visibility Equivalency Emission Units
[9] BBC report, page III-6.

requirements and will prepare detailed inventories annually for sources of sulfur dioxide of 100 tons per year or greater for compliance with the stationary source provisions of §309.[10] The WRAP will use these state and tribal data for tracking emissions in general and can summarize emissions for the counties and tribal lands within the corridor and for areas outside the corridor for use by states and tribes as they revise their regional haze SIPs every five years. Further information on tracking point sources and area sources is provided below.

POINT SOURCES. Any new, large source will be required to undergo a Prevention of Significant Deterioration review and an Air Quality Related Values analysis before receiving an air quality permit and will also be subject to New Source Performance Standards and other requirements, giving the public, states, tribes, and federal land managers ample opportunity to evaluate any possible visibility impacts on the 16 Class I areas. Thus, it is unlikely that point sources will lead to a 25% increase and even less likely that a trend in that direction would go unnoticed.

AREA AND MOBILE SOURCES. Population and economic growth is expected to be slow in the corridor, holding down emissions from area and mobile sources within the corridor. Federal standards recently promulgated for on-road sources and additional ones pending for non-road sources are expected to reduce emissions from both of these source categories during the first planning period of the implementation plans (2018). However, emissions from prescribed burning are expected to increase and, depending on the location of the burns, could affect visibility in the 16 Class I areas. It is hard to predict how great the effect will be on clean days, but it is not expected to be severe. For one, prescribed fires generally occur in the spring and fall, whereas most clear days occur in the winter. In addition, prescribed fires are much less intense than wild fires. Nonetheless, careful fire emissions tracking is warranted and is being developed under separate WRAP policy and technical efforts.

B. BOUNDARY OF THE CLEAN AIR CORRIDOR – §309(d)(3)(i)

> *The WRAP identifies one clean air corridor as shown in **Figure 1**. The counties within the corridor are listed in **Table 1**. For ease of administration, the corridor's boundary follows county lines.*

The WRAP adopts this boundary based on a balancing of demographic, economic, and air quality impact analyses performed on this corridor and their subsequent review and consensus-based approval by the Commission. The boundary identified is a slight modification of the boundary defined in the BBC report described above. The grid cells in the air quality analyses did not follow state or county boundaries, and for ease of administration the WRAP has removed small areas of southern Washington and southwestern Montana from the corridor. These small areas are far from the Colorado Plateau and unlikely to affect the Class I areas on the Plateau. In contrast, counties have been added to the corridor that were not originally included in the boundary defined in the BBC report. These include Box Elder, Tooele, and Grand Counties in Utah, Wasco and Sherman Counties in Oregon, and Cassia and Lemhi Counties in Idaho.

[10] Also see Western Regional Air Partnership. Voluntary Emissions Reduction Program for Major Industrial Sources of Sulfur Dioxide in Nine Western States and a Backstop Market Trading Program, An Annex to the Report of the Grand Canyon Visibility Transport Commission. Denver, CO. September 29, 2000.

C. IDENTIFICATION OF EMISSIONS INCREASES – §309(d)(3)(ii) and (iii)

Pursuant to 40 CFR 51.309(d)(3)(ii), the WRAP has examined patterns of growth in the corridor and finds that they are not causing significant emission increases that could have or are having visibility impacts at one or more of the 16 Class I areas. Nor, at this time, are such emission increases expected during the first planning period (2003-2018). Analyses performed by the Grand Canyon Visibility Transport Commission found that an increase of 25% in weighted emissions would result in a 0.7 dv reduction in visibility, whereas the weighted emission increase expected by 2018 is only 4%.

Patterns of growth in the corridor are first examined by comparing 1990 emissions (those used in the Commission's final report) to 1996 emissions (the most recent comprehensive data set). This comparison is not easily made because emissions were aggregated into different categories. Nonetheless, it appears that emissions in 1996 were only slightly higher than in 1990. In the clean air corridor 73,637 tons of SO_2 were emitted in 1990 and 73,756 were emitted in 1996; 232,704 tons of NO_x were emitted in 1990 and 256,762 were emitted in 1996. In addition, the WRAP examined data from IMPROVE monitors and found that none of the seven long-term sites showed any significant decrease in visibility on the cleanest days for the period from 1988 through 1998.[11]

The WRAP is recommending, as part of this policy, that future clean air corridor analyses use a baseline year of 1996 to quantify emission increases. The first reason for this recommendation is that the 1996 inventory has been more carefully assembled than the 1990 inventory. The second reason is that future inventories are more likely to be structured like the 1996 inventory, thereby facilitating comparison. In addition, the most recent and comprehensive projection of emissions (discussed below) is based on the 1996 inventory, not the 1990 inventory.

The WRAP also examined emission projections. These are used as a means to identify potential future increases that should be more carefully tracked and to identify preventive measures that could be implemented in a timely fashion. **Table 2** summarizes the projected change in emissions between 1996 and 2018. PM_{10} and $PM_{2.5}$ emissions are expected to increase about 7% and 18%, respectively. NOx and VOC emissions, however, are expected to decrease about 15% and 26%, respectively. SO_2 emissions are expected to increase about 5% within the corridor, even with the declining milestones of the backstop emissions trading program. Overall, SO_2 emissions are expected to decline by 17% in the 13-state contiguous WRAP region by 2018, [12] and the fact that the projections show a 5% increase in SO_2 within the clean air corridor is a result of non-road mobile sources using high-sulfur diesel fuel. This source of sulfur dioxide is expected to be drastically reduced (e.g., from a fuel sulfur content of 3,000 ppm to 15 ppm) before 2018 according to announcements by EPA to develop new engine certification and fuel standards for non-road vehicles and equipment. Thus, 5% should be viewed as an upper bound on the possible increase of SO_2.

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[11] EPA. Visibility in Mandatory Federal Class I Areas (1994-1998), A Report to Congress. EPA-452/R-01-008.
[12] WRAP Emissions Inventory Forum. 2018-1996 Difference: Actual to Control Spreadsheet. WRAP Web Site. September 25, 2002.

Since different pollutants have different impacts on visibility, the WRAP estimated a weighted emissions increase according to the VEEU system used by the Commission. As shown in **Table 3**, the weighted increase is expected to be 4%, substantially less than the 25% increase thought to be necessary to achieve an impact that may be perceptible. It is also worth noting the safety margins included within this analysis – the fact that the BBC corridor protects 30% of the clean days, not 20%; the benefits of new non-road mobile source standards; and the uncertainty in where additional electricity generating capacity will be located.

> *Pursuant to 40 CFR 51.309(d)(3)(iii), the WRAP has examined emissions growth in areas outside the corridor and finds that significant emissions growth is not occurring that could begin or is beginning to impair the quality of the air in the corridor and thereby lead to visibility degradation for the least impaired days in one or more of the 16 Class I areas.*

The WRAP sees two purposes for emissions tracking in areas outside the corridor: first, to determine if such emissions are degrading visibility in the corridor, which may potentially affect one or more of the 16 Class I areas; and second, to compensate for any uncertainties in establishing the boundary of the corridor, such as those relating to computed airmass trajectories or introduced by aligning the corridor with county boundaries. Again, SO_2 emissions are expected to decline throughout the WRAP region. Emissions of other pollutants are also expected to decline. All visibility-impairing pollutants from on-road mobile sources, with the exception of some minor ammonia emissions, are expected to decline substantially. And all visibility impairing pollutants from non-road mobile sources are expected to decline, especially in areas upwind of the corridor. This decline would be greatly enhanced if the EPA promulgates stricter standards for non-road engines and fuel, as it has announced to do. Also, NOx and PM from existing stationary sources remains to be addressed in future implementation plans by 2008 under Sections 308 and 309 of the regional haze rule. Finally, all states will have to implement measures to achieve reasonable progress in other Class I areas by 2008. Such measures are likely to “overlap” the clean air corridor and areas outside the corridor in such a way that provide further protection to the 16 Class I areas on the 20% cleanest days.

D. If Impairment Of Air Quality In The Corridor Is Identified – §309(d)(3)(iv)

> *Since impairment of air quality in clean air corridors has not been identified pursuant to 40 CFR 51.309(d)(3)(ii) and (iii), the WRAP finds no requirement under 40 CFR 51.309(d)(3)(iv) for further visibility impact analysis or additional emission reduction measures until at least the next SIP revision (2008). However, the WRAP encourages its appropriate technical activities – such as the Causes of Haze report – to take into account the assessment and protection of clean air corridors.*

The rule specifies that if impairment of air quality in the clean air corridor is identified, the plan must include "an analysis of the effects of increased emissions, including provisions for the identification of the need for additional emission reduction measures, and implementation of the additional measures if necessary." For reasons stated above, the WRAP finds no need at this time for additional emission reduction measures.

The periodic WRAP inventories to be produced by the TOC, as instructed above, will identify growth in emissions, and the periodic updates to the WRAP Causes of Haze report will help identify any effect on visibility that may result from such emissions increases. Should any effects be identified, the WRAP will conduct an analysis to determine the sources of impairment within six months of completion of the inventory indicating the increase. Additional control measures that may be warranted would be developed within another six months. The criteria the states and tribes would follow in making this determination are (a) the location of the significant emissions growth, (b) type of source activity causing the emissions growth, and (c) the appropriate control measure for the source(s) based on feasibility, cost, and anticipated visibility benefits. Any necessary additional control measures would be added in the next five-year SIP revision.

E. DO OTHER CORRIDORS EXIST? – §309(d)(3)(v)

*The WRAP finds no other clean air corridors beyond the corridor identified in **Figure 1**.*

The regional haze rule requires that implementation plans identify whether any other clean air corridors exist for any of the 16 Class I areas. The WRAP finds no such areas other than the corridor to the northwest of the Colorado Plateau identified in **Figure 1**. The WRAP recognizes, however, that additional work to identify clean air corridors may be needed. For example, several monitors have recently been installed at Class I areas on the Plateau which were not previously monitored. These may generate a slightly different set of 20% cleanest days and a slightly different set of back trajectories on those days, especially at sites furthest to the north and east. This may result in a broader or separate corridor. Such analysis should be performed when sufficient data are available. Adequate monitoring data could be available by 2004, and analysis of those data could be published by the WRAP as part of its Causes of Haze report.

V. Conclusion

The bottom line is that, while the area to the northwest of the Colorado Plateau delivers clean air to the Plateau on the cleanest days, emissions from throughout much of the region affect the Class I areas on the Plateau. Thus, emissions throughout the WRAP region will be tracked carefully. Ongoing WRAP efforts to improve the quality of inventories and the models used to make projections, and to produce a periodic Causes of Haze report, will bring increased understanding of the role that clean air corridors play in protecting the cleanest days.   In the final analysis, the indicator of success or failure will be whether the measured light extinction at the Class I areas on the Colorado Plateau improves or declines on the cleanest days. Any indication of deterioration on the cleanest days should trigger an immediate investigation of the cause, as well as efforts to correct the problem.

Figure 1. Clean Air Corridor Endorsed by the WRAP.

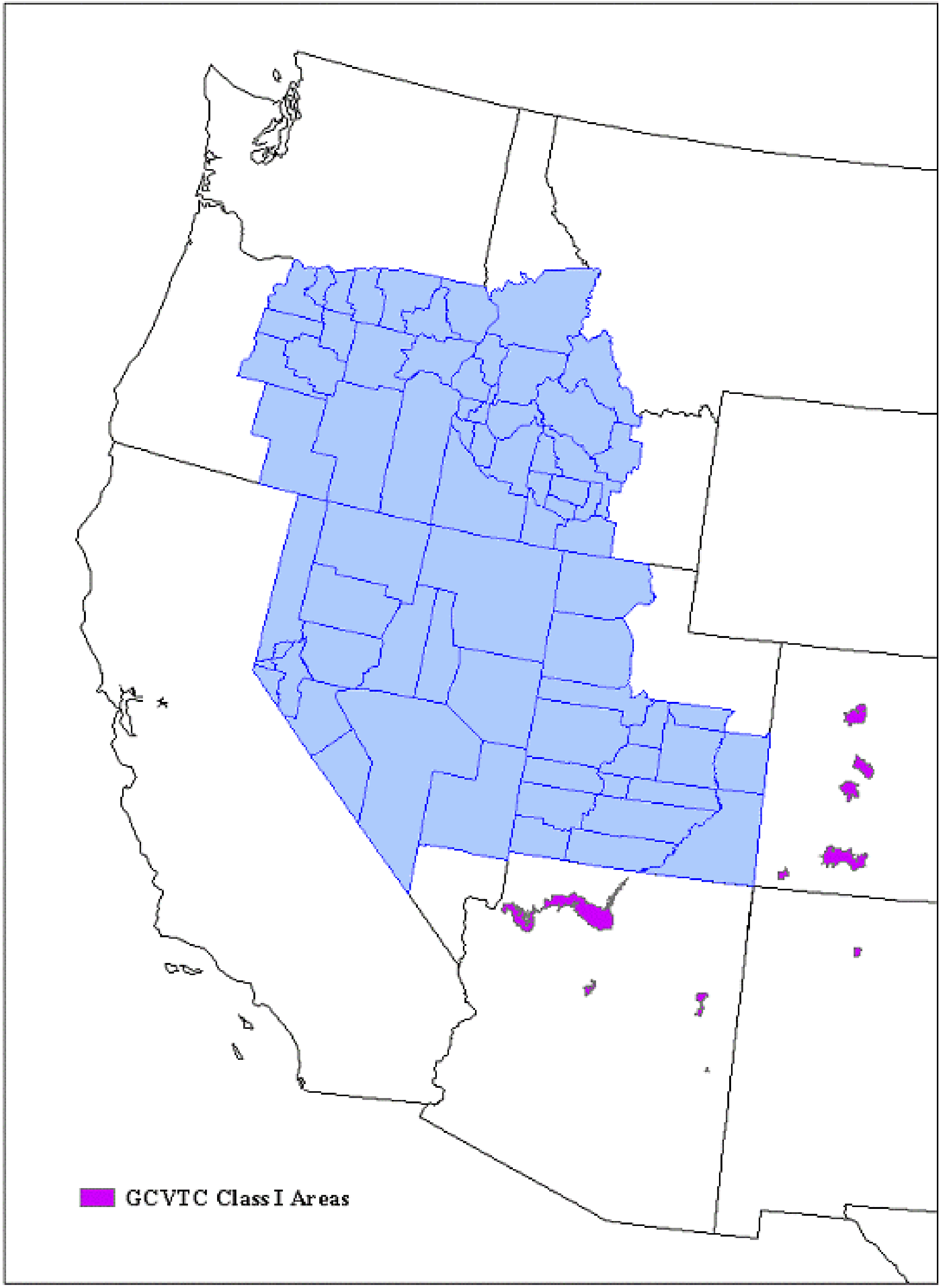

Table 1. Counties Within the Clean Air Corridor Endorsed by the WRAP.

State	County	State	County
Idaho	Ada	Oregon	Grant
Idaho	Adams	Oregon	Harney
Idaho	Blaine	Oregon	Jefferson
Idaho	Boise	Oregon	Lake
Idaho	Butte	Oregon	Malheur
Idaho	Camas	Oregon	Morrow
Idaho	Canyon	Oregon	Sherman
Idaho	Cassia	Oregon	Umatilla
Idaho	Custer	Oregon	Union
Idaho	Elmore	Oregon	Wallowa
Idaho	Gem	Oregon	Wasco
Idaho	Gooding	Oregon	Wheeler
Idaho	Idaho	Utah	Beaver
Idaho	Jerome	Utah	Box Elder
Idaho	Lemhi	Utah	Carbon
Idaho	Lincoln	Utah	Emery
Idaho	Minidoka	Utah	Garfield
Idaho	Owyhee	Utah	Grand
Idaho	Payette	Utah	Iron
Idaho	Twin Falls	Utah	Juab
Idaho	Valley	Utah	Kane
Idaho	Washington	Utah	Millard
Nevada	Churchill	Utah	Piute
Nevada	Douglas	Utah	San Juan
Nevada	Elko	Utah	Sanpete
Nevada	Esmeralda	Utah	Sevier
Nevada	Eureka	Utah	Tooele
Nevada	Humboldt	Utah	Washington
Nevada	Lander	Utah	Wayne
Nevada	Lincoln		
Nevada	Lyon		
Nevada	Mineral		
Nevada	Nye		
Nevada	Pershing		
Nevada	Storey		
Nevada	Washoe		
Nevada	White Pine		
Nevada	Carson City		
Oregon	Baker		
Oregon	Crook		
Oregon	Deschutes		
Oregon	Gilliam		

Table 2. Changes in Clean Air Corridor Emissions (Assuming SO_2 Milestones Are Met).

		Point	Area	On Road	Non Road	Paved	Unpaved	Total
SO_2	1996	51,413	9,260	2,065	10,838	0	0	73,576
	2018	45,330	10,614	413	21,596	0	0	77,954
	2018-1996	-6,082	1,354	-1,652	10,758	0	0	4,378
NOx	1996	85,782	12,935	93,581	64,462	0	0	256,762
	2018	109,863	17,576	28,692	62,557	0	0	218,689
	2018-1996	24,080	4,641	-64,889	-1,905	0	0	-38,072
PM_{10}	1996	27,055	142,776	3,872	5,952	5,740	47,733	233,128
	2018	32,748	154,966	2,640	6,763	12,402	38,828	248,347
	2018-1996	5,692	12,190	-1,232	811	6,662	-8,904	15,219
$PM_{2.5}$	1996	11,987	41,595	3,495	5,487	1,435	7,160	71,160
	2018	14,583	52,069	2,058	6,228	3,101	5,824	83,863
	2018-1996	2,595	10,474	-1,438	740	1,665	-1,336	12,702
VOC	1996	5,993	95,921	69,899	38,535	0	0	210,349
	2018	7,921	95,515	22,651	29,233	0	0	155,321
	2018-1996	1,927	-406	-47,248	-9,301	0	0	-55,029

Table 3. Total Change in Emissions Weighted to Reflect Relative Impact on Visibility.

	SO2	NOx	PM10	PM2.5	VOC	EC*	OC*	Total	Change
1996 VEEU	5,445	1,746	1,958	932	294	902	856	12,133	--
2018 VEEU	5,769	1,487	2,086	1,099	217	985	935	12,578	4%

* Estimates of elemental and organic carbon, EC and OC, were not available to the CAC Work Group for the 1996 and 2018 emission inventories. Values for this analysis were derived from the estimates of EC and OC for the 1990 inventory of the 9 GCVTC states. The method used was to take the proportion of EC to fine and coarse particulates (PM2.5 + PM10) in the 1990 inventory and use that same proportion to calculate an EC value for the 1996, 2018, and 2018 milestone inventories. The same method was used for OC.

**** VEEU – Visibility Equivalency Emission Units** (Used in the GCVTC IAS Model.)
VEEU weights

PM2.5	PM10	NOx	VOC	SO2	EC	OC
0.0131	0.0084	0.0068	0.0014	0.0740	0.6497	0.2466

Each category in the inventory is multiplied by these factors to create the VEEU-weighted inventory.

Appendix A-6b. WRAP Emission Tracking System and Assessment Process for the Clean Air Corridor

FINAL

NEEDS ASSESSMENT FOR EVALUATION AND DESIGN OF AN EMISSIONS DATA REPORTING, MANAGEMENT, AND TRACKING SYSTEM

Prepared for

Western Governor's Association
Western Regional Air Partnership
1515 Cleveland Place
Suite 200
Denver, Colorado 80202

Prepared by

EA Engineering, Science, and Technology
15 Loveton Circle
Sparks, MD 21152

July 25, 2003

NEEDS ASSESSMENT FOR EVALUATION AND DESIGN OF AN EMISSIONS DATA REPORTING, MANAGEMENT, AND TRACKING SYSTEM

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July 25, 2003

EA Project No: 1406601

CONTENTS

1.0 INTRODUCTION

1.1 Regional Haze

Regional haze is defined as air pollution that is transported long distances and reduces visibility in national parks and wilderness areas. The pollutants that create this haze are sulfates, nitrates, organic carbon, elemental carbon, and soil dust. Human-caused haze sources include industry, motor vehicles, agricultural and forestry burning, and windblown dust from roads and farming practices.

In 1999, the US Environmental Protection Agency (EPA) issued regulations that address regional haze in one hundred fifty six (156) national parks and wilderness areas across the country. The goal of the Regional Haze Rule (RHR) is to eliminate human-caused visibility impairment in national parks and wilderness areas across the country. It contains strategies to improve visibility over the next sixty (60) years, and requires states to adopt implementation plans.

The RHR provides two paths to address regional haze. One is 40 CFR 51.308 (Section 308), and requires most states to develop long-term strategies out to the year 2064. These strategies must be shown to make "reasonable progress" in improving visibility in Class I areas inside the state and in neighboring jurisdictions. The other is 40 CFR 51.309 (Section 309), and is an option for nine states - Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Wyoming - and the two hundred eleven (211) Tribes located within those States to adopt regional haze strategies for the period from 2003 to 2018. These strategies are based on recommendations from the Grand Canyon Visibility Transport Commission (GCVTC), for protecting the sixteen (16) Class I areas in the Colorado Plateau area (GCTVC, 1996). Adopting these strategies constitutes reasonable progress until 2018. These same strategies can also be used by the nine western states and tribes to protect the other Class I areas within their own jurisdiction.

The RHR specifically requires comprehensive emissions tracking and reporting for clean air corridors (CAC), sulfur dioxide (SO_2) stationary sources, fire sources, mobile sources, and windblown dust sources among other requirements.

1.2 Consolidated Emission Reporting Rule

One of the recent EPA's rules that will affect the data submission requirements of the RHR is the Consolidated Emission Reporting Rule (CERR) (67 FR 39602-39616) issued in 2002. The CERR will simplify and consolidate emissions inventory reporting requirements to a single location within the CFR and establish new reporting requirements related to particulate matter with aerodynamic size less than 2.5 µm ($PM_{2.5}$), regional haze, and statewide reporting of area and mobile source emissions. In fact, new inventories will add $PM_{2.5}$ and ammonia (NH_3). Currently area and mobile sources are reported by nonattainment area, and under the CERR, inventories will include all sources statewide by county. Moreover, there will be an option to report smaller point sources once every three years or one-third of the sources every year.

1.3 RPO Data Exchange Protocol

The RPO data exchange protocol will also affect the data submission and reporting requirements. The goal of the RPO data exchange protocol is to facilitate the sharing of databases for emissions modeling in a regionally consistent and model-independent nature. Therefore, it seeks to develop data exchange formats and naming conventions so that emissions modelers from the five RPOs and states and tribes have common datasets from which to pursue regulatory modeling of ozone (O_3), regional haze, and PM. It includes nine different protocols:

- Industrial point source protocol
- Area source protocol
- Temporal allocation and profile assignment protocol
- On-road mobile sources protocol
- Off-road mobile sources protocol
- Continuous emissions monitoring and day-specific protocol
- Spatial surrogate protocol
- Speciation profile protocol
- Growth and control factors protocol

The data sources, data formats, and issues associated with each of these protocols are further detailed in the Midwest RPO's *Draft RPO Data Exchange Protocol* (Pechan, 2003).

1.4 Western Regional Air Partnership

The Western Regional Air Partnership (WRAP) is a regional planning organization (RPO) that was established in 1997 as the successor organization of the GCVTC. The WRAP is a collaborative effort of tribal governments, state governments, and various federal agencies to implement the recommendations of the GCVTC and to develop the technical and policy tools needed by western states and tribes to comply with the RHR. The WRAP Emissions Forum (EF) oversees the development of a comprehensive emissions tracking and forecasting system which can be utilized by the WRAP or its member entities to monitor the trends in actual emissions, and forecast the anticipated emissions which will result from current regulatory requirements and alternative control strategies. In addition, this forum is responsible for the oversight of the assembly and quality assurance of the emissions inventories and forecasts to be utilized by the WRAP forums.

1.5. Regulatory Framework for Tribal Visibility Implementation Plans

The RHR explicitly recognizes the authority of tribes to implement the provisions of the rule, in accordance with principles of federal Indian law, and as provided by the Clean Air Act (CAA) Section 301(d) and the tribal authority rule (TAR) (40 CFR 49.1–11). Those provisions create the following framework:

- Absent special circumstances, reservation lands are not subject to state jurisdiction.
- Federally recognized tribes may apply for and receive delegation of federal authority to implement CAA programs, including visibility regulation, or "reasonably severable"

elements of such programs (40 CFR 49.3, 49.7). The mechanism for this delegation is a tribal implementation plan (TIP). A reasonably severable element is one that is not integrally related to program elements that are not included in the plan submittal, and is consistent with applicable statutory and regulatory requirements.

- The RHR expressly provides that tribal visibility programs are "not dependent on the strategies selected by the state or states in which the tribe is located" (64 FR 35756), and that the authority to implement Section 309 TIPs extends to all tribes within the GCVTC region (40 CFR 51.309(d)(12)).
- The EPA has indicated that under the TAR, tribes are not required to submit Section 309 TIPs by the end of 2003. Rather, they may choose to opt-in to Section 309 programs at a later date (67 FR 30439).
- Where a tribe does not seek delegation through a TIP, EPA, as necessary and appropriate, will promulgate a federal implementation plan (FIP) within reasonable timeframes to protect air quality in Indian country (40 CFR 49.11). EPA is committed to consulting with tribes on a government-to-government basis in developing tribe-specific or generally applicable TIPs where necessary (63 FR 7263-64).

The amount of modification, if any, needed for this report to fulfill tribal needs may vary considerably from tribe to tribe. The authors have striven to ensure that all references to tribes in the document are consistent with principles of tribal sovereignty and autonomy as reflected in the above framework. Any inconsistency with this framework is strictly inadvertent and not an attempt to impose requirements on tribes, which are not present under existing law.

Tribes, along with states and federal agencies, are full partners in the WRAP, having equal representation on the WRAP Board as states. Whether Board members or not, it must be remembered that all tribes are governments, as distinguished from the "stakeholders" (private interest) which participate on Forums and Committees but are not eligible for the Board. Despite this equality of representation on the Board, tribes are very differently situated than states. There are over four hundred (400) federally recognized tribes in the WRAP region, including Alaska. The sheer number of tribes makes full participation impossible. Moreover, many tribes are faced with pressing environmental, economic, and social issues, and do not have the resources to participate in an effort such as the WRAP, however important its goals may be. These factors necessarily limit the level of tribal input into and endorsement of WRAP products.

The tribal participants in the WRAP, including Board members, Forum and Committee members, and co-chairs, make their best effort to ensure that WRAP products are in the best interest of the tribes, the environment, and the public. One interest is to ensure that WRAP policies, as implemented by states and tribes, will not constrain the future options of tribes who are not involved in the WRAP. With these considerations and limitations in mind, it is anticipated that the tribal participants will join the state, federal, and private stakeholder interests in approving this report as a consensus document.

1.6 Objectives

The EF is currently seeking to implement a comprehensive internet web-based air pollution emissions data reporting, management, and tracking system to support state and tribal regional haze implementation plan (SIP/TIP) development. The system is to be capable of receiving and storing emissions data in EPA-compliant emissions reporting formats commonly used by various agencies and sources with little or no additional effort, producing user-specified reports, performing user-selected quality control and assurance tests, allowing data queries and graphic display, and presenting this information in geographic information system (GIS) format.

The EF contracted with EA Engineering, Science, and Technology, Inc (EA) to assess the needs of the WRAP emissions database management system (WRAP EDMS). The overall approach of this needs assessment consists of the following tasks.

- Task 1: Determine the emissions data to be reported, managed and tracked.
- Task 2: Conduct a comparative analysis of existing emissions data management systems approved and in use by EPA and state air quality agencies.
- Task 3: Prepare a report addressing issues associated with developing a new system, long-term system maintenance and operation of the recommended data management system, by integrating information gathered in Tasks 1 and 2.

This report presents the results of Task 3 and represents the final technical report of the project. It provides the documentation from the two workshops and questionnaires, the findings based on the input received from the two workshops and questionnaires, an evaluation of existing EDMS, and the system recommendations.

2.0 WORKSHOP AND QUESTIONNAIRE FINDINGS

2.1 Description of the Workshops

The WRAP EDMS needs assessment survey consisted of two interview workshops. The first workshop took place in Santa Fe, New Mexico, on March 20th, 2003. It was intended for members of the WRAP Forums. Thirty-five (35) people attended the meeting. The workshop lasted approximately three hours, and included a presentation by the EA team covering the project overview and timeline, the goals and roles of the WRAP EDMS, a comparative summary of existing systems, a straw man presentation of the conceptual WRAP EDMS, and the conceptual timeline of the development and population of the WRAP EDMS. The presentation was followed by specific discussions on the WRAP EDMS needs. Appendices A1, A2, and A3 present the EA presentation, a summary of the discussion points, and the list of the workshop participants respectively.

The second workshop took place in Denver, Colorado, on May 7th, 2003 and was planned in order to provide an opportunity for state, tribe, and local (STL) air pollution control agencies staff and other stakeholders to participate in the project. Prospective attendees were notified by email several weeks prior to the meeting, and via an online questionnaire. Thirteen (13) people attended this day long workshop. The session included a presentation by the EA team that covered the project overview and timeline, the goals and roles of the WRAP EDMS, a summary of the RHR and CERR, a comparative summary of existing systems, a straw man presentation of the conceptual WRAP EDMS, the conceptual timeline of the development and population of the WRAP EDMS, and the summary of the Santa Fe workshop. This was followed by an oral presentation of the special needs of the Fire Emission Joint Forum (FEJF) and specific discussions on the WRAP EDMS needs were brought up during and after the presentations. Appendices B1, B2, and B3 present the EA presentation, a summary of the discussion points, and the list of the workshop participants respectively.

2.2 Description of Questionnaire

As mentioned above, in addition to the interview workshop, a web-based questionnaire was posted on http://wrap.eaest.com for a period of three months. All potential users of the WRAP EDMS, stakeholders, and interested parties were invited to fill it out. The questionnaire comprised thirty-four (34) questions designed to collect ideas on all the possible needs of the WRAP EDMS. Overall, twenty (20) peoples responded to the web-based questionnaire. Appendix C shows the results of this questionnaire. Furthermore, one person responded to this questionnaire via email before it was posted on the internet. Appendix C also shows these responses.

2.3 Findings

The workshop interviews and questionnaire results underscored the emerging project consensus that the WRAP EDMS needs to be different from any of the other existing systems (including the national emissions inventory (NEI)) because of its architecture, technical capabilities, and contents. The system needs to be developed with all possible users in mind, and with the intent to accommodate several distinct user groups. The WRAP EDMS will not only be a repository of the WRAP regional emissions inventories but will also be able to be used to implement the emissions tracking and reporting requirements of the RHR. The WRAP EDMS would be located either at the WRAP regional modeling center (RMC) or at a university center as is the monitoring database. Moreover, it will be made publicly accessible through the internet and will contain online training manuals.

The WRAP EDMS will track all the visibility-impairing pollutants: volatile organic compounds (VOC), nitrogen oxides (NOx), SO_2, PM_{10}, $PM_{2.5}$, elemental carbon (EC), organic carbon (OC), carbon monoxide (CO), and NH_3 and all the necessary activity data for all the sources and emission factors needed to calculate their emissions.

A metadata describing and characterizing all of the emissions data will be developed. Furthermore, The WRAP EDMS will be linked to other related external databases. These databases will contain related surrogate and activity data used to estimate some of the emissions such as mobile, biogenic, and windblown dust sources emissions as well as speciation profiles for VOC and PM data. The WRAP EDMS will also adopt the RPO data exchange protocol in order to capture all the necessary external data.

The emissions data will primarily be submitted by STL agencies. Emissions from mobile, biogenic, and windblown dust sources may be estimated through modeling using activity data submitted by STL agencies and other surrogate data. The estimated emissions will be sent to STL agencies for review and approval before inclusion in the final database. Fire source emissions data that are not generated by STL agencies will be estimated by the WRAP EDMS based on fire activity data submitted by STL agencies, federal agencies, private entities, or generated by WRAP. Some STL agencies may estimate fire emissions themselves. These emissions would be submitted by the STL agencies along with all the activity and surrogate data used for the estimation. WRAP will obtain and process the international (Canada and Mexico) data.

The large majority of participants in both workshops felt that the WRAP EDMS should be developed and populated in two phases. In Phase I, the system will include the core database architecture, including all of the functioning modules and all of the reporting and queries capabilities (see Section 4). It will be used primarily to store emissions data that will be used to implement the tracking and reporting requirements of both Sections 308 and 309. The focus will be on the implementation of the emissions tracking and reporting requirements of the CAC, fire sources, stationary SO_2 sources, and mobile sources. The minimum spatial resolutions of the emissions data will be the county and reservation levels. The submittal temporal resolution of the activity data would be variable (i.e. hourly, daily, seasonal, and annual) depending on the source category. However, the emissions will be reported and tracked on an annual resolution basis.

In Phase II, the system could be expanded to incorporate new and updated technical functionality that would allow for storage, tracking, and reporting of hourly, daily, seasonal, and annual emissions data as necessary. The system would include others pollutants (e.g. methane (CH_4), mercury (Hg), etc) and their emissions data. It may be used to track other RHR requirements (e.g. annual emission goals) and other regulations (e.g. Clear Skies, Greenhouse Gas, etc) requirements.

There was general agreement that the WRAP EDMS will be built and tested by the end of 2003 and will be live on the web in early 2004. This first version of the WRAP EDMS will be populated with the 2002 comprehensive emissions data. The collection, processing, and quality assurance/quality control (QA/QC) of these data from the STL agencies will start in early 2004 and will continue throughout 2004. At the same time, the 2002 base and 2018 projection years' emissions files that will be used by RMC will be produced. The system will also produce the emission reports as needed for both Sections 308 and 309. From 2005 to 2007, annual emissions will be generated from the 2002 comprehensive emissions data in order to satisfy the tracking and reporting requirements of the RHR. At the same time, refined emissions inventories representing the effect of control strategies in 2018 will be developed, and the 2005 comprehensive emissions data will be collected from STL agencies, processed, and QA/QC'd. It should be noted that the emissions data submitted by tribal agencies may be from any given inventory year. Moreover, wherever tribal emissions data are available, the state should adjust its inventory taking into account these tribal data. The conceptual development timeline of the WRAP EDMS is as follow.

- Mid 2003: finish needs assessment project
- Late 2003:
  1. WRAP contractor builds and alpha tests Phase I of WRAP EDMS
  2. Beta test of the WRAP EDMS
- Early 2004:
  1. Initiate live Phase I of the WRAP EDMS on the web
  2. Provide training and user support
- Throughout 2004: begin collection, processing, and QA/QC of 2002 emissions from STL agencies
- Late 2004:
  1. Implement Phase II of the WRAP EDMS
  2. Provide training and user support
  3. Produce emissions reports as needed for Section 308 and 309 requirements
  4. Prepare 2002 base and 2018 projection years' emissions files for use by RMC
- 2005-2007: ongoing operation of the WRAP EDMS
  1. Track emissions as needed for Section 308 and 309
  2. Develop refined emissions inventories representing the effect of control strategies in 2018
  3. Provide training and user support
  4. Populate the WRAP EDMS with annual emissions data to meet Section 308 and 309 regulatory requirements
  5. Collection, processing, and QA/QC of 2005 emissions from STL agencies

There was also consensus that the WRAP EDMS should be built in a modular fashion, to allow for easy expansion and improvement. It will include six major modules representing the sources (point, area, fire, mobile, windblown dust, and biogenic) in addition to the GIS, QA/QC, and database administrator (DBA) modules. The submission formats will be similar to that of the

NEI format (NIF) and the minimum submission cycle would coincide with the submission cycle of the NEI (annual and triennial cycles). However, the WRAP EDMS will have an open submittal process, where STL agencies' emissions data will be submitted at different times. Currently, state submit the NIF in several file formats including ASCII Text (Text), Microsoft Access database (MS Access), and eXtended Markup Language (XML). The results of the questionnaire indicated that, across the WRAP region, states are using Text, MS Access, in-house developed systems, and other systems (i.e. AMS Tempo) that need to be converted to the NIF. Therefore, the WRAP EDMS will accept all the file formats already accepted by NEI.

The WRAP EDMS will be managed by a DBA whose functions could include QA/QC, some emission calculations, data gap filling, data archiving, and data version management among others.

3.0 COMPARATIVE ANALYSIS

3.1 Conceptual WRAP EDMS

The conceptual WRAP EDMS was developed based on the findings of the interview workshops and the web-based questionnaire.

3.1.1 Data Tracking

The WRAP EDMS should contain all visibility-impairing pollutants: VOC, NO_x, SO_2, PM_{10}, $PM_{2.5}$, EC, OC, CO, and NH_3. The WRAP EDMS should also track all necessary activity data for all the sources and emission factors needed to calculate emissions. These pollutants and related activity data should be tracked for the following sources: point, area, mobile, biogenic, windblown dust, and fire sources. The data will be tracked at the county and reservation level for all sources and also individually for point and fire sources. The emissions data will be submitted to the WRAP EDMS by STL agencies, except for biogenic, mobile, windblown dust, and certain fire sources emissions data that will be calculated by WRAP using emissions estimation models. The submissions will be in a standard format similar to the NIF and done at the NEI minimum cycle but STL agencies may submit emissions data frequently.

3.1.2 Data QA/QC

The WRAP EDMS should include a QA/QC module to perform two levels of QA/QC. The first level of QA/QC should include a validation of the format of the submitted data files. This will ensure that the submitting entity supply all data to WRAP in the expected format and also identify any errors. The submittal check will be at the point of entry to the WRAP EDMS in order to minimize the DBA work and encourage STL agencies to submit clean data. The second level of QA/QC should consist of checks of the data that is submitted to WRAP, and include checking reference values and acceptable data ranges for specific data points. The data should also be checked for completeness, ensuring that all data exists for all sources and geographic areas.

3.1.3 Data Reporting

The WRAP EDMS should include a series of standard summary reports broken down by source type, geographic location, and pollutant. It should also include a series of reports designed specifically to meet the RHR emissions tracking and reporting requirements. The RHR reports will include special reports for CAC, pre-trigger SO_2 stationary sources, mobile sources, fire sources, and windblown dust sources. The WRAP EDMS should also include a series of data export formats for inclusion in external systems including emissions modeling programs such as SMOKE (MCNC, 1999).

3.1.4 GIS Components

The WRAP EDMS should include a fully functioning GIS module that provides multiple tools to display data over the internet. The inclusion of a GIS module will provide a means for users to select data that is of importance to them and display the data in a fashion that is easily understood. The WRAP EDMS should include the following GIS functionality: pan, zoom, query layer information, ability to add/remove multiple layers of data, point and click, measure distances, buffer, print multiple sizes of maps, and select map features by line, rectangle, or polygon.

The WRAP EDMS GIS module should include the following layers of data: county, state and country polygons, tribal reservation polygons, roadways and railroad line features, CAC polygons, international polygons, metropolitan statistical areas polygons, nonattainment area polygons, class I areas polygons, bodies of water polygons, census data polygons, other federal land polygons (i.e. national parks, monuments, forest, and refuges), and WRAP modeling domain grid system. It should have the ability to select and display emissions sources and associated emissions data by geographical area.

3.1.5 User Access and Preferences

All reporting features of the WRAP EDMS should be available to the public via the internet. STL agencies will have a separate, non-public interface for submitting their data to a central submission area. The user interface for the WRAP EDMS should be easy and intuitive to use while providing all necessary functionality.

3.2 Comparison

Five existing EDMS were evaluated and compared each to the conceptual WRAP EDMS. Each system was evaluated in terms of meeting the design and functionality requirements of the conceptual WRAP EDMS. As expected, none of the individual systems included all of the required elements for the conceptual WRAP EDMS. This was due in part to the fact that none of the systems tracked all of the required pollutants or included emissions data from all of the required, individual sources. In some instances, individual systems included most or all of the required functionality, such as a GIS module or the ability to export data, but did not track emissions data for all of the required pollutants or sources. Without all of the required data available, the output of these systems will be incomplete. Appendix D illustrates the overall comparison between the conceptual WRAP EDMS and the selected existing systems and Section 3.3 below describes these systems further.

3.3 Existing EDMS

This section lists each of the selected five existing database management systems, provides a brief description and background information for each, and highlights any elements from each system that could be utilized by the WRAP EDMS.

3.3.1 National Emissions Inventory – NEI

The EPA's Emission Factor and Inventory Group (EFIG) maintains a national emissions inventory containing information on air emissions and their sources for each state in the U.S., the U.S. Virgin Islands, Puerto Rico and the District of Columbia. The NEI has a public website (http://www.epa.gov/air/data/index.html) where users can query the emissions database and produce reports based on their specific needs.

3.3.1.1 System Details

The NEI tracks seven pollutants: VOC, NO_x, SO_2, PM_{10}, $PM_{2.5}$, CO, and NH_3. The pollutants are tracked for four source types: point, area, mobile, and biogenic sources. All data is tracked at the county level for all sources, and also individually for point sources. The data is submitted on an annual and triennial basis to EPA by state and tribal agencies. The data is submitted in the EPA's standard submission format, the NIF.

The NEI includes a QA/QC process that performs multiple levels of QA/QC checks. The first level consists of a validation of the format of the submitted data files, which ensures that the submitting entity supplied all data to NEI, in the expected format, and also identifies any errors with the submitted format. The second level of QA/QC checks includes checks of the data that is submitted to NEI. Reference values are checked against standard lists and data points are checked against acceptable data ranges. The data is also checked for completeness, ensuring that all data exists for all sources and geographic areas. If data points are missing, the NEI will replace the missing values with national averages or previous year data for the particular data point.

The NEI includes a series of standard summary reports broken down by source category, geographic location, and pollutant. The NEI also includes a data export feature to allow data to be extracted from the NEI database for inclusion in external systems.

The NEI includes a basic mapping capability to display emissions data over the internet. The NEI mapping functionality includes the ability to pan, zoom, and displays county, state and country boundaries.

All reporting features of the NEI are available to the public via the internet. The NEI user interface is easy to use and navigate to reach the desired data.

3.3.1.2 Key System Elements

The NEI has three key elements that should be utilized in the WRAP EDMS. First, the NEI requires a standard submission format (NIF) for all data submitted to the system. The WRAP EDMS could utilize this same submission format for all data sources, except for fire sources. The submission format captures the required emissions and activity data for all pollutants except OC and EC, which can be calculated by the WRAP system, based on the $PM_{2.5}$ data. Also, since STL agencies are already required to submit their data in the NIF format, no additional work will be necessary on their part to create submissions for the WRAP EDMS. See Appendix E for the recent version of the NIF submission formats.

Second, the NEI has a well-established and defined QA/QC process for all submitted emissions data. This process does a thorough analysis of the submission format and data content to identify all possible issues before the data is included in the system. The WRAP EDMS could adopt a modified version of this QA/QC Process to ensure that all data submitted to the WRAP EDMS is accurate. However, instead of automatically replacing missing or erroneous data with a default set of data, WRAP could make recommendations for replacing missing data or supplementing existing data to STL agencies while leaving the final approval for all data included in the WRAP EDMS with them. See Appendix F for a detailed explanation of the NEI QA/QC process.

Finally, the NEI includes an adequate set of standard reports for users to utilize when accessing the NEI database. The set of reports is not exhaustive, but does provide an excellent basis for data reporting and gathering to serve the public's data needs. The NEI report interface is also very easy to use and intuitive, making the data gathering process easy for the user. The WRAP EDMS could adopt this report functionality and design for the general data gathering and reporting capabilities of its system.

3.3.2 Tribal Emissions Inventory Software Solution – TEISS

Northern Arizona University is currently developing an air emissions inventory for all western region tribes. The Tribal Emissions Inventory Software Solution (TEISS) will be a desktop application where users can query the emissions database and produce reports based on their specific needs.

3.3.2.1 System Details

The TEISS tracks seven pollutants: VOC, NO_x, SO_2, PM_{10}, $PM_{2.5}$, CO, and NH_3. The pollutants are tracked for three source types: point, area, and mobile sources. All data is tracked at the reservation level for all sources, and also individually for point sources. The data is collected from the tribes on a continuing basis. The data is submitted in multiple formats and can also be hand-entered through data entry screens.

The TEISS includes a series of standard reports broken down by source category, geographic location, and pollutant. The TEISS also includes a data export feature to allow data to be extracted from the TEISS database for inclusion in external systems, including the NEI and modeling programs such as SMOKE.

The TEISS includes a fully functioning GIS module that provides multiple tools to display data geographically. The TEISS includes several advanced GIS features including: pan, zoom, query layer information, ability to add/remove multiple layers of data, measure distances, buffer, print multiple sizes of maps, and select map features by line, rectangle, or polygon. The TEISS GIS module includes several static layers of data, such as county, state and country, and tribal reservation boundaries, and the ability to select and display emissions sources and associated emissions levels by geographical area.

The TEISS utilizes an advanced user interface, since it is a desktop application and not accessible via the internet.

3.3.2.2 Key System Elements

The TEISS has two key elements that should be utilized in the WRAP EDMS. First, the TEISS has a fully functioning GIS module embedded in the system. This allows TEISS users to display map features in conjunction with relevant emissions and activity data on a real-time basis. The TEISS GIS module includes a full set of tools for manipulation of any map created in the system. The WRAP EDMS could include a majority of this functionality in its GIS module to provide its users a complete internet GIS capability. However, since current web GIS capabilities are limited compared to desktop capabilities, the WRAP EDMS will not be able to implement all of the features of the TEISS GIS module.

Second, the TEISS has a flexible set of exporting functions to allow for multiple data export formats. The WRAP EDMS could include a comparable set of exporting features to accommodate the need of multiple formats for the system's users.

3.3.3 California Air Resources Board Emissions Inventory – CARBEI

The California Air Resources Board maintains an emissions inventory (CARBEI) containing information on air emissions and their sources for the state of California. The CARBEI has a public website (http://www.arb.ca.gov/emisinv/eib.htm) where users can query the emissions database and produce reports based on their specific needs.

3.3.3.1 System Details

The CARBEI tracks five pollutants: NO_x, SO_2, PM_{10}, $PM_{2.5}$, and CO. The pollutants are tracked for three sources types: point, area, and mobile sources. All data is tracked at the county level for all sources, and also individually for point sources. The data is submitted by local agencies in the California Air Resources Board's standard submission format, the California Emission Inventory Development and Reporting System (CEIDARS).

The CARBEI includes a QA/QC process that performs multiple levels of QA/QC checks. The first level consists of a validation of the format of the submitted data files, which ensures that the submitting entity supplied all data to CARBEI, in the expected format, and also identifies any errors with the submitted format. The second level of QA/QC checks includes checks of the data that is submitted to CARBEI. Data points are checked against acceptable data ranges to ensure the submitted data are accurate and reasonable.

The CARBEI includes standard summary reports broken down by source category, geographic location, and pollutant. The CARBEI also includes a data export feature to allow data to be extracted from the CARBEI database for inclusion in external systems.

All reporting features of the CARBEI are available to the public via the internet. The CARBEI user interface is easy to use and navigate for the user to reach the desired data.

3.3.3.2 Key System Elements

The CARBEI has one key element that should be utilized in the WRAP EDMS. The CARBEI report interface is very easy to use and intuitive, making the data gathering process easy for the user. The WRAP EDMS could adopt this report functionality and design for the general data gathering capabilities of its system.

3.3.4 Colorado Department of Health Air Pollution Inventory – CAPI

The Colorado Department of Health maintains an Air Pollution Inventory (CAPI) containing information on air emissions and their sources for the state of Colorado. The CAPI has a public website (http://emaps.dphe.state.co.us/APInv/viewer.htm) where users can query the emissions database and produce reports based on their specific needs. It should be noted that CAPI is not the Colorado primary emissions inventory system. It is included in this analysis because of its internet capabilities.

3.3.4.1 System Details

The CAPI tracks five pollutants: VOC, NO_x, SO_2, PM_{10}, and CO. The pollutants are tracked for three source types: point, area, and mobile sources. All data is tracked at the county level for all sources, and also individually for point sources. The data is submitted by local agencies on a continuing basis.

The CAPI includes standard summary reports broken down by source category, geographic location, and pollutant.

The CAPI includes a fully functioning GIS module that provides multiple tools to visually display data. The CAPI includes several advanced GIS features including: pan, zoom, query layer information, ability to add/remove multiple layers of data, measure distances, buffer, print, and select map features by line, rectangle, or polygon. The CAPI GIS module includes several static layers of data, such as county and state boundaries, and various attainment area boundaries.

All reporting features of the CAPI are available to the public via the internet. The CAPI user interface is easy to use and navigate for the user to reach the desired data.

3.3.4.2 Key System Elements

The CAPI includes a functioning, internet-based GIS module. The CAPI GIS module includes a full set of tools for manipulation of any map created in the system. Although the CAPI does not have the capability of mapping data from the emissions database, it does represent a good example of internet-based GIS functionality. The WRAP EDMS could include this functionality in its GIS module to provide its users internet-based GIS capability.

3.3.5 Delaware Environmental Navigator – DEN

The Delaware Department of Natural Resources and Environmental Control maintains a database of information for all aspects of environmental monitoring and control. The Delaware Environmental Navigator (DEN) has a public website (http://www.dnrec.state.de.us/dnreceis/) where users can query the database and produce reports based on their specific needs.

3.3.5.1 System Details

At the air emissions level, the DEN tracks five pollutants: VOC, NO_x, SO_2, PM_{10}, and CO. The pollutants are tracked for three source types: point, area, and mobile sources. All data is tracked at the county level for all sources, and also individually for point sources. The data is submitted by local agencies on a continuing basis.

The DEN includes a limited QA/QC process that performs quality checks of all submitted data.

The DEN includes standard summary reports broken down by source category, geographic location, and pollutant.

The DEN includes a fully functioning GIS module that provides multiple tools to display data geographically. The DEN includes several advanced GIS features including: pan, zoom, query layer information, ability to add/remove multiple layers of data, measure distances, print, and select map features by line, rectangle or polygon. The DEN GIS module includes several static layers of data, such as county, state and country boundaries, interstate and highway line features, and the ability to select and display data by geographical area.

All reporting features of the DEN are available to the public via the internet. The DEN user interface is easy to use and navigate to reach the desired data.

3.3.5.2 Key System Elements

The DEN has a fully functioning, internet-based GIS module included in the system. This allows DEN users to display map features in conjunction with relevant emissions and activity data on a real-time basis. The DEN GIS module includes a full set of tools for manipulation of any map created in the system. The DEN was included in this comparison due to its advanced internet-based GIS functionality and its ability to map user defined data queried from the DEN database on a real time basis. The WRAP EDMS could include this functionality in its GIS module to provide its users internet-based GIS capability.

4.0 RECOMMENDATIONS

4.1 Flow Chart of the WRAP EDMS

Appendix G presents the flow chart of the WRAP EDMS that shows the information needs, from the emissions data submission to the report generations, data queries, graphic display, and GIS presentation. The sections below explain the different parts of this flow chart.

4.2 Point Source Module

For point sources, at a minimum, the emissions data listed below should be submitted, stored, and tracked for each inventory. The data file should be organized into records for the submitting format. In the NIF Version 3, the point source file contains eight records with specific key fields represented by these emissions data (see Appendix E).

1) Inventory year
2) Inventory start date
3) Inventory end date
4) Inventory type
5) Country code
6) State and county FIPS code
7) Tribal code
8) Facility ID code
9) Point ID code
10) Process ID code
11) Stack ID code
12) Site name
13) Physical address
14) SCC code
15) Heat content (fuel) (annual average)
16) Ash content (fuel) (annual average)
17) Sulfur content (fuel) (annual average)
18) Pollutant code
19) Activity/throughput (annual)
20) Activity/throughput (daily)
21) Work weekday emissions
22) Annual emissions
23) Emission factor
24) Winter throughput (%)
25) Spring throughput (%)
26) Summer throughput (%)
27) Fall throughput (%)
28) Hours/day in operation
29) Start time (hour)
30) Day/week in operation
31) Weeks/year in operation

32) X stack coordinate (latitude)
33) Y stack coordinate (longitude)
34) Stack height
35) Stack diameter
36) Exit gas temperature
37) Exit gas velocity
38) Exit gas flow rate
39) SIC code
40) Design capacity
41) Maximum nameplate capacity
42) Primary control efficiency (%)
43) Secondary control efficiency (%)
44) Control device type
45) Rule effectiveness (%)

Emissions from point sources will be estimated by STL agencies using emission factors published in AP-42 (EPA, 1998) or from stack test data and submitted at the individual source level on an annual temporal resolution basis. According to the CERR, the minimum point source reporting thresholds are 100 tons per year (tpy) for VOC, NOx, SO_2, PM_{10}, $PM_{2.5}$, and NH_3 and 1000 tpy for CO. Many states have different reporting thresholds tied to other state environmental regulations and would like to be able to retrieve data from the EDMS as they are submitted. Therefore, the WRAP EDMS will allow different point source cutoff level submissions and will check for these discrepancies in order to avoid double counting emissions.

4.3 Area Source Module

Based on input and discussion, it appears that area sources represent all other stationary sources not included in the point source category, excluding fire and windblown dust sources. These sources also include open burning activities on residential, commercial, and industrial properties.

For area sources, at a minimum, the emissions data listed below should be submitted, stored, and tracked for each inventory. Similar to the point sources, the data file should be organized into records. The area source file contains five records in the NIF version 3 (see Appendix E).

1) Inventory year
2) Inventory start date
3) Inventory end date,
4) Inventory type
5) Country code
6) State and county FIPS code
7) Tribal code
8) SCC code
9) Emission factor
10) Activity/throughput level (annual)
11) Total capture/control efficiency (%)
12) Rule effectiveness (%)

13) Rule penetration (%)
14) Pollutant code
15) Summer/winter work weekday emissions
16) Annual emissions
17) Winter throughput (%)
18) Spring throughput (%)
19) Summer throughput (%)
20) Fall throughput (%)
21) Hours/day in operation
22) Days/week in operation
23) Weeks/year in operation

Emissions from area sources will be estimated by STL agencies using mostly emission factors published in AP-42 (EPA, 1998) and submitted at the county level on an annual temporal resolution basis. The area source definitions are different from STL to STL. For example, some STL define gas stations or dry cleaners as point sources while others do as area sources. Therefore, the WRAP EDMS will allow different source category submissions and will check for these discrepancies in order to avoid double counting emissions.

4.4 Mobile Source Module

Mobile sources are divided into two main categories: onroad and nonroad mobile sources. Onroad mobile sources are motor vehicles licensed for use on highways or roadways (i.e. automobiles, trucks, etc). Onroad mobile source emissions are the product of emission factors obtained through the execution of the latest EPA's MOBILE model (EPA, 2002) or the California EMFAC model (CARB, 2002) and activity levels represented by the vehicle mile traveled (VMT). Dust from paved and unpaved roads may be estimated by using either the method in AP-42, Section 11 (EPA, 1998) or the EPA's PART5 model (EPA, 1995).

Nonroad mobile sources are the other mobile sources represented for instance by construction equipment, lawn and garden equipment, snowmobiles, boats, trains, and airplanes. Their emissions can be estimated using the EPA's NONROAD model (EPA, 2000) and/or published emission factors, especially for boats and trains. Emissions of airplanes and associated ground support equipment and auxiliary power units are estimated using the Federal Aviation Administration (FAA) Emission and dispersion Modeling System model (FAA, 2002). It is not anticipated that the WRAP EDMS will contain these models.

Most mobile emissions will be submitted at the county level on an annual temporal resolution basis. However, many mobile source emissions data are seasonal in nature. Therefore, the WRAP EDMS may store applicable seasonal mobile emissions data as well. For unsubmitted and/or missing mobile source emissions data for a given area, the WRAP EDMS DBA will estimate the inventories using available mobile emissions models and area-specific data or national average data. These inventories will be submitted to STL agencies for review and approval before inclusion in the final database.

For mobile sources, the emissions data listed below should be submitted, stored, and tracked for each inventory. Similar to the point sources, the data file should be organized into records. The onroad and nonroad mobile source files contain three and five records respectively in the NIF version 3 (see Appendix E).

For on-road mobile sources,

1) Inventory year
2) Inventory start date
3) Inventory end date
4) Inventory type
5) Country code
6) State and county FIPS code
7) Tribal code
8) SCC code
9) Emission factor
10) Activity (VMT by roadway class)
11) Pollutant code
12) Summer/winter work weekday emissions
13) Annual emission
14) Refueling emissions classification

For non-road mobile sources,

1) Inventory year
2) Inventory start date
3) Inventory end date
4) Inventory type
5) Country code
6) State and county FIPS code
7) Tribal code
8) SCC code
9) Emission factor
10) Activity/throughput level (annual)
11) Total capture/control efficiency (%)
12) Rule effectiveness (%)
13) Rule penetration (%)
14) Pollutant code
15) Summer/winter work weekday emissions
16) Annual emissions
17) Winter throughput (%)
18) Spring throughput (%)
19) Summer throughput (%)
20) Fall throughput (%)
21) Hours/day in operation
22) Days/week in operation

23) Weeks/year in operation

4.5 Biogenic Source Module

The latest EPA's Biogenic Emissions Inventory System (BEIS) model (EPA, 1998) will be used to generate the region-wide biogenic emissions using activity data submitted by STL agencies and other surrogate land use and meteorological data. The emission inventories will then be submitted to STL agencies for review and approval before inclusion in the final database. The reporting spatial resolution will be the county level and the temporal resolution will be annual for the biogenic emissions data in Phase I. In phase II, hourly, daily, or seasonal temporal resolutions may be tracked. The biogenic emissions are currently being generated at RMC on a 36-km grid system for each hour. Therefore, they will need to be converted to a county level and aggregate on an annual temporal resolution basis before being sent to STL agencies for review and subsequent inclusion in the WRAP EDMS.

For biogenic sources, at a minimum, the emissions data listed below should be submitted, stored, and tracked for each inventory. Similar to the point sources, the data file should be organized into records. The biogenic source file contains two records in the NIF version 3 (see Appendix E).

1) Inventory year
2) Inventory start date
3) Inventory end date
4) Inventory type
5) Country code
6) State and county FIPS code
7) Tribal code
8) SCC code
9) Pollutant code
10) Summer/winter work weekday emissions
11) Annual emissions

4.6 Windblown Dust Source Module

Windblown dust emissions will be generated region-wide through modeling. The emission inventories will then be submitted to STL agencies for review and approval before inclusion in the final database. The spatial resolution will be the county level and the temporal resolution will be annual for the windblown dust source data in Phase I. In phase II, hourly, daily, or seasonal temporal resolutions may be tracked. The dust emissions (PM_{10} and $PM_{2.5}$) are currently being estimated using wind data as emissions per grid square. Therefore they will need to be converted to a county level before being sent to STL agencies for review and subsequent inclusion in the WRAP EDMS.

For windblown dust sources, at a minimum, the emissions data listed below should be submitted, stored, and tracked for each inventory. Windblown dust source is not included in the NEI as a separate source category. Therefore, the data file needs to be created and the records defined. A definition based on the NIF biogenic source file should suffice.

1) Inventory year
2) Inventory start date
3) Inventory end date
4) Inventory type
5) Country code
6) State and county FIPS code
7) Tribal code
8) SCC code
9) Pollutant code
10) Summer/winter work weekday emissions
11) Annual emissions
12) Natural or anthropogenic classification

4.7 Fire Source Module

There are four types of fire emissions sources - wildfire, prescribed fire, wildland fire use, and agricultural burning - that will be included in the fire source module of the WRAP EDMS. It should be noted that wildfire, prescribed fire, wildland fire use include rangeland. Fire sources such as open burning activities on residential, commercial, and industrial properties will be included in the area source module. The WRAP Fire Tracking System (FTS) (WRAP, 2001) identified seven essential data (9 – 17) that will provide the basis for calculating the emissions for fire through the use of an emissions calculation mechanism, such as the WRAP emissions inventory system, to integrate the appropriate emissions factors and emission calculation techniques. The FTS also identified optional data (18 – 21) that are equally important in calculating fire emissions. Note that for fire sources, the WRAP EDMS will calculate the emissions. However, some STL agencies may estimate fire emissions themselves. These emissions will be submitted by the STL agencies with all the activity and surrogate data used for the estimation.

For fire sources, at a minimum, the emissions data listed below should be submitted, stored, tracked, and also used to calculate fire emissions when necessary. In the NEI, fire sources are contained in the area source category. Therefore, a data file which records are similar to the NIF area source file may define the fire source file.

1) Inventory year
2) Inventory start date
3) Inventory end date
4) Inventory type
5) County code
6) State and county FIPS code
7) Tribal code
8) SCC code
9) Date of burn

10) Duration of burn
11) Burn location latitude
12) Burn location longitude
13) Area of burn
14) Fuel type
15) Pre-burn fuel loading
16) Type of burn
17) Anthropogenic or natural classification
18) Daily tracking components
19) Fuel consumption
20) Non-burning techniques
21) Additional fire tracking information
22) Pollutant code
23) Emission factor
24) Daily emissions
25) Annual emissions

4.8. Standard Reports and Queries

The EDMS should have the capability to produce the following standard reports in tabular and simple plots (i.e. bar graph and pie chart) formats and allow queries of the same information including presentation in GIS format.

- A summary report of the annual WRAP emission inventory, compiled at the county and reservation levels and totaled for each state, tribe, and the WRAP region, for all pollutants, broken down by point, area, mobile, fire, biogenic, and windblown dust source categories, and by summed total emissions for all six source categories.
- A summary report of the annual WRAP emissions from the stationary point sources in each county and reservation and the stationary point sources for each state, tribe and the entire region (broken down by plant name), for each pollutant.
- A summary report of the annual WRAP emissions from the stationary point sources in each county and reservation and the stationary point sources for each state, tribe and the entire region (broken down by SCC code), for each pollutant.
- A summary report of the annual WRAP emissions from the area sources in each county and reservation and the area sources for each state, tribe and the entire region (broken down by SCC code), for each pollutant.
- A summary report of the annual WRAP emissions from the “Top 10” stationary point sources in each county and reservation and the “Top 10” stationary point sources for each state, tribe and the entire region (broken down by plant name), for each pollutant.
- A summary report of the annual WRAP emissions from the “Top 10” stationary point sources in each county and reservation and the “Top 10” stationary point sources for each state, tribe and the entire region (broken down by SCC code), for each pollutant.
- A summary report of the annual WRAP emissions from the “Top 10” area sources in each county and reservation and the “Top 10” area sources for each state, tribe and the entire region (broken down by SCC code), for each pollutant.

- A summary report of the annual WRAP emissions from on-road mobile sources in each county and reservation and on-road mobile sources for each state, tribe and the entire region (broken down by the sixteen (16) mobile source categories), for each pollutant and dust from paved and unpaved road.
- A summary report of the annual WRAP emissions from non-road mobile sources in each county and reservation and non-road mobile sources for each state, tribe, and the entire region (broken down by SCC code), for each pollutant.
- A summary report of the annual WRAP emissions from fire sources in each county and reservation and fire sources for each state, tribe, and the entire region (broken down by the 3 fire categories (wildfire, prescribed wild land burning, and agricultural burning activities), for each pollutant.
- A summary report of the annual WRAP emissions from biogenic sources in each county and reservation and biogenic sources for each state, tribe, and the entire region (broken down by emission source name).
- Data reports in the NEI Input Format Version 3.0 (NIF V3.0) for submittal to the EPA under the CERR.
- For stationary point sources, data reports for all emission points on site by text description name and by Stack ID, for NEI file format stack parameters (STKHGT, STKDIAM, STKTEMP, STKFLOW, STKVEL), production rates (BOILCAP, CAP_UNITS, THRUPUT, MAXRATE, NETDC), fuel parameters (HEATCON, SULFCON, ASHCON), standard industrial classification code (SIC), location (LATC, LONG), and emission controls ("pollutant"_CE, "pollutant"_CPRI, "pollutant"_CSEC).
- For stationary point sources, data reports for all emission points on site by text description name and by Stack ID, for actual emission rates of each pollutant, on an annual (tpy) and on a short term (pounds per hour) basis. This emission data will be summed for a cumulative total of emissions from each stationary point source.
- In addition to these standard reports, the EDMS will produce regional emission model (SMOKE)-ready emissions input files for the regional visibility modeling efforts.

4.9. Special Section 309 Tracking

Section 309 of the RHR requires that the first SIP be submitted by December 31, 2003 and that SIP must be effective until December 2018. Section 309 also specifically requires comprehensive emissions tracking and reporting for the clean air corridors (CAC), stationary SO_2 sources, mobile sources, fire sources, and windblown dust based on annual emissions.

4.9.1 Clean Air Corridors (CAC)

The preamble of the RHR defines a CAC as “a region that generally brings clean air to a receptor region”. The preamble also says, “the requirement to track emissions will enable states to quickly determine if changes in patterns of emissions will reduce the number of clean air days (defined as the average of the 20% clearest days) in any of the 16 Class I areas.” The actual requirements state that the Section 309 SIP/TIP must describe and provide for implementation of comprehensive emission tracking strategies for CAC to ensure that the visibility does not degrade on the least-impaired days at any of the 16 Class I areas. The strategy must include:

- An identification of CAC.
- Within areas that are CAC, an identification of patterns of growth or specific sites of growth that could cause, or are causing, significant emissions increases that could have, or are having, visibility impairment at one or more of the 16 Class I areas.
- In areas outside of CAC, an identification of significant emissions growth that could begin, or is beginning, to impair the quality of air in the corridor and thereby lead to visibility degradation for the least-impaired days in one or more of the 16 Class I areas.
- If impairment of air quality in CAC is identified, an analysis of the effects of increased emissions, including provisions for the identification of the need for additional emission reduction measures, and implementation of the additional measures where necessary.
- A determination of whether other clean air corridors exist for any of the 16 Class I areas. For any such CAC, an identification of the necessary measures to protect against future degradation of air quality in any of the 16 Class I areas.

WRAP identified one CAC as shown in Appendix H. Using the most recent state emission inventories available through the WRAP EDMS, WRAP will produce a report for each five-year implementation plan revision (2008, 2013, and 2018) on the current and projected emissions in the CAC and in areas outside the corridor and compare these emissions to a 1996 baseline emissions.

WRAP has examined patterns of growth in the CAC and found that they are not causing significant emission increases that could have or are having visibility impacts at one or more of the 16 Class I areas. Nor, at this time, are such emission increases expected during the first planning period (2003-2018). WRAP also has examined emissions growth in areas outside the corridor and found that significant emissions growth is not occurring that could begin or is beginning to impair the quality of the air in the corridor and thereby lead to visibility degradation for the least impaired days in one or more of the 16 Class I areas.

Since impairment of air quality in clean air corridors has not been identified, WRAP finds no requirement under for further visibility impact analysis or additional emission reduction measures until at least the next SIP revision (2008). WRAP finds no other clean air corridors beyond the corridor identified in Appendix H.

Consequently, the EDMS should have the capability to produce the following special reports in tabular and simple plots (i.e. bar graph and pie chart) formats and allow queries of the same information including presentation in GIS format, in addition to the standard reports.

- A summary report of the annual summed total emissions for all six source categories and all of the pollutants by county/state and tribal lands, as well as for the entire CAC.
- A summary report of the annual summed total emissions for all six source categories and all of the pollutants for the same types of political boundaries surrounding the CAC.
- A summary report of the comparison of the annual summed total emissions for all six source categories and all of the pollutants for the same types of political boundaries, as well as the entire CAC and the corresponding base year total emissions.

4.9.2 Pre-Trigger SO_2 Annex

The SO_2 Annex program, as proposed by WRAP and adopted by EPA, requires the tracking of SO_2 emissions from eligible stationary sources within states or tribal reservations participating in Section 309, to determine if the regional SO_2 emissions cap has been exceeded. This is known as "pre-trigger" tracking. Beginning with the 2003 calendar year and continuing through 2018, each state and tribe participating in the program will submit an annual SO_2 emissions report to the WRAP EDMS for the sources covered by the program. These annual reports will contain the following information:

- Identification and explanation for new/additional SO_2 sources which emissions are greater than100 tpy that were not contained in the previous year's emissions report.
- Explanation for sources shut down or removed from the previous year's emissions report.
- Explanation for emissions variations at any covered source that exceeds +/- 20% from the previous year.
- Identification and explanation of new emissions reporting methods at any source.

WRAP will compile the annual emissions reports submitted by the states and tribes participating in the program into a regional emission report for SO_2 using the WRAP EDMS. By December 31 of the year following the applicable compliance year, WRAP will prepare a regional emission report that will include the following information:

- Summary of regional SO_2 emissions (tpy).
- Identification of any paper emission increases and decreases that have occurred due to changes in emission inventory techniques since the last SIP revision for the regional haze SIP. The report will contain a running regional total, as well as supporting documentation identifying the specific changes that have occurred at individual sources.
- Average emissions for the last three years (if applicable) for comparison to the regional milestone.
- Regional milestone for the compliance period.
- Draft determination that the milestone has either been met, or has been exceeded thereby triggering the backstop trading program.

Consequently, The EDMS should have the capability to produce the following special reports in tabular and simple plots (i.e. bar graph and pie chart) formats and allow queries of the same information including presentation in GIS format, in addition to the standard reports.

- A summary report of the annual WRAP emissions from the stationary sources emitting more than 100 tpy of SO_2 in the base year for each state, tribe and the entire region.
- A summary report of the new stationary sources emitting more than 100 tpy of SO_2 that were not contained in the previous year's inventory for each state, tribe and the entire region.
- A summary report of the stationary sources emitting more than 100 tpy of SO_2 that are retired compared to the previous year's inventory for each state, tribe and the entire region.

- A summary report of the regional average SO_2 emissions from stationary sources emitting more than 100 tpy of SO_2 for the last three years and comparison to the regional milestone for the compliance period.
- A summary report of the stationary sources emitting more than 100 tpy of SO_2 which emissions exceed +/- 20% compared to the previous year's inventory for each state, tribe and the entire region.
- A summary report identifying all the stationary sources emitting more than 100 tpy of SO_2 that choose to opt in the program for each state, tribe and the entire region.
- A summary report identifying all the stationary sources emitting more than 100 tpy of SO_2 that were not included in the base year for each state, tribe and the entire region.

4.9.3 Mobile Emissions

For mobile sources, the SIP/TIP submissions must provide for statewide inventories of on-road and non-road mobile source emissions of VOC, NO_X, SO_2, $PM_{2.5}$, EC, OC, and paved and unpaved road dust for the years 2003, 2008, 2013, and 2018. The inventories must demonstrate a continuous decline in total mobile source emissions for the aforementioned pollutants, evaluated separately. This means that the statewide mobile source emissions of each pollutant in 2008, 2013, and 2018 must be less than the estimated emissions of that pollutant for the previous period.

Consequently, the EDMS should have the capability to produce the following special report in tabular and simple plots (i.e. bar graph and pie chart) formats and allow queries of the same information including presentation in GIS format, in addition to the standard reports.

- A summary report of the comparison of annual WRAP total (on-road plus nonroad) emissions from the mobile sources (VOC, NOx, SO_2, $PM_{2.5}$, EC, OC, and paved and unpaved road dust) for each state, tribe and the entire region and the corresponding previous period total emissions, for each pollutant.

4.9.3 Fire Emissions

For fire emissions, Section 309 of the RHR specifically calls for a statewide inventory and emissions tracking system (spatial and temporal) of VOC, NO_X, EC, OC, and $PM_{2.5}$ emissions from fire. The WRAP inventory will add SO_2, PM_{10}, CO, and NH_3 emissions.

Under Section 309, states and tribes must identify a method or a timeline to develop a method to track fire activity data and calculate the resulting required emissions inventory in their SIP/TIP. Tracking of fire activity data and calculation of the resulting emissions through the WRAP EDMS will provide information critical to the successful implementation of other requirements under Section, including the development, adoption, and implementation of enhanced smoke management programs, the establishment of annual emission goals, and future projections of fire emissions.

The WRAP EDMS will track activity data as reported by states and tribes participating in Section 309, as well as the same type of data provided by other WRAP region state, tribal, and local air agencies, and federal/state/private sources using prescribed and/or agricultural burning techniques. The WRAP EDMS will calculate the resulting emissions for fire source types including prescribed fire, wildfire, wildland fire use, and agricultural burning.

The EDMS should have the capability to produce a special report in tabular and simple plots (i.e. bar graph and pie chart) formats and allow queries of the same information including presentation in GIS format in the standard report style presented in Section 3.8 of this report.

4.10 GIS Module

GIS provides users with the ability to display and analyze data that is related to a geographic location. GIS provides a means for an organization to display data that is easily read and understood. The WRAP EDMS should include a fully functioning GIS module that provides multiple tools to display data over the internet. The inclusion of a GIS module will provide a means for users to select data that is of importance to them and display the data in a fashion that is easily understood.

During Phase I of development, the WRAP EDMS should include the following GIS Functionality.

- Pan and zoom
- Query layer information
- Ability to add/remove multiple layers of data
- Point and click
- Measure distances
- Buffer
- Print – multiple sizes of maps
- Select map features by line, rectangle or polygon

Phase II development of the WRAP EDMS could include some of the following additional functionality.

- Export selected maps shape files
- Generate polygons/layers from coordinates stored in the WRAP EDMS (e.g. create polygons for fire burn areas)

The WRAP EDMS GIS module should include the following layers of data for Phase I development.

Static layers
- County, state and country polygons
- Tribal reservation polygons
- Metropolitan statistical areas polygons
- Nonattainment area polygons
- Class I areas polygons

- Interstate and highway line features
- Other roadways and railroad line features
- Bodies of water polygons
- Census data polygons
- Other federal land polygons (i.e. national parks, monuments, forest, and refuges)
- CAC polygons
- International area polygons
- WRAP modeling domain grid system

Dynamic/Data driven layers

- Select and display emissions sources and associated emissions levels by geographical area.

4.11 DBA Module

All major applications and systems include an administrative section or module that allows the application administrator(s) to perform general system maintenance as well as application specific system maintenance. These maintenance routines consist of tasks that are routinely performed by the application or system administrator(s) and can easily be automated through a graphical user interface. Often times there are tasks that administrators need to perform that cannot easily be automated, due to the complexity or changing nature of the task, and would not be included in the administrative module of the application.

The WRAP EDMS will require a DBA Module, which will provide the necessary functionality required to perform several administrative tasks. During Phase I of development, the WRAP EDMS should include the following DBA Functionality.

- User account maintenance – maintain the list and permissions for users of the WRAP EDMS.
- Lookup table maintenance (unit conversions, threshold values, etc.) – maintain the multiple lookup tables and associated data that will be included in the WRAP EDMS.
- Versioning/maintenance of submitted data – ability to version submitted data and determine current version of all data.
- Data gap filling triggered from a QA/QC check, following specific methods that will be developed by WRAP.
- International data maintenance – maintain the tables and data for all international data necessary for the WRAP EDMS.
- Opt-in options for individual states, tribes, and sources – maintain list of states and tribes with associated emissions sources that decide to opt-in for Sections 308 and 309 tracking, after 2003.
- Others – other DBA module functionality requirements as determined necessary.

During Phase II development, the WRAP EDMS should include the following DBA Functionality.

- Data warehousing/archiving – ability to move historical data out of the production database and into a WRAP data warehouse.
- Historical data retrieval – ability to generate reports and data sets from the WRAP data warehouse.

4.12 QA/QC Module

The WRAP EDMS will include a QA/QC module to perform two levels of QA/QC. The QA/QC protocol will be similar to that of NEI with some modifications (see Appendix F for the NEI QA/QC process). The first level of QA/QC should include a validation of the format of the submitted data files at the submission point of entry. This would ensure that the submitting entity supplied all data to the WRAP EDMS in the expected format and also identify any errors. The second level of QA/QC should consist of checks of the data that was submitted to WRAP. This should include checking reference values and acceptable data ranges for specific data points.

The WRAP EDMS QA/QC module should perform the following types of format checks.

- Does the file conform to the format specification? - The initial checks performed on each submitted data set will verify that the file format is correct, and therefore readable for further processing (e.g., field widths, begin/end position, data types).
- Are mandatory data elements reported? - The presence or absence of mandatory data elements will be confirmed. Some of the mandatory data fields are the primary keys (i.e. FIPS codes and SCC Codes) in each record that help relate and maintain the individual records together in a file for subsequent processing.
- Does the data set contain what the STL agency said they are submitting? - The data in the file will be compared to the Inventory Submittal Form (ISF) that was provided with the file to verify the noted and intended coverage for geographic area, pollutants, source categories, and temporal information.

WRAP will keep a log of errors and problems encountered with each of the data submissions, and will provide those to the STL agency when communicating with the agency.

The WRAP EDMS QA/QC for data content will consist of two areas of QA/QC. First, the data will be checked for completeness, ensuring that all data exists for all sources and geographic areas. Second, the data integrity will be checked, ensuring that supplied values are within acceptable ranges and all codes are valid. The QA/QC module should perform the following types of data content checks for completeness.

- Add records to fill in missing facilities or source categories, or to fill in for missing geographic areas (e.g., where data were not reported for entire counties).
- Add, or solve for, data elements missing in existing records.

Additionally, the QA/QC module will perform the following data augmentation processes:

- Calculate EC and OC emissions.

- Aggregate dust and biogenic source data from the supplied grid and hourly levels to county/reservation and annual levels.
- Modify county data to exclude sources and emissions from tribal reservations that are within the county's boundaries.

The QA/QC module should perform the following types of data integrity checks.

- Conditional fields - fields required by other fields in the same table. For example, if there is a PCT Capture Efficiency in the Control Equipment (CE) table, then there should also be a Primary Device Type in the CE Table.
- Acceptable codes - the Pollutant Code (and all acceptable codes) should be consistent.
- Numeric values in acceptable range - For example, the annual average days per week in the Emission Point (EP) table should be less than seven.
- Inter-File Format - fields required by other fields in different tables. If there is an Emission Record in the Emission (EM) table, then there should be an associated activity record in the Activity Code (AC) table.
- Inter-source relationships
- Inter-pollutant relationships
- Advance point source diagnostic – check of largest sources, out of range stacks, stack location.

5.0 CONCLUSIONS

Under contract with the WRAP EF, EA performed an EDMS needs assessment that included two interview workshops, a web-based questionnaire, and an evaluation of selected existing systems. Five existing database management systems were evaluated and compared to the conceptual WRAP EDMS developed from the findings of the workshops and web-based questionnaire.

The workshops and questionnaire results indicated that the WRAP EDMS should be used as the repository of WRAP regional emissions data, and as a tool that can help in the implementation of the emissions tracking and reporting requirements of the RHR. The WRAP EDMS will be able to track all the visibility-impairing pollutants. The emissions data will primarily be submitted by STL agencies in an EPA-compliant format according to an open submittal process. Furthermore, the WRAP EDMS will contain six major sources representing the emissions sources: point, area, mobile, fire, biogenic, and windblown dust sources in addition to a QA/QC module, a GIS module, and a DBA module. Finally, the WRAP EDMS will produce user-specified standard and RHR-special reports and will allow data queries and graphical display, and presentation of this information in GIS format.

The results of the comparative analysis showed that the conceptual WRAP EDMS has a unique set of requirements that are not fully implemented in any existing EDMS. Therefore, a new individual EDMS needs to be developed to meet the requirements for the conceptual WRAP EDMS. Also, this new system could utilize some of the features incorporated in several of the existing systems to accomplish some of the WRAP EDMS requirements.

6.0 REFERENCES

California Air Resources Board (CARB), EMFAC 2002 Vehicle Emission Model, 2002.

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APPENDIX A-7. STATIONARY SOURCES

This appendix contains work products and references relied upon by Arizona in the development of Chapter 7 of the Regional Haze SIP.

Appendix A-7a. Arizona Draft Western Backstop SO_2 Trading Program Rule

DRAFT RULE

<u>NOTE</u>: This draft rule has been included in Arizona's Regional Haze State Implementation Plan in order to give the reader an opportunity to see how Arizona has currently interpreted the Model Rule for state-specific rulemaking. This draft rule will go through revisions prior to its submission to Arizona's Secretary of State, after the public comment period, and is subject to the final review of the Governors' Regulatory Review Council.

TITLE 18. ENVIRONMENTAL QUALITY
CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR POLLUTION CONTROL

ARTICLE 16. VISIBILITY; REGIONAL HAZE

Section

ARTICLE 16. VISIBILITY; REGIONAL HAZE

R18-2-1607. Reserved

R18-2-1608. Reserved

R18-2-1609. Reserved

R18-2-1610. Western Backstop SO_2 Trading Program; Definitions

A. This rule implements the Western Backstop SO_2 Trading Program ("WEB Trading Program") provisions required under the federal Regional Haze Rule, 40 CFR 51.309, and the SO_2 Milestones and Backstop Trading Program.

1. All applicable sources as described in Sections 1611 and 1613 of this Rule shall meet the pre-trigger monitoring, recordkeeping and reporting requirements as outlined in Section 1611 of this Rule.
2. Nothing in this Rule waives any requirement otherwise in effect or subsequently required under another program, including rules governing new sources.

B. The definitions in this part apply only to this Rule.

1. "Account Certificate of Representation" means the completed and signed submission required to designate an Account Representative for a WEB source or an Account Representative for a general account.
2. "Account Representative" means the individual who is authorized through an Account Certificate of Representation to represent owners and operators of the WEB source with regard to matters under the WEB Trading Program or, for a general account, who is authorized through an Account Certificate of Representation to represent the persons having an ownership interest in allowances in the general account with regard to matters concerning the general account.
3. "Act" means the federal Clean Air Act, as amended, 42 U.S.C. 7401, *et seq*.
4. "Actual Emissions" means total annual sulfur dioxide emissions determined in accordance with Section 1618 of this Rule, or determined in accordance with [refer to state or tribal inventory rule] for sources that are not subject to Section 1618 of this Rule.
5. "Allocate" means to assign allowances to a WEB source.
6. "Allowance" means the limited authorization under the WEB Trading Program to emit one ton of SO_2 during a specified control period or any control period thereafter subject to the terms and conditions for use of unused allowances as established by this Rule.
7. "Allowance limitation" means the tonnage of SO_2 emissions authorized by the allowances available for compliance deduction for a WEB source for a control period under Section 1621(A) of this Rule on the allowance transfer deadline for that control period.

8. “Allowance Tracking System” means the system developed by the Director where allowances under the WEB Trading Program are recorded, held, transferred and deducted.

9. “Allowance Tracking System” account means an account in the Allowance Tracking System established for purposes of recording, holding, transferring, and deducting allowances.

10. “Allowance transfer deadline” means the deadline established in Section 1619(B) of this Rule when allowances must be submitted for recording in a WEB source’s compliance account in order to demonstrate compliance for that control period.

11. “Compliance account” means an account established in the Allowance Tracking System under Section 1617(A) of this Rule for the purpose of recording allowances that a WEB source might hold to demonstrate compliance with its allowance limitation.

12. “Compliance certification” means a submission to the Director by the Account Representative as required under Section 1621(B) of this Rule to report a WEB source’s compliance or noncompliance with this Rule.

13. “Control period” means the period beginning January 1 of each year and ending on December 31 of the same year, inclusive.

14. “Emissions tracking database” means the central database where SO_2 emissions for WEB sources as recorded and reported in accordance with this Rule are tracked to determine compliance with allowance limitations.

15. “Emission unit” means any part of a stationary source that emits or would have the potential to emit any pollutant submitted to regulations under the Clean Air Act.

16. “Existing source” means a stationary source that commenced operation before the Program Trigger Date.

17. “Fugitive emissions” means those emissions that could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening.

18. “General account” means an account established in the Allowance Tracking System under Section 1617 of this Rule for the purpose of recording allowances held by a person that are not to be used to show compliance with an allowance limitation.

19. “Milestone” means the maximum level of stationary source regional sulfur dioxide emissions for each year from 2003 to 2018.

20. “New WEB Source” means a WEB source that commenced operation on or after the Program Trigger Date.

21. “New Source Set-aside” means a pool of allowances that are available for allocation to new sources.

22. “Owner or operator” means any person who is an owner or who operates, controls or supervises a WEB source, and includes but is not be limited to any holding company, utility system or plant manager.

23. “Potential to emit” means the maximum capacity of a stationary source to emit any air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of a source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored or processed, shall be treated as part of its design if the limitation is enforceable by the EPA Administrator.

24. “Program trigger date” means the date that the Director determines that the WEB Trading Program has been triggered.

25. “Program trigger years” means the years for the applicable milestone if the WEB Trading Program is triggered.

26. “Renewable Energy Resource” means a resource that generates electricity by non-nuclear and non-fossil technologies that results in low or no air emissions. The term includes electricity generated by wind energy technologies; solar photovoltaic and solar thermal technologies; geothermal technologies; technologies based on landfill gas and biomass sources, and new low-impact hydropower that meets the Low-Impact Hydropower Institute criteria. Biomass includes agricultural, food and wood wastes. The term does not include pumped storage or biomass from municipal solid waste, black liquor, or treated wood.

27. “Retired source” means a WEB source that has received a retired source exemption as provided in Section 1613(C) of this Rule. Any retired source resuming operations under Section 1613(C)(4) of this Rule, must submit its exemption as part of its registration materials.

28. “Serial number” means, when referring to allowances, the unique identification number assigned to each allowance by the Tracking Systems Administrator, in accordance with Section 1616(B) of this Rule.

29. “SO_2 emitting unit” means any equipment that is located at a WEB source and that emits SO_2.

30. “Stationary source” means any building, structure, facility or installation that emits or may emit any air pollutant subject to regulation under the Clean Air Act.

31. “Submit” means sent to the appropriate authority under the signature of the Account Representative. For purposes of determining when something is

submitted, an official U.S. Postal Service postmark, or equivalent electronic time stamp, shall establish the date of submittal.

32. "Ton" means 2000 pounds and, for any control period, any fraction of a ton equaling 1000 pounds or more shall be treated as one ton and any fraction of a ton equaling less than 1000 pounds shall be treated as zero tons.

33. "Tracking System Administrator" means the person designated by the Director as the administrator of the Allowance Tracking System and the emissions tracking database.

34. "WEB source" means a stationary source that meets the applicability requirements of Section 1613 of this Rule.

35. "Western Backstop SO_2 Trading Program ("WEB Trading Program")" means in reference to this Rule, the program triggered as a backstop, if necessary, to ensure that regional SO_2 emissions are reduced.

R18-2-1611. Pre-trigger Applicability; Monitoring, Recordkeeping and Reporting

A. Applicable sources are described in Section 1613 of this Rule.

B. All applicable sources shall follow the provisions for monitoring, recordkeeping and reporting as outlined in R18-2-304, R18-2-306, R18-2-327, or R18-2-715.01, and, in addition, shall:

1. Submit an annual inventory of SO_2 emissions, beginning with the 2003 emission inventory.

   a. A source that emits 100 tons per year or more of SO_2 in a later year shall continue to submit an SO_2 inventory for tracking compliance with the regional SO_2 milestones until 2018 or until the WEB Trading Program has been fully implemented and emissions tracking is occurring, whichever is earlier.

   b. Smelters shall submit an annual report of sulfur input in tons per year with the submission of the annual emissions inventory.

2. Utilize appropriate emission factors and estimating techniques, and document the emissions monitoring or estimation methodology used.

3. Include emissions from start up, shut down, and upset conditions in the annual total inventory.

4. Utilize, if subject to the federal acid rain program, methods from 40 CFR Part 75 to report emissions from all sources.

5. Include the rate and period of emissions, the specific installation that is the sources of the air pollution, composition of air contaminant, type and efficiency of

the air pollution control equipment, and other information necessary to quantify operation and emissions, and to evaluate pollution control.

6. Retain records for a minimum of 10 years from the date of creation, or if the record was the basis for an adjustment to a milestone, 5 years from the date of a state implementation plan revision, whichever is longer.

R18-2-1612. WEB Trading Program Trigger

A. Except as provided in 1612(B), Sections 1613 through 1621 of this Rule shall become effective on the program trigger date that is established in accordance with the procedures outlined in the 40 CFR 51.309(4)(h).

B. Section 1622 of this Rule, Special Penalty Provisions for Year 2018, shall become effective on January 1, 2018 and shall remain effective until the provisions of Section 1622 of this Rule have been fully implemented.

R18-2-1613. WEB Trading Program Applicability

A. General Applicability. This Rule applies to any stationary source or group of stationary sources that are located on one or more contiguous or adjacent properties and which are under the control of the same person or persons under common control, belonging to the same industrial grouping, and that are described in paragraphs (1) through (4) of this subsection. A stationary source or group of stationary sources shall be considered part of a single industrial grouping if all of the pollutant emitting activities at such source or group of sources on contiguous or adjacent properties belong to the same Major Group (i.e., all have the same two-digit code) as described in the Standard Industrial Classification Manual, 1987.

B. The following are WEB sources:

1. All BART-eligible sources as defined in 40 CFR 51.301 that are BART-eligible due to SO_2 emissions.
2. All stationary sources not meeting the criteria of 1613(A) of this Rule that have actual SO_2 emissions of 100 tons or more per year in the Program Trigger Years or any subsequent year. The fugitive emissions of a stationary source shall not be considered in determining whether it is a WEB source unless the source belongs to one of the following categories of stationary source:
   a. Coal cleaning plants (with thermal dryers);
   b. Kraft pulp mills;
   c. Portland cement plants;
   d. Primary zinc smelters;

e. Iron and steel mills;

f. Primary aluminum ore reduction plants;

g. Primary copper smelters;

h. Municipal incinerators capable of charging more than 250 tons of refuse per day;

i. Hydrofluoric, sulfuric, or nitric acid plants;

j. Petroleum refineries;

k. Lime plants;

l. Phosphate rock processing plants;

m. Coke oven batteries;

n. Sulfur recovery plants;

o. Carbon black plants (furnace process);

p. Primary lead smelters;

q. Fuel conversion plants;

r. Sintering plants;

s. Secondary metal production plants;

t. Chemical process plants;

u. Fossil-fuel boilers (or combination thereof) totaling more than 250 million British thermal units per hour heat input;

v. Petroleum storage and transfer units with a total storage capacity exceeding 300,000 barrels;

x. Taconite ore processing plants;

y. Glass fiber processing plants;

z. Charcoal production plants;

aa. Fossil-fuel-fired steam electric plants of more than 250 million British thermal units per hour heat input; or

bb. Any other stationary source category, which as of August 7, 1980 is being regulated under Section 111 or 112 of the Act.

3. A new source that begins operation after the Program Trigger Date and has the potential to emit 100 tons or more of SO_2 per year.

4. The Director may determine on a case-by-case basis, with concurrence from the EPA Administrator, that a source defined in Section 1613(B)(2) of this Rule is not a WEB source if the source:

a. In each of the previous five years had actual SO_2 emissions of less than 100 tons per year; and

b. Had actual SO_2 emissions of 100 tons or more in a single year due to a temporary emission increase that was caused by a sudden, infrequent and not reasonably preventable failure of air pollution control equipment, failure of process equipment, or a failure to operate in a normal or usual manner;

c. Took timely and reasonable action to minimize the temporary emission increase; and

d. Has corrected the failure of air pollution control equipment, process equipment, or process by the time of the Director's determination under this section; or

e. Had to switch fuels or feedstocks on a temporary basis and as a result of an emergency situation or unique and unusual circumstances besides cost of such fuels or feedstocks.

f. A temporary emission increase due to poor maintenance or careless operation does not meet the criteria of this section.

C. Duration of Program Participation. Except as provided for in Section 1613(D) of this Rule, once a source is subject to the WEB Trading Program, it will remain in the program every year thereafter.

D. Application for Retired Source Exemption. Any WEB that is retired shall apply for a retired source exemption. The WEB source may only be considered retired if all SO_2 emitting units at the source are retired. The application shall contain the following information:

1. Identification of the WEB source, including plant name and an appropriate identification code in a format specified by the Director.
2. Name of Account Representative.
3. Description of the status of the WEB source, including the date that the WEB source was retired.
4. Signed certification that the WEB source is retired and will comply with the requirements of Sections 1613(D) through (H) of this Rule.
5. Verification that the WEB source has a general account where any unused allowances or future allocations will be recorded.

E. Notice of Retired Source Exemption. The retired source exemption becomes effective When the Director, or control officer with jurisdiction over the source, notifies the source that the retired source exemption has been granted.

F. Responsibilities of Retired Sources:

1. A retired source shall be exempt from Sections 1618 and 1621 of this Rule, except as provided below.
2. A retired source shall not emit any SO_2 after the date the retired source exemption is effective.
3. A source shall submit SO_2 emissions reports, as required by Section 1618(H) of this Rule for any time period the source was operating prior to the effective date of the retired source exemption. The retired source shall be subject to the compliance provisions of Section 1621 of this Rule, including the requirement to hold allowances in the source's compliance account to cover all SO_2 emissions prior to the date the source was permanently retired.
4. A retired source that is still in existence but no longer emitting SO_2 shall, for a period of five years from the date the records are created, retain records demonstrating the effective date of the retired source exemption for purposes of this Rule.

G. Resumption of Operations. Should a retired source desire to resume operation, the retired source must submit registration materials as follows:

1. If the source is required to obtain a new source review permit or operating permit under [refer to applicable new source permitting rule] prior to resuming operation, then registration information as described in Section 1615(A) of this Rule and a copy of the retired source exemption must be submitted with the application required under [refer to applicable new source permitting rule];
2. If the source is not required to obtain a new source review permit or operating permit under [refer to applicable new source permitting rule] prior to resuming operation, then registration information as described in Section 1615(A) of this Rule and a copy of the retired source exemption must be submitted to the Director at least ninety days prior to resumption of operation.
3. The retired source exemption shall automatically expire on the day the source resumes operation.

H. Loss of Future Allowances.

1. A WEB source that is retired and that does not apply to the Director for a retired source exemption within ninety days of the date that the source is retired shall forfeit any unused and future allowances. The abandoned allowances shall be retired by the Tracking System Administrator.

Note to Reviewer: This is not intended to be a punitive action, but a method to correct the number of allowances being tracked by the state.

The Director will need to establish due process procedures for forfeiting these "abandoned" allowances in a manner that is consistent with the administrative procedures process. This provision is intended to address sources that go out of business, leave no forwarding address, and truly abandon their allowances. It is assumed that the Director will have a process to notify sources that their allowances may be forfeited so this provision does not lead to forfeiture just because the deadline was missed Arizona will draft the appropriate notification language for this section.

R18-2-1614. Account Representative for WEB Sources

A. Each WEB source must identify one Account Representative and may also identify an alternate Account Representative who may act on behalf of the Account Representative. Any representation, action, inaction or submission by the alternate Account Representative will be deemed to be a representation, action, inaction or submission by the Account Representative.

B. Identification and Certification of an Account Representative.

1. The Account Representative and any Alternate Account Representative shall be appointed by an agreement that makes the representations, actions, inactions or submissions of the Account Representative and any alternate binding on the owners and operators of the WEB source.
2. The Account Representative shall submit to the Director and the Tracking System Administrator a signed and dated Account Certificate of Representation (Certificate) that contains the following elements:
    a. Identification of the WEB source by plant name, state and an appropriate identification code in a format specified by the Director;
    b. The name, address, e-mail (if available), telephone and facsimile number of the Account Representative and any alternate;
    c. A list of owners and operators of the WEB source;
    d. Information to be part of the emission tracking system database in accordance with the Implementation Plan. The specific data elements shall be as specified by the Director to be consistent with the data system structure, and may include basic facility information that may appear in other reports and notices submitted by the WEB source, such as county location, industrial classification codes, and similar general facility information.
    e. The following certification statement:

"I certify that I was selected as the Account Representative or alternate Account Representative, as applicable, by an agreement binding on the owners and operators of the WEB source. I certify that I have all the necessary authority to carry out my duties and responsibilities under the WEB Trading Program on behalf of the owners and operators of the WEB source and that each such owner and operator shall be fully bound by my representations, actions, inactions, or submissions and by any decision or order issued to me by the Director regarding the WEB Trading Program."

3. Upon receipt by the Director of the complete Certificate, the Account Representative and any alternate Account Representative represents and, by his or her representations, actions, inactions, or submissions, legally binds each owner and operator of the WEB source in all matters pertaining to the WEB Trading Program. The owners and operators shall be bound by any decision or order issued by the Director regarding the WEB Trading Program.
4. No WEB Allowance Tracking System account shall be established for the WEB source until the Tracking System Administrator has received a complete Certificate. Once the account is established, the Account Representative shall make all submissions concerning the account, including the deduction or transfer of allowances.

C. Requirements and Responsibilities of the Account Representative.

1. The responsibilities of the Account Representative include, but are not limited to, the transferring of allowances, and the submission of monitoring plans, registrations, certification applications, SO_2 emissions data and compliance reports as required by this Rule, and representing the source in all matters pertaining to the WEB Trading Program.
2. Each submission under this program shall be signed and certified by the Account Representative for the WEB source. Each submission shall include the following truth and accuracy certification statement by the Account Representative:
   "I am authorized to make this submission on behalf of the owners and operators of the WEB source for which the submission is made. I certify under penalty of law that I have personally examined, and am familiar with, the statements and information submitted in this document and all its attachments Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the statements and information are to the best of my knowledge and belief true, accurate, and complete. I amaware that there are

significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment.”

D. Changes to the Account Representative; Owners and Operators.

1. Changes to the Account Representative or the alternate Account Representative.

    a. The Account Representative or alternate Account Representative may be changed at any time by sending a complete superseding Certificate to the Director and the Tracking System Administrator under Section 1614(B) of this Rule, with the change taking effect upon receipt of such Certificate by the Director.

    b. Notwithstanding any such change, all representations, actions, inactions, and submissions by the previous Account Representative or alternate prior to the time and date when the Tracking System Administrator receives the superseding Certificate shall be binding on the new Account Representative and the owners and operators of the WEB source.

2. Changes in Owners and Operators.

    a. Within thirty days of any change in the owners and operators of the WEB source, including the addition of a new owner or operator, the Account Representative shall submit a revised Certificate amending the list of owners and operators to include such change.

    b. In the event a new owner or operator of a WEB source is not included in the list of owners and operators submitted in the Certificate, such new owner or operator shall be deemed to be subject to and bound by the Certificate, the representations, actions, inactions, and submissions of the Account Representative of the WEB source, and the decisions, orders, actions, and inactions of the Director as if the new owner or operator were included in such list.

R18-2-1615. Registration

A. Deadlines.

1. Each source that is a WEB source on or before the Program Trigger Date shall register by submitting the initial Certificate required in Section 1614(B) of this Rule to the Director no later than 180 days after the Program Trigger Date.

2. Any existing source that becomes a WEB source after the Program Trigger Date shall register by submitting the initial Certificate required in Section 1614(B) of this Rule to the Director by September 30 of the year following the inventory year

in which the source exceeded the emission threshold.

3. Any new WEB source shall register by submitting the initial Certificate required in Section 1614(B) of this Rule to the Director prior to the commencement of operation.

B. Integration into Permits

1. Any allocation, transfer or deduction of allowance to or from the compliance account of a WEB source shall not require revision of the WEB source's operating permit.
2. Any WEB source that is not required to have a permit under [state's New Source Review Rule] at any time after this Rule becomes effective must at all times possess a permit that includes the requirements of this Rule. If it does not possess a Title V permit under [state's Title V rule], it may do so by obtaining or modifying a permit under [state or tribe's New Source Review Rule] to incorporate the requirements of this Rule. The source must at all times possess a permit that includes these requirements.

R18-2-1616. Allowance Allocations

A. The Tracking System Administrator will record the allowances for each WEB source in the compliance account for a WEB source once the allowances are allocated by the Director. If applicable, the Tracking System Administrator will record a portion of the SO_2 allowances for a WEB source in a special reserve account assigned to the Director to account for any allowances to be held by the Director in accordance with Section 1618(A)(2) of this Rule.

B. The Tracking System Administrator will assign a serial number to each allowance.

C. All allowances shall be allocated, recorded, transferred, or used as whole allowances. To determine the number of whole allowances, the number of allowances shall be rounded down for decimals less than 0.50 and rounded up for decimals of 0.50 or greater.

D. An allowance is not a property right, and is a limited authorization to emit one ton of SO_2 valid only for the purpose of meeting the requirements of this Rule. No provision of this WEB Trading Program or other law should be construed to limit the authority of the Director to terminate or limit such authorization.

E. Early Reduction Bonus Allocation.

1. Any WEB source that reduces permitted annual SO_2 emissions to a level that is below the floor level allocation established for that source between 2003 and the program trigger year may apply to the Director for an early reduction bonus allocation.

2. The application must be submitted no later than ninety days after the Program Trigger Date. Any WEB source that applies and receives early reduction bonus allocations must retain the records referenced below for a minimum of five years after the early reduction bonus allowance is certified.

3. The application for an early reduction bonus allocation must contain the following information:

   a. Copies of all permits or other enforceable documents that include annual SO_2 emissions limits for the WEB source during the period the WEB source was generating the early reductions. Such permits or enforceable documents require monitoring for SO_2 emissions that meets the requirements in Sections 1618(A)(1) and 1618(A)(3) of this Rule.

   Note to reviewer: The early reduction bonus allocation needs to address sources that are not using Part 75 equipment monitoring. This is under discussion.

   b. Copies of emissions monitoring reports, for the period the WEB source was generating the early reductions, that documents the actual annual SO_2 emissions and demonstrates that the actual annual SO_2 emissions were below the floor level allocation established for that source.

   c. Demonstration that the floor level established for the source was calculated using data consistent with the new monitoring methodology. If new monitoring techniques change the floor level for the source, then a demonstration of the new floor level based on new monitoring techniques should be included in the application.

F. Request for allowances for new WEB sources or modified WEB Sources.

1. A new WEB source or an existing WEB source that has increased production capacity through a permitted change in operations [refer to state's NSR Rules] may apply to the Director for an allocation from the new source set-aside.

   a. A new WEB source is eligible to apply for an annual allocation equal to the permitted annual SO_2 emission limit for that source after the source has commenced operation.

   b. An existing WEB source is eligible to apply for an annual allocation equal to the permitted annual SO_2 emission limit for that source that is attributable to any amount of production capacity that is greater than the permitted production capacity for that source as of January 1, 2003.

c. A source that has received a retired source exemption under Section 1613)D of this Rule is not eligible to apply for an allocation from the new source set-aside.

2. The application for an allocation from the new source set-aside must contain the following information:

a. Demonstration that shows the permitted production capacity of the source before and after the new permit;

b. For new WEB sources, documentation of the actual date of the commencement of operation and a copy of the permit.

R18-2-1617. Establishment of Accounts

A. Allowance Tracking System Accounts.

1. All WEB sources are required to open a compliance account. Any person may open a general account for holding and transferring allowances. To open either type of account, an application that contains the following information shall be submitted:

a. The name, mailing address, e-mail address, telephone number, facsimile number of the Account Representative. For a compliance account, include a copy of the Account Certificate of Representation of the Account Representative and any alternate as required in Section 1614(B)(2) of this Rule. For a general account, include the Account Certificate of Representation of the Account Representative and any alternate as required in Section 1617(C)(2) of this Rule.

b. The WEB source or organization name;

c. The type of account to be opened; and

d. A signed certification of truth and accuracy by the Account Representative according to Section 1614(C) of this Rule for compliance accounts and for general accounts, certification of truth and accuracy by the Account Representative according to Section 1617(D) of this Rule.

B. Account Representative for General Accounts.

1. For a general account, one Account Representative must be identified and an alternate Account Representative may be identified and may act on behalf of the Account Representative. Any representation, action, inaction or submission by the alternate Account Representative will be deemed to be a representation, action, inaction or submission by the Account Representative.

C. Identification and Certification of an Account Representative for General Accounts.

1. The Account Representative shall be appointed by an agreement that makes the representations, actions, inactions or submissions of the Account Representative binding on all persons who have an ownership interest with respect to allowances held in the general account.
2. The Account Representative shall submit to the Director and the Tracking System Administrator a signed and dated Account Certificate of Representation (Certificate) that contains the following elements:
   a. The name, address, e-mail (if available), telephone and facsimile number of the Account Representative and any alternate;
   b. The organization name;
   c. The following certification statement:

      "I certify that I was selected as the Account Representative or alternate Account Representative, as applicable, by an agreement binding on all persons who have an ownership interest in allowances in the general account with regard to matters concerning the general account. I certify that I have all the necessary authority to carry out my duties and responsibilities under the WEB Trading Program on behalf of said persons and that each such person shall be fully bound by my representations, actions, inactions, or submissions and by any decision or order issued to me by the Director regarding the general account."
3. Upon receipt by the Director of the complete Certificate, the Account Representative represents and, by his or her representations, actions, inactions, or submissions, legally binds each person who has an ownership interest in allowances held in the general account with regard in all matters concerning the general account. Such persons shall be bound by any decision or order issued by the Director.
4. No WEB Allowance Tracking System general account shall be established until the Tracking System Administrator has received a complete Certificate. Once the account is established, the Account Representative shall make all submissions concerning the account, including the deduction or transfer of allowances.

D. Requirements and Responsibilities.

1. Each submission for the general account shall be signed and certified by the Account Representative for the general account. Each submission shall include the following truth and accuracy certification statement by the Account Representative:

   "I am authorized to make this submission on behalf of all person

who have an ownership interest in allowances held in the general account. I certify under penalty of law that I have personally examined, and am familiar with, the statements and information submitted in this document and all its attachments. Based on my inquiry of those individuals with primary responsibility for obtaining the information, I certify that the statements and information are to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment."

E. Changing the Account Representative.

1. The Account Representative or alternate Account Representative may be changed at any time by sending a complete superseding Certificate to the Director and the Tracking System Administrator under Section 1617(C)(2) of this rule, with the change taking effect upon receipt of such Certificate by the Director. Notwithstanding any such change, all representations, actions, inactions, and submissions by the previous Account Representative or alternate prior to the time and date when the Director receives the superseding Certificate shall be binding on the new Account Representative and all person having ownership interest with respect to allowances held in the general account.

F. Changes to the Account.

1. Any change to the information required in the application for an existing account under Section 1617(A) of this Rule shall require a revision of the application.

R18-2-1618. Monitoring, Recordkeeping and Reporting

Note to Reviewer: Theses provisions will be reviewed and compared to the revised provisions prepared by the Western Regional Air Partnership (WRAP) and EPA on August 13, 2003. Revisions to this section of the rule may be necessary. References within this section are to the Model Rule versus this Rule. The Model Rule is available on WRAP's Web page at www.wrapair.org.

A. General Requirements.

1. For each SO_2 emitting unit at a WEB source the owner or operator shall comply with the following, as applicable, to monitor and record SO_2 mass emissions:
   a. If a unit is subject to 40 CFR Part 75 under a requirement separate from the WEB Trading Program, the unit shall meet the requirements contained

in Part 75 with respect to monitoring, recording and reporting SO_2 mass emissions. [As necessary, insert state rule language to address changes to 40 CFR Part 75.]

b. If a unit is not subject to 40 CFR Part 75 under a requirement separate from the WEB Trading Program, a unit shall use one of the following monitoring methods, as applicable:

i. A continuous emission monitoring system (CEMS) for SO_2 and flow that complies with all applicable monitoring provisions in 40 CFR Part 75;

ii. If the unit is a gas- or oil-fired combustion device, the excepted monitoring methodology in Appendix D to 40 CFR Part 75, or, if applicable, the low mass emissions (LME) provisions (with respect to SO_2 mass emissions only) of section 75.19 of 40 CFR Part 75;

iii. One of the optional WEB protocols, if applicable, in Appendix A to this Rule (attached); or

iv. A petition for site-specific monitoring that the source submits for approval by the Director, and approval by the U.S. Environmental Protection Agency in accordance with Section I8(e) of this Rule (relating to petitions).

c. A permanently retired unit shall not be required to monitor under this Section if such unit was permanently retired and had no emissions for the entire period for which the WEB source implements this paragraph (3) and the Account Representative certifies in accordance with Section L2 of this Rule that these conditions were met.

2. Notwithstanding paragraph (a) of this Section, the owner or operator of a unit that meets one of the conditions of paragraph (b)(1) may elect to have the provisions of this paragraph (b) apply to that unit.

a. Any of the following units may implement this paragraph (b):

i. Any smelting operation where all of the emissions from the operation are not ducted to a stack; or

ii. Any flare, except to the extent such flares are used as a fuel gas combustion device at a petroleum refinery.

iii. Any other type of unit without add-on SO_2 control equipment, if no control level was assumed for the WEB source in establishing the floor level (and reducible allocation).

b. For each unit covered by this paragraph (b), the Account Representative shall submit a notice to request that this paragraph (b) apply to one or more SO_2 emitting units at a WEB source. The notice shall be submitted in accordance with the compliance dates specified in Section I6(a) of this Rule, and shall include the following information (in a format specified by the Director with such additional, related information as may be requested):

i. A notice of all units at the applicable source, specifying which of the units are to be covered by this paragraph (b);

ii. Consistent with the emission estimation methodology used to determine the floor level (and reducible allocation) for the source in accordance with Section C1 of the Implementation Plan, the portion of the WEB source's overall allowance allocation that is attributable to any unit(s) covered by this paragraph; and

iii. An identification of any such units that are permanently retired.

c. For each new unit at an existing WEB source for which the owner or operator seeks to comply with this paragraph (b) and for which the Account Representative applies for an allocation under the new source set-aside provisions of Section G6 of this Rule, the Account Representative shall submit a modified notice under paragraph (b)(2) that includes such new SO_2 emitting unit(s). The modified notice shall be submitted in accordance with the compliance dates in Section I6(a) of this Rule, but no later than the date on which a request is submitted under Section G6 of this Rule for allocations from the set-aside.

d. The Director shall evaluate the information submitted by the WEB source in paragraphs (b)(2) and (b)(3), and may issue a notice to the source to exclude any units that do not qualify under this paragraph (b) or to adjust the portion of allowances attributable to units that do qualify to be consistent with the emission estimation methodology used to establish the floor level (and reducible allocation) for the source. Any such notice shall be provided within 180 days after the date on which the notice from the WEB source was received.

e. The Director shall hold allowances equal to the adjusted portion of the WEB source's allowances under paragraphs (b)(2), (b)(3), and (b)(4) in an account maintained by the Director, provided that no such hold back of the WEB source's allocation will be required for any unit that is permanently retired.

f. The Account Representative for a WEB source shall submit an annual emissions statement for each unit under this paragraph (b). The WEB source shall maintain operating records sufficient to estimate annual emissions in a manner consistent with the emission estimation methodology used to establish the floor level (and reducible allocation) for the source. The Director will retire the allowances held under paragraph (b)(5) to account for the emissions from such units. In addition, if the estimated emissions from all such units at the WEB source are greater than the allowances held under paragraph (b)(5) for the WEB source, the Account Representative will report the excess amount as part of the cumulative annual emissions report for the WEB source and be required to use other allowances in the compliance account for the WEB source to account for such emissions, in accordance with Section I8 of this Rule.

g. The remaining provisions of this Section 1618 shall not apply to units covered by this paragraph except where otherwise noted.

h. A WEB source may opt to modify the monitoring for an SO_2 emitting unit to use monitoring under Section I1(a) of this Rule, but any such monitoring change must take effect on January 1 of the next compliance year. In addition, the Account Representative must submit an initial monitoring plan at least 180 days prior to the date on which the new monitoring will take effect and a detailed monitoring plan in accordance with Section I2 of this Rule. The Account Representative shall also submit a revised notice under paragraph (b)(2) at the same time that the initial monitoring plan is submitted.

3. For any monitoring method that the owner or operator uses under this Section (including paragraph (b)), the owner or operator (and, as applicable, the Account Representative) shall implement, certify, and use such method in accordance with this Section, and record and report the data from such method as required in this Section. In addition, the owner or operator (and, as applicable, the Account Representative) may not:

a. Use an alternative monitoring system, alternative reference method or another alternative for the required monitoring method without having obtained prior written approval in accordance with Section I8(e) of this Rule (relating to petitions);

b. Operate an SO_2 emitting unit so as to discharge, or allow to be discharged, SO_2 emissions to the atmosphere without accounting for these emissions in accordance with the applicable provisions of this Section;

c. Disrupt the approved monitoring method or any portion thereof, and thereby avoid monitoring and recording SO_2 mass emissions discharged into the atmosphere, except for periods of recertification or periods when calibration, quality assurance testing or maintenance is performed in accordance with the applicable provisions of this Section; or

d. Retire or permanently discontinue use of an approved monitoring method, except under one of the following circumstances:

i. During a period when the unit is exempt from the requirements of this Section, including retirement of a unit as addressed in Section I1(a)(3);

ii. The owner or operator is monitoring emissions from the unit with another certified monitoring method approved under this Section for use at the unit that provides data for the same parameter as the retired or discontinued monitoring method; or

iii. The Account Representative submits notification of the date of certification testing of a replacement monitoring system in accordance with this Section, and the owner or operator recertifies thereafter a replacement monitoring system in accordance with the applicable provisions of this Section.

B. Monitoring Plan.

1. General Provisions. The owner or operator of an SO_2 emitting unit that uses a monitoring method under Section I1(a)(2) of this Rule shall meet the following requirements:

a. Prepare and submit to the Director an initial monitoring plan for each monitoring method that the owner or operator uses to comply with this Section. In accordance with paragraph I2(C) of this Rule, the plan shall contain sufficient information on the units involved, the applicable method, and the use of data derived from that method to demonstrate that all unit SO_2 emissions are monitored and reported. The plan shall be submitted in accordance with the compliance dates specified in Section I5 of this Rule.

b. Prepare, maintain and submit to the Director a detailed monitoring plan at least 45 days prior to the first day of certification testing. The plan will contain the applicable information required by paragraph I2(d) of this Rule. the Director may require that the monitoring plan (or portions thereof) be submitted electronically. The Director also may require that the plan be submitted on an ongoing basis in electronic format as part of the quarterly report submitted under Section I8(a) of this Rule or resubmitted separately within 30 days after any change is made to the plan in accordance with the following paragraph (a)(3).

c. Whenever the owner or operator makes a replacement, modification, or change in one of the systems or methodologies provided for in Section I1(a)(2), including a change in the automated data acquisition and handling system or in the flue gas handling system, that affects information reported in the monitoring plan (e.g., a change to serial number for a component of a monitoring system), then the owner or operator shall update the monitoring plan.

2. The owner or operator of an SO_2 emitting unit that uses a method under Section I1(a)(1) of this Rule (a unit subject to 40 CFR Part 75 under a program other than this WEB Trading Program) shall meet the requirements of Section I2(a)-(f) by preparing, maintaining and submitting a monitoring plan in accordance with the requirements of 40 CFR Part 75, provided that the owner or operator also shall submit the entire monitoring plan to the Director upon request.

3. Initial Monitoring Plan. The Account Representative shall submit an initial monitoring plan for each SO_2 emitting unit (or group of units sharing a common methodology) that, except as otherwise specified in an applicable provision in Appendix A, contains the following information:

a. For all SO_2 emitting units involved in the monitoring plan:

i. Plant name and location;

ii. Plant and unit identification numbers assigned by the Director;

iii. Type of unit (or units for a group of units using a common monitoring methodology);

iv. Identification of all stacks or pipes associated with the monitoring plan;

v. Types of fuel(s) fired (or sulfur containing process materials used in the SO_2 emitting unit), and the fuel classification of the unit if combusting more than one type of fuel and using a 40 CFR Part 75 methodology;

vi. Type(s) of emissions controls for SO_2 installed or to be installed, including specifications of whether such controls are pre-combustion, post-combustion, or integral to the combustion process;

vii. Maximum hourly heat input capacity, or process throughput capacity, if applicable;

viii. Identification of all units using a common stack; and

viv. Indicator of whether any stack identified in the plan is a bypass stack.

b. For each unit and parameter required to be monitored, identification of monitoring methodology information, consisting of monitoring methodology, monitor locations, substitute data approach for the methodology, and general identification of quality assurance procedures. If the proposed methodology is a site-specific methodology submitted pursuant to Section I1(a)(2)(D) of this Rule, the description under this paragraph shall describe fully all aspects of the monitoring equipment, installation locations, operating characteristics, certification testing, ongoing quality assurance and maintenance procedures, and substitute data procedures.

c. If the WEB source intends to petition for a change to any specific monitoring requirement otherwise required under this Section, such petition may be submitted as part of the initial monitoring plan.

d. The Director may issue a notice of approval or disapproval of the initial monitoring plan based on the compliance of the proposed methodology with the requirements for monitoring in this Section. Except for any petition contained in the initial monitoring plan, if such notice is not issued within 180 days after the date on which the Director received the initial monitoring plan, the plan shall be deemed approved.

4. Detailed Monitoring Plan. The Account Representative shall submit a detailed monitoring plan that, except as otherwise specified in an applicable provision in Appendix A, shall contain the following information:

a. Identification and description of each monitoring component (including each monitor and its identifiable components, such as analyzer and/or probe) in a CEMS (e.g., SO_2 pollutant concentration monitor, flow monitor, moisture monitor), a 40 CFR Part 75, Appendix D monitoring system (e.g., fuel flowmeter, data acquisition and handling system), or a protocol in Appendix A, including:

i. Manufacturer, model number and serial number;

ii. Component/system identification code assigned by the facility to each identifiable monitoring component, such as the analyzer and/or probe;

iii. Designation of the component type and method of sample acquisition or operation (e.g., in situ pollutant concentration monitor or thermal flow monitor);

iv. Designation of the system as a primary or backup system;

v. First and last dates the system reported data;

vi. Status of the monitoring component; and

vii. Parameter monitored.

b. Identification and description of all major hardware and software components of the automated data acquisition and handling system, including:

i. Hardware components that perform emission calculations or store data for quarterly reporting purposes (provide the manufacturer and model number); and

ii. Software components (provide the identification of the provider and model/version number).

c. Explicit formulas for each measured emissions parameter, using component/system identification codes for the monitoring system used to measure the parameter that links the system observations with the reported concentrations and mass emissions. The formulas must contain all constants and factors required to derive mass emissions from component/system code observations and an indication of whether the formula is being added, corrected, deleted, or is unchanged. The owner or operator of a low mass emissions unit for which the owner or operator is using the optional low mass emissions excepted methodology in section 75.19(c) of 40 CFR Part 75 is not required to report such formulas.

d. Inside cross-sectional area (ft^2) at flow monitoring location (for units with flow monitors, only).

e. If using CEMS for SO_2 and flow, for each parameter monitored: scale, maximum potential concentration (and method of calculation), maximum expected concentration (if applicable) (and method of calculation), maximum potential flow rate (and method of calculations), span value, full-scale range, daily calibration units of measure, span effective date/hour, span inactivation date/hour, indication of whether dual spans are required, default high range value, flow rate span, and flow rate span value and full scale value (in scfh) for each unit or stack using SO_2 or flow component monitors.

f. If the monitoring system or excepted methodology provides for use of a constant, assumed, or default value for a parameter under specific circumstances, then include the following information for each value of such parameter:

   i. Identification of the parameter;
   ii. Default, maximum, minimum, or constant value, and units of measure for the value;
   iii. Purpose of the value;
   iv. Indicator of use during controlled/uncontrolled hours;
   v. Types of fuel;
   vi. Source of the value;
   vii. Value effective date and hour;
   viii. Date and hour value is no longer effective (if applicable); and
   viv. For units using the excepted methodology under section 75.19 of 40 CFR Part 75, the applicable SO_2 emission factor.

g. Unless otherwise specified in section 6.5.2.1 of Appendix A to 40 CFR Part 75, for each unit or common stack on which hardware CEMS are installed:

   i. The upper and lower boundaries of the range of operation (as defined in section 6.5.2.1 of Appendix A to 40 CFR Part 75), or thousand of lb/hr of steam, or ft/sec (as applicable);
   ii. The load or operating level(s) designated as normal in section 6.5.2.1 of Appendix A to 40 CFR Part 75, or thousands of lb/hr of steam, or ft/sec (as applicable);
   iii. The two load or operating levels (i.e., low, mid, or high) identified in section 6.5.2.1 of Appendix A to 40 CFR Part 75 as the most frequently used;
   iv. The date of the data analysis used to determine the normal load (or operating) level(s) and the two most frequently-used load (or operating) levels; and
   v. Activation and deactivation dates when the normal load or operating level(s) change and are updated.

h. For each unit that is complying with 40 CFR Part 75 for which the optional fuel flow-to-load test in section 2.1.7 of appendix D to 40 CFR Part 75 is used:

   i. The upper and lower boundaries of the range of operation (as defined in section 6.5.2.1 of Appendix A to 40 CFR Part 75), expressed in thousand of lb/hr of steam;

   ii. The load level designated as normal, pursuant to section 6.5.2.1 of Appendix A to 40 CFR Part 75, expressed in thousands of lb/hr of steam; and

   iii. The date of the load analysis used to determine the normal load level.

i. Information related to quality assurance testing, including (as applicable): identification of the test strategy; protocol for the relative accuracy test audit; other relevant test information; calibration gas levels (percent of span) for the calibration error test and linearity check; calculations for determining maximum potential concentration, maximum expected concentration (if applicable), maximum potential flow rate, and span;

j. If applicable, apportionment strategies under sections 75.10 through 75.18 of 40 CFR Part 75.

k. Description of site locations for each monitoring component in a monitoring system, including schematic diagrams and engineering drawings and any other documentation that demonstrates each monitor location meets the appropriate siting criteria. For units monitored by a continuous emission monitoring system, diagrams shall include:

   i. A schematic diagram identifying entire gas handling system from unit to stack for all units, using identification numbers for units, monitor components, and stacks corresponding to the identification numbers provided in the initial monitoring plan and paragraphs (d)(1) and (3). The schematic diagram must depict the height of any monitor locations. Comprehensive and/or separate schematic diagrams shall be used to describe groups of units using a common stack.

   ii. Stack and duct engineering diagrams showing the dimensions and locations of fans, turning vanes, air preheaters, monitor components, probes, reference method sampling ports, and other equipment that affects the monitoring system location, performance, or quality control checks.

l. A data flow diagram denoting the complete information handling path from output signals of CEMS components to final reports.

5. In addition to supplying the information in paragraphs (c) and (d) above, the owner or operator of an SO_2 emitting unit using either of the methodologies in paragraph I.1(a)(2)(B) of this Section shall include the following information in its monitoring plan for the specific situations described:

a. For each gas-fired or oil-fired SO_2 emitting unit for which the owner or operator uses the optional protocol in appendix D to 40 CFR Part 75 for SO_2 mass emissions, the Account Representative shall include the following information in the monitoring plan:

i. Parameter monitored;

ii. Type of fuel measured, maximum fuel flow rate, units of measure, and basis of maximum fuel flow rate (i.e., upper range value or unit maximum) for each fuel flowmeter;

iii. Test method used to check the accuracy of each fuel flowmeter;

iv. Submission status of the data;

v. Monitoring system identification code;

vi. The method used to demonstrate that the unit qualifies for monthly GCV sampling or for daily or annual fuel sampling for sulfur content, as applicable;

vii. A schematic diagram identifying the relationship between the unit, all fuel supply lines, the fuel flowmeter(s), and the stack(s). The schematic diagram must depict the installation location of each fuel flowmeter and the fuel sampling location(s). Comprehensive and/or separate schematic diagrams shall be used to describe groups of units using a common pipe;

viii. For units using the optional default SO_2 emission rate for "pipeline natural gas" or "natural gas" in appendix D to 40 CFR Part 75, the information on the sulfur content of the gaseous fuel used to demonstrate compliance with either section 2.3.1.4 or 2.3.2.4 of appendix D to 40 CFR Part 75;

ix. For units using the 720 hour test under section 2.3.6 of appendix D to 40 CFR Part 75 to determine the required sulfur sampling requirements, report the procedures and results of the test; and

x. For units using the 720 hour test under section 2.3.5 of appendix

D to 40 CFR Part 75 to determine the appropriate fuel GCV sampling frequency, report the procedures used and the results of the test.

b. For each SO_2 emitting unit for which the owner or operator uses the low mass emission excepted methodology of section 75.19 to 40 CFR Part 75, the designated representative shall include the following information in the monitoring plan that accompanies the initial certification application:

i. The results of the analysis performed to qualify as a low mass emissions unit under section 75.19(c) to 40 CFR Part 75. This report will include either the previous three years actual or projected emissions. The following items should be included:

(1) Current calendar year of application;

(2) Type of qualification;

(3) Years one, two, and three;

(4) Annual measured, estimated or projected SO_2 mass emissions for years one, two, and three; and

(5) Annual operating hours for years one, two, and three.

ii. A schematic diagram identifying the relationship between the unit, all fuel supply lines and tanks, any fuel flowmeter(s), and the stack(s). Comprehensive and/or separate schematic diagrams shall be used to describe groups of units using a common pipe;

iii. For units which use the long term fuel flow methodology under section 75.19(C)(3) to 40 CFR Part 75, a diagram of the fuel flow to each unit or group of units and a detailed description of the procedures used to determine the long term fuel flow for a unit or group of units for each fuel combusted by the unit or group of units;

iv. A statement that the unit burns only gaseous fuel(s) and/or fuel oil and a list of the fuels that are burned or a statement that the unit is projected to burn only gaseous fuel(s) and/or fuel oil and a list of the fuels that are projected to be burned;

v. A statement that the unit meets the applicability requirements in sections 75.19(a) and (b) to 40 CFR Part 75 with respect to SO_2 emissions; and

vi. Any unit historical actual, estimated and projected SO_2 emissions data and calculated SO_2 emissions data demonstrating that the unit qualifies as a low mass emissions unit under sections 75.19(a) and (b) to 40 CFR Part 75.

c. For each gas-fired unit the Account Representative shall include the following in the monitoring plan: current calendar year, fuel usage data as specified in the definition of gas-fired in section 72.2 of 40 CFR Part 72, and an indication of whether the data are actual or projected data.

6. An operating permit for a WEB source issued in accordance with Title V of the Clean Air Act shall require a source to maintain a detailed monitoring plan in accordance with this Part, but the specific elements of the plan shall not be part of the permit, and modifications to the elements of the plan shall not require a permit modification.

C. Certification/Recertification.

1. All monitoring systems are subject to initial certification and recertification testing as specified in 40 CFR Part 75 or Appendix A to this Rule, as applicable. Certification or recertification of a monitoring system by the U.S. Environmental Protection Agency for a WEB source that is subject to 40 CFR Part 75 under a requirement separate from this Rule shall constitute certification under the WEB Trading Program.

2. The owner or operator of an SO_2 emitting unit not otherwise subject to 40 CFR Part 75 that monitors SO_2 mass emissions in accordance with 40 CFR Part 75 to satisfy the requirements of this Section shall perform all of the tests required by that regulation and shall submit the following:

a. A test notice, not later than 21 days before the certification testing of the monitoring system, provided that the Director may establish additional requirements for adjusting test dates after this notice as part of the approval of the initial monitoring plan under paragraph I2(C) of this Rule; and

b. An initial certification application within 45 days after testing is complete. A monitoring system will be considered provisionally certified while the application is pending, and the system shall be deemed certified if the Director does not approve or disapprove the system within six months after the date on which the application is submitted.

D. Ongoing Quality Assurance and Quality Control.

1. The WEB source shall satisfy the applicable quality assurance and quality control requirements of Part 75 or, if the WEB source is subject to a WEB protocol in Appendix A, the applicable quality assurance and quality control requirements in Appendix A on and after the date that certification testing commences.

E. Substitute Data Procedures.

1. For any period after certification testing is complete in which valid data are not being recorded by a monitoring system specified in this Rule, missing or invalid data shall be replaced with substitute data in accordance with 40 CFR Part 75 or, if the WEB source is subject to a WEB protocol in Appendix A of this rule, with substitute data in accordance with Appendix A of this rule.

2. For an SO_2 emitting unit that does not have a certified (or provisionally certified) monitoring system in place as of the beginning of the first control period for which the unit is subject to the WEB Trading Program, the owner or operator shall:

   a. If the owner or operator will use a CEMS to comply with this Section, substitute the maximum potential concentration of SO_2 for the unit and the maximum potential flow rate, as determined in accordance with 40 CFR Part 75. The procedures for conditional data validation under section 75.20(b)(3) may be used for any monitoring system under this Rule that uses these 40 CFR Part 75 procedures, as applicable;

   b. If the owner or operator will use the 40 CFR Part 75 Appendix D methodology, substitute the maximum potential sulfur content, density or gross calorific value for the fuel and the maximum potential fuel flow rate, in accordance with section 2.4 of Appendix D to 40 CFR Part 75;

   c. If the owner or operator will use the 40 CFR Part 75 LME methodology, substitute the SO_2 emission factor required for the unit as specified in 40 CFR 75.19 and the maximum rated hourly heat input, as defined in 40 CFR 72.2; or

   d. If using a protocol in Appendix A to this Rule, follow the procedures in the applicable protocol.

F. Compliance Dates.

1. The initial monitoring plan shall be submitted by the following dates:

   a. For each source that is a WEB source on or before the Program Trigger Date, the monitoring plan shall be submitted 180 days after such Program Trigger Date.

   b. For any existing source that becomes a WEB source after the Program

Trigger Date, the monitoring plan shall be submitted by September 30 of the year following the inventory year in which the source exceeded the emissions threshold.

c. For any new WEB source, the monitoring plan shall be included with the permit application for New Source Review. [State shall modify the language as necessary to conform with state's new source review rules.]

2. Emission monitoring systems shall be installed, operational and shall have met all of the certification testing requirements of this Section I (including any referenced in Appendix A) by the following dates:

a. For each source that is a WEB source on or before the Program Trigger Date, two years prior to the start of the first control period as described in Section L of this Rule.

b. For any existing source that becomes a WEB source after the Program Trigger Date, one year after the due date for the monitoring plan under I1(C)(2) of this Rule.

c. For any new WEB source, the earlier of 90 unit operating days or 180 calendar days after the date the new source commences operation.

G. Recordkeeping.

1. Except as provided in Section I7(b), the WEB source shall keep copies of all reports, registration materials, compliance certifications, sulfur dioxide emissions data, quality assurance data, and other submissions under this Rule for a period of five years. Unless otherwise requested by the WEB source and approved by the Director, the copies shall be kept on site.

2. The WEB source shall keep all Account Certificates of Representation on site at the source through the year 2018.

3. The WEB source shall keep records of all operating hours, quality assurance activities, fuel sampling measurements, hourly averages for SO_2, stack flow, fuel flow, or other continuous measurements, as applicable, and any other applicable data elements specified in this Section or in Appendix A to this Rule. The WEB source shall maintain the applicable records specified in 40 CFR Part 75 for any SO_2 emitting unit that uses a Part 75 monitoring method to meet the requirements of this Section.

H. Reporting.

1. Quarterly Reports. For each SO_2 emitting unit, the Account Representative shall submit a quarterly report within thirty days after the end of each calendar quarter. The report shall be in a format specified by the Director and shall be submitted in

a manner compatible with the emissions tracking database designed for the WEB Trading Program. the Director may require the WEB source to submit hourly and quality assurance activity information comparable to quarterly reports under 40 CFR Part 75. If the owner or operator submits a quarterly report under 40 CFR Part 75 to the U.S. EPA Administrator, no additional report under this paragraph (a) shall be required, provided, however, that the Director may require that a copy of that report (or a separate statement of quarterly and cumulative annual SO_2 mass emissions) be submitted separately to the Director.

2. Annual Report. Based on the quarterly reports, each WEB source shall submit an annual statement of total annual SO_2 emissions for all SO_2 emitting units at the source. The annual report shall contain four elements: total emissions for all units monitored in accordance with Section I1(a) of this Rule; total emissions for all units with emissions estimated in accordance with Section I1(b) of this Rule; the number of tons, if any, of SO_2 emissions estimated under Section I1(b) of this Rule that are subject to deduction of allowances from the source's compliance account in accordance with Section I1(b)(6); and the total number of SO_2 tons subject to deduction of allowances from the source's compliance account in accordance with Section 1621 of this Rule. The annual report shall be submitted within 30 days after the end of a control period.

3. The Director may direct that any monitoring plan, report, certification/recertification, or emissions data required to be submitted under this Section be submitted to the Tracking System Administrator.

4. The Director may review and reject any report submitted under this Section I7 that contains errors or fails to satisfy the requirements of this Section, and the Account Representative shall resubmit the report to correct any deficiencies.

5. Petitions. A WEB source may petition for an alternative to any requirement specified in Section I1(a)(2). The petition shall require approval of the Director and the U.S. EPA Administrator. Any petition submitted under this paragraph shall include sufficient information for the evaluation of the petition, including, at a minimum, the following information:

   a. Identification of the WEB source and applicable SO_2 emitting unit(s);

   b. A detailed explanation of why the proposed alternative is being suggested in lieu of the requirement;

   c. A description and diagram of any equipment and procedures used in the proposed alternative, if applicable;

   d. A demonstration that the proposed alternative is consistent with the purposes of the requirement for which the alternative is proposed and is consistent with the purposes of this Rule and that any adverse effect of approving such alternative will be *de minimis*; and

e. Any other relevant information that the Director may require.

6. For any monitoring plans, reports, or other information submitted under Section 1618 of this Rule, the Account Representative shall ensure that, where applicable, identifying information is consistent with the identifying information provided in the most recent certificate of representation for the WEB source submitted under Section 1614 of this Rule.

R18-2-1619. Allowance Transfers

A. Procedure.

1. To transfer allowances, the Account Representative shall submit the following information to the Tracking System Administrator:
   a. The transfer account number(s) identifying the transferor account;
   b. The transfer account number(s) identifying the transferee account;
   c. The serial number of each allowance to be transferred; and
   d. The transferor's Account Representative's name and signature and date of submission.

B. Deadline.

1. The allowance transfer deadline is midnight Pacific Standard Time March 1 of each year (or if this date is not a business day, midnight of the first business day thereafter) following the end of the control period. By this time, the transfer of the allowances into the WEB source's compliance account must be correctly submitted to the Tracking System Administrator in order to demonstrate compliance under Section 1621(A) of this Rule for that control period.

C. Retirement of Allowances.

1. To transfer allowances for the purpose of retirement, the Account Representative shall submit the following information to the Tracking System Administrator:
   a. The transfer account number(s) identifying the transferor account;
   b. The serial number of each allowance to be retired; and
   c. The transferor's Account Representative's name and signature and date of submission accompanied by a signed statement acknowledging that each retired allowance as no longer available for future transfers from or to any account.

R.18-2-1620. Use of Allowances from a Previous Year

A. Any allowance that is held in a compliance account or general account will remain in such an account unless and until the allowance is deducted in conjunction with the compliance process, or transferred to another account.

B. In order to demonstrate compliance under Section 1621(A) of this Rule for a control period, WEB sources shall only use allowances allocated for that current control period or any previous year.

C. If flow control procedures for the current control period have been triggered, then the use of allowances that were allocated for any previous year will be limited as follows:

1. The number of allowances that are held in each compliance account and general account as of the allowance transfer deadline for the immediately previous year and that were allocated for any previous year will be determined.
2. The number determined in (1) will be multiplied by the flow control ratio to determine the number of allowances that were allocated for a previous year that can be used without restriction for the current control period.
3. Allowances that were allocated for a previous year in excess of the number determined in (2) may also be used for the current control period. If such allowances are used to make a deduction, two allowances must be deducted for each deduction of one allowance required under Section 1621 of this Rule.

D. Special provisions for the year 2018. After compliance with the 2017 allowance limitation has been determined in accordance with Section 1621(A) of this Rule, allowances allocated for any year prior to 2018 shall not be used for determining compliance with the 2018 allowance limitation or any future allowance limitation.

R18-2-1621. Compliance

A. Compliance with Allowance Limitations.

1. The WEB source must hold allowances, in accordance with Section 1620 and Section 1621(A)(2) of this Rule, as of the allowance transfer deadline in the WEB source's compliance account (together with any current control year allowances held for the WEB source by the Director under Section 1618(A)(2) of this Rule) in an amount not less than the total SO_2 emissions for the control period from the WEB source, as determined under the monitoring and reporting requirements of Section 1618 of this Rule.
   a. For each source that is a WEB source on or before the Program Trigger Date, the first control period is the calendar year that is six years following the calendar year for which SO_2 emissions exceeded the

milestone.

b. For any existing source that becomes a WEB source after the Program Trigger Date, the first control period is the calendar year that is four years following the inventory year in which the source exceeded the SO_2 emissions threshold.

c. For any new WEB source after the Program Trigger Date the first control period is the first full calendar year that the source is in operation.

d. If the WEB Trading Program is triggered in accordance with the 2013 review, the first control period for each source that is a WEB source on or before the Program Trigger Date is the year 2018.

2. Allowance transfer deadline. An allowance may only be deducted from the WEB source's compliance account if:

a. The allowance was allocated for the current control period or meets the requirements in Section 1620 of this Rule for use of allowances from a previous control period, and

b. The allowance was held in the WEB source's compliance account as of the allowance transfer deadline for the current control period, or was transferred into the compliance account by an allowance transfer correctly submitted for recording by the allowance transfer deadline for the current control period.

3. Compliance with allowance limitations shall be determined by comparing the following two numbers:

a. The monitored SO_2 emissions data reported by the source to the Director, in accordance with Section 1618 of this Rule, and recorded in the emissions tracking database and

b. The allowance allocations and transfers recorded in the Allowance Tracking System, adjusted in accordance with Section 1620 of this Rule.

4. To the extent consistent with Section 1620 of this Rule, allowances shall be deducted for a WEB source for compliance with the allowance limitation as directed by the WEB source's Account Representative. Deduction of any other allowances as necessary for compliance with the allowance limitation shall be on a first-in, first-out accounting basis in the order of the date and time of their recording in the WEB source's compliance account, beginning with the allowances allocated to the WEB source and continuing with the allowances transferred to the WEB source's compliance account from another compliance account or general account. The allowances held by the Director for compliance at

a WEB source pursuant to Section 1618(A)(2) of this Rule shall be deducted as specified in that Section.

B. Certification of Compliance.

1. For each control period in which a WEB source is subject to the allowance limitation, the Account Representative of the source shall submit to the Director a Compliance Certification report for the source.

2. The Compliance Certification report shall be submitted no later than the allowance transfer deadline of each control period, and shall contain the following:

   a. Identification of each WEB source;

   b. At the Account Representative's option, the serial numbers of the allowances that are to be deducted from a source's compliance account for compliance with the allowance limitation; and

   c. The Compliance Certification report according to subpart 3 of this section.

3. In the Compliance Certification report, the Account Representative shall certify, based on reasonable inquiry of those persons with primary responsibility for operating the WEB source in compliance with the WEB Trading Program, whether the WEB source for which the compliance certification is submitted was operated during the control period covered by the report in compliance with the requirements of the WEB Trading Program applicable to the source including:

   a. Whether the WEB source operated in compliance with the SO_2 allowance limitation;

   b. Whether SO_2 emissions data has been submitted to [states or tribe] in accordance with Section 1618(A) of this Rule and other applicable guidance, for review, revision as necessary, and finalization for forwarding to the SO_2 Allowance Tracking System for recording;

   c. Whether the monitoring plan that governs the WEB source has been maintained to reflect the actual operation and monitoring of the source, and contains all information necessary to attribute SO_2 emissions to the source, in accordance with Section 1618(A) of this Rule;

   d. Whether all the SO_2 emissions from the WEB source if applicable, were monitored or accounted for either through the applicable monitoring or through application of the appropriate missing data procedures;

   e. If applicable, whether any SO_2 emitting unit for which the WEB source is not required to monitor in accordance with Section 1618(A)(1)(c) of this rule remained permanently retired and had no emissions for the entire applicable period; and

f. Whether there were any changes in the method of operating or monitoring the WEB source that required monitor recertification. If there were any such changes, the report must specify the nature, reason, and date of the change, the method to determine compliance status subsequent to the change, and specifically, the method to determine SO_2 emissions.

C. Penalties for any WEB source exceeding its allowance limitations.

1. Allowance deduction penalties.

a. If emissions from a WEB source exceed the allowance limitation for a control period, as determined in accordance with Section 1621(A) of this Rule, the source's allowances held in its compliance account will be reduced by an amount equal to two times the source's tons of excess emissions.

b. If the compliance account does not have sufficient allowances allocated for that control period, the required number of allowances will be deducted from the WEB source's compliance account regardless of the control period for which they were allocated, once allowances are recorded in the account.

c. Any allowance deduction required under this Section shall not affect the liability of the owners and operators of the WEB source for any fine, penalty or assessment or their obligation to comply with any other remedy, for the same violation, as ordered under the Clean Air Act, implementing regulations or applicable state or tribal law..

2. A financial penalty of $5,000 per ton of SO_2 emissions in excess of the WEB source's allowance limitation shall be levied.

3. WEB Source liability for non-compliance

a. Separate and regardless of any automatic penalties assessed for allowance deduction penalty and financial penalty, a WEB source that violates any requirement of this Rule, including monitoring record keeping and reporting requirements, is subject to civil and criminal penalties under the Director law and the Clean Air Act. Each day of the control period is a separate violation, and each ton of SO_2 emissions in excess of a source's allowance limitation is a separate violation.

R18-2-1622. Special Penalty Provisions for the 2018 Milestone

A. If the WEB Trading Program is triggered and the first control period will not occur until after the year 2018, the following provisions shall apply for the 2018 emissions year.

1. All WEB sources shall register, and open a compliance account within 180 days after the Program Trigger Date, in accordance with Sections 1615(A)and 1617 of this Rule.
2. The Tracking System Administrator will record the allowances for the 2018 control period for each WEB source in the source's compliance account once the Director allocates the 2018 allowances.
3. The allowance transfer deadline is midnight Pacific Standard Time on May 30, 2021. WEB sources may transfer allowances as provided in Section 1619(A) of this Rule until the allowance transfer deadline.
4. A WEB source must hold allowances allocated for 2018 including those transferred into the compliance account by an allowance transfer correctly submitted by the allowance transfer deadline, in an amount not less than the WEB source's total SO_2 emissions for 2018. Emissions are determined using the pre trigger monitoring provisions in Section 1611 of this rule.
5. An allowance deduction penalty and financial penalty shall be assessed and levied in accordance with Sections 1620(D), 1621(A)(4) and 1621(C) of this Rule, except that SO_2 emissions shall be determined under Section 1622(A)(4) of this Rule.

B. If the program has been triggered and provision 1622(A) is implemented, the provisions of 1622(C) of this Rule shall apply for each year after the 2018 emission year until:

1. The first control period under the WEB trading program; or
2. The Director determined that the 2018 SO2 milestone has been met.

C. If provision in Section 1622(A) has been implemented, the following shall apply to each emissions year after the 2018 emissions year:

1. The Tracking System Administrator will record the allowances for the control period for the specific year for each WEB source in the source's compliance account once the Director allocates the allowances.
2. The allowance transfer deadline is midnight Pacific Standard Time on March 1 of each year (or if this date is not a business day, midnight of the first business day thereafter) following the end of the specific emissions year. WEB sources may transfer allowances as provided in Section 1619(A) of this Rule until the allowance transfer deadline.
3. A WEB source must hold allowances allocated for that specific emissions year, or any year after 2018, including those transferred into the compliance account by an

allowance transfer correctly submitted by the allowance transfer deadline, in an amount not less than the WEB source's total SO_2 emissions for the specific emissions year. Emissions are determined using the pre-trigger monitoring provisions in Section 1611 of this rule.

4. An allowance deduction penalty and financial penalty shall be assessed and levied in accordance with Sections 1620(D), 1621(A)(4) and 1621(C) of this Rule, except that SO_2 emissions shall be determined under Section 1622(C)(3) of this Rule.

NOTE: Appendix A follows.

APPENDIX A: WEB MODEL RULE MONITORING PROTOCOLS

Protocol WEB-1: SO_2 Monitoring of Fuel Gas Combustion Devices

1. Applicability

    (a) The provisions of this protocol are applicable to fuel gas combustion devices at petroleum refineries.

    (b) Fuel gas combustion devices include boilers, process heaters, and flares used to burn fuel gas generated at a petroleum refinery.

    (c) Fuel gas means any gas which is generated and combusted at a petroleum refinery. Fuel gas does not include (1) natural gas, unless combined with other gases generated at a petroleum refinery, (2) gases generated by a catalytic cracking unit catalyst regenerator, (3) gases generated by fluid coking burners, (4) gases combusted to produce sulfur or sulfuric acid, or (5) process upset gases generated due to startup, shutdown, or malfunctions.

2. Monitoring Requirements

    (a) Except as provided in paragraphs (b) and (c) of this Section 2, fuel gas combustion devices shall use a continuous fuel gas monitoring system (CFGMS) to determine the total sulfur content (reported as H_2S) of the fuel gas mixture prior to combustion, and continuous fuel flow meters to determine the amount of fuel gas burned.

        (1) Fuel gas combustion devices having a common source of fuel gas may be monitored for sulfur content at one location, if monitoring at that location is representative of the sulfur content of the fuel gas being burned in any fuel gas combustion device.

        (2) The CFGMS shall meet the performance requirements in Performance Specification 2 in Appendix B to 40 CFR Part 60, and the following:

            (i) Continuously monitor and record the concentration by volume of total sulfur compounds in the gaseous fuel reported as ppmv H_2S.

            (ii) Have the span value set so that the majority of readings fall between 10 and 95% of the range.

            (iii) Record negative values of zero drift.

            (iv) Calibration drift shall be # 5.0% of the span, for initial certification and daily calibration error tests.

            (v) Methods 15A, 16, or approved alternatives for total sulfur, are the reference methods for the relative accuracy test. The relative accuracy test shall include a bias test in accordance with paragraph 4.(c) of this section.

(3) All continuous fuel flow meters shall comply with the provisions of section 2.1.5 of Appendix D to 40 CFR Part 75.

(4) The hourly mass SO_2 emissions rate for all the fuel gas combustion devices monitored by this approach shall be calculated using the following equation:

$$E_t = (C_S)(Q_t)(K)$$

where: E_t = Total SO_2 emissions in lb/hr from applicable fuel gas combustion devices
C_S = Sulfur content of the fuel gas as H_2S(ppmv)
Q_t = Fuel gas flow rate to the applicable fuel gas combustion devices (scf/hr)
$K = 1.660 \times 10^{-7}$ (lb/scf)/ppmv

(b) In place of a CFGMS in paragraph (a) of this Section 2, fuel gas combustion devices having a common source of fuel gas may be monitored with an SO_2 CEMS, a flow CEMS, and (if necessary) a moisture monitoring system at only one location, if the CEMS monitoring at that location is representative of the SO_2 emission rate (lb SO_2/scf fuel gas burned) of all applicable fuel gas combustion devices. Continuous fuel flow meters shall be used in accordance with paragraph (a), and the fuel gas combustion device monitored by a CEMS shall have separate fuel metering.

(1) Each CEMS for SO_2, flow, and (if applicable) moisture, shall comply with the operating requirements, performance specifications, and quality assurance requirements of 40 CFR Part 75.

(2) All continuous fuel flow meters shall comply with the provisions of section 2.1.5 of Appendix D to 40 CFR Part 75.

(3) The SO_2 hourly mass emissions rate for all the fuel gas combustion devices monitored by this approach shall be determined by the ratio of the amount of fuel gas burned by the CEMS-monitored fuel gas combustion device to the total fuel gas burned by all applicable fuel gas combustion devices using the following equation:

$$E_t = (E_m)(Q_t)/(Q_m)$$

where: E_t = Total SO_2 emissions in lb/hr from applicable fuel gas combustion devices
E_m = SO_2 emissions in lb/hr from the CEMS-monitored fuel gas combustion device, calculated using Equation F-1 or (if applicable) F-2 in Appendix F to 40 CFR Part 75
Q_t = Fuel gas flow rate (scf/hr) to the applicable fuel gas combustion devices
Q_m = Fuel gas flow rate (scf/hr) to the CEMS-monitored fuel gas combustion device

(c) In place of a CFGMS in paragraph (a) of this section, fuel gas combustion devices having a common source of fuel gas may be monitored with an SO_2 - diluent CEMS at only one location, if the CEMS monitoring at that location is representative of the SO_2 emission rate (lb SO_2/mmBtu) of all applicable fuel gas combustion devices. If this option is selected, the owner or operator shall conduct fuel gas sampling and analysis for gross calorific value (GCV), and shall use continuous fuel flow metering in accordance with paragraph (a) of this Section 2, with separate fuel metering for the CEMS-monitored fuel gas combustion device.

(1) Each SO_2-diluent CEMS shall comply with the applicable provisions for SO_2 monitors and diluent monitors in 40 CFR Part 75, and shall use the procedures in section 3 of Appendix F to Part 75 for determining SO_2 emission rate (lb/mmBtu) by substituting the term SO_2 for NO_x in that section, and using a K factor of 1.660×10^{-7} (lb/scf)/ppmv instead of the NO_x K factor.

(2) All continuous fuel flow meters and fuel gas sampling and analysis for GCV to determine the heat input rate from the fuel gas shall comply with the applicable provisions in sections 2.1.5 and 2.3.4 of Appendix D to 40 CFR Part 75.

(3) The SO_2 hourly mass emissions rate for all the fuel gas combustion devices monitored by this approach shall be calculated by using the following equation:

$$E_t = (E_m)(Q_t)(GCV)/10^6$$

where:

E_t = Total hourly SO_2 mass emissions in lb/hr from the applicable fuel gas combustion devices
E_m = SO_2 emission rate in lb/mmBtu from the CEMS - monitored fuel gas combustion device
Q_t = Fuel gas flow rate (scf/hr) to the applicable fuel gas combustion devices
GCV = Fuel Gross Calorific Value (Btu/scf)
10^6 = Conversion from Btu to million Btu

(d) Calculate total SO_2 mass emissions for each calendar quarter and each calendar year based on the emissions in lb/hr and Equations F-3 and F-4 in Appendix F to 40 CFR Part 75, Appendix F.

3. Certification/Recertification Requirements

All monitoring systems are subject to initial certification and recertification testing as follows:

(a) The owner or operator shall comply with the initial testing and calibration requirements in Performance Specification 2 in Appendix B to 40 CFR Part 60 and paragraph 2 (a)(2) of this section for each CFGMS.

(b) Each CEMS for SO_2 and flow or each SO_2-diluent CEMS shall comply with the testing and calibration requirements specified in 40 CFR Part 75, section 75.20 and Appendices A and B, except that each SO_2-diluent CEMS shall meet the relative accuracy requirements for a NO_x-diluent CEMS (lb/mmBtu).

(c) A continuous fuel flow meter shall comply with the certification and quality-assurance requirements in sections 2.1.5 and 2.1.6 to Appendix D to 40 CFR Part 75.

4. Quality Assurance/Quality Control Requirements

(a) A quality assurance/quality control (QA/QC) plan shall be developed and implemented for each CEMS for SO_2 and flow or the SO_2-diluent CEMS in compliance with sections 1, 1.1, and 1.2 of Appendix B to Part 75.

(b) A QA/QC plan shall be developed and implemented for each continuous fuel flow meter and fuel sampling and analysis in compliance with sections 1, 1.1, and 1.3 of Appendix B to 40 CFR Part 75.

(c) A QA/QC plan shall be developed and implemented for each CFGMS in compliance with sections 1 and 1.1 of Appendix B to 40 CFR Part 75, and the following:

(i) Perform a daily calibration error test of each CFGMS at two gas concentrations, one low level and one high level. Calculate the calibration error as described in Appendix A to 40 CFR Part 75. An out of control period occurs whenever the error is greater than 5.0% of the span value.

(ii) In addition to the daily calibration error test, an additional calibration error test shall be performed whenever a daily calibration error test is failed, whenever a monitoring system is returned to service following repairs or corrective actions that may affect the monitor measurements, or after making manual calibration adjustments.

(iii) Perform a linearity test once every operating quarter. Calculate the linearity as described in Appendix A to 40 CFR Part 75. An out of control period occurs whenever the linearity error is greater than 5.0 percent of a reference value, and the absolute value of the difference between average monitor response values and a reference value is greater than 5.0 ppm.

(iv) Perform a relative accuracy test audit once every four operating quarters. Calculate the relative accuracy as described in Appendix A to 40 CFR Part 75. An out of control period occurs whenever the relative accuracy is greater than 20.0% of the mean value of the reference method measurements.

(v) Using the results of the relative accuracy test audit, conduct a bias test in accordance with Appendix A to 40 CFR Part 75, and calculate and apply a bias adjustment factor if required.

5. Missing Data Procedures

(a) For any period in which valid data are not being recorded by an SO_2 CEMS or flow CEMS specified in this section, missing or invalid data shall be replaced with substitute data in accordance with the requirements in Subpart D of 40 CFR Part 75.

(b) For any period in which valid data are not being recorded by an SO_2-diluent CEMS specified in this section, missing or invalid data shall be replaced with substitute data on a rate basis (lb/mmBtu) in accordance with the requirements for SO_2 monitors in Subpart D of 40 CFR Part 75.

(c) For any period in which valid data are not being recorded by a continuous fuel flow meter or for fuel gas GCV sampling and analysis specified in this section, missing or invalid data shall be replaced with substitute data in accordance with missing data requirements in Appendix D to 40 CFR Part 75.

(d) For any period in which valid data are not being recorded by the CFGMS specified in this section, hourly missing or invalid data shall be replaced with substitute data in accordance with the missing data requirements for units performing hourly gaseous fuel sulfur sampling in section 2.4 of Appendix D to 40 CFR Part 75.

6. Monitoring Plan and Reporting Requirements

In addition to the general monitoring plan and reporting requirements of Section I of this Rule, the owner or operator shall meet the following additional requirements:

(a) The monitoring plan shall identify each group of units that are monitored by a single monitoring system under this Protocol WEB-1, and the plan shall designate an identifier for the group of units for emissions reporting purposes. For purpose of submitting emissions reports, no apportionment of emissions to the individual units within the group is required.

(b) If the provisions of paragraphs 2.(b) or (c) are used, provide documentation and an explanation to demonstrate that the SO_2 emission rate from the monitored unit is representative of the rate from non-monitored units.

Protocol WEB-2: Predictive Flow Monitoring Systems for Kilns with Positive Pressure Fabric Filter

1. Applicability

The provisions of this protocol are applicable to cement kilns or lime kilns that (1) are controlled by a positive pressure fabric filter, (2) combust only a single fuel, no fuel blends, and (3) have operating conditions upstream of the fabric filter that the WEB source documents would reasonably prevent reliable flow monitor measurements. This protocol does not modify the SO_2 monitoring requirements in section I of this Rule.

2. Monitoring Requirements

(a) A cement or lime kiln with a positive pressure fabric filter shall use a predictive flow monitoring system (PFMS) to determine the hourly kiln exhaust gas flow.

(b) A PFMS is the total equipment necessary for the determination of exhaust gas flow using process or control device operating parameter measurements and a conversion equation, a graph, or computer program to produce results in cubic feet per hour.

(c) The PFMS shall meet the following performance specifications:

(1) Sensors readings and conversion of sensor data to flow in cubic feet per hour must be automated.

(2) The PFMS must allow for the automatic or manual determination of failed monitors. At a minimum a daily determination must be performed.

(3) The PFMS shall have provisions to check the calibration error of each parameter that is individually measured. The owner or operator shall propose appropriate performance specifications in the initial monitoring plan for all parameters used in the PFMS comparable to the degree of accuracy required for other monitoring systems used to comply with this Rule. The parameters shall be tested at two levels, low: 0 to 20% of full scale, and high: 50 to 100% of full scale. The reference value need not be certified.

(4) The relative accuracy of the PFMS must be $\leq$ 10.0% of the reference method average value, and include a bias test in accordance with paragraph 4(c) of this section.

3. Certification Requirements

The PFMS is subject to initial certification testing as follows:
(a) Demonstrate the ability of the PFMS to identify automatically or manually a failed monitor.

(b) Provide evidence of calibration testing of all monitoring equipment. Any tests conducted within the previous 12 months of operation that are consistent with the QA/QC plan for the PFMS are acceptable for initial certification purposes.

(c) Perform an initial relative accuracy test over the normal range of operating conditions of the kiln. Using the results of the relative accuracy test audit, conduct a bias test in accordance with Appendix A to 40 CFR Part 75, and calculate and apply a bias adjustment factor if required.

4. Quality Assurance/Quality Control Requirements

A QA/QC plan shall be developed and implemented for each PFMS in compliance with sections 1 and 1.1 of Appendix B of 40 CFR Part 75, and the following:

(a) Perform a daily monitor failure check.

(b) Perform calibration tests of all monitors for each parameter included in the PFMS. At a minimum, calibrations shall be conducted prior to each relative accuracy test audit.

(c) Perform a relative accuracy test audit and accompanying bias test once every four operating quarters. Calculate the relative accuracy (and bias adjustment factor) as described in Appendix A to 40 CFR Part 75. An out of control period occurs whenever the flow relative accuracy is greater than 10.0% of the mean value of the reference method.

5. Missing Data

For any period in which valid data are not being recorded by the PFMS specified in this section, hourly missing or invalid data shall be replaced with substitute data in accordance with the flow monitor missing data requirements for non-load based units in Subpart D of 40 CFR Part 75.

6. Monitoring Plan Requirements

In addition to the general monitoring plan requirements of Section I of this Rule, the owner or operator shall meet the following additional requirements:

(a) The monitoring plan shall document the reasons why stack flow measurements upstream of the fabric filter are unlikely to provide reliable flow measurements over time.

(b) The initial monitoring plan shall explain the relationship of the proposed parameters and stack flow, and discuss other parameters considered and the reasons for not using those parameters in the PFMS. The [state or tribe] may require that the subsequent monitoring plan include additional explanation and documentation for the reasonableness of the proposed PFMS.

Appendix A-7b. Proposed WRAP 309 Coordinating Committee Charter

WRAP Board of Directors

Proposal to form a standing 309 Coordinating Committee

October 15, 2003

Background:

Section 309 of the Regional Haze Rule provides that the 9 western “transport region” states and Indian tribes within those states may opt to develop regional haze SIPs following the recommendations of the Grand Canyon Visibility Transport Commission (GCVTC). If implemented, the GCTVC recommendations satisfy the requisite showing of “Reasonable Progress” toward meeting the national visibility goal. Transport states electing to submit 309 SIPs must incorporate the GCVTC recommendations, and submit their initial SIPs by December 31, 2003. Eligible tribes are not subject to this deadline and may submit 309 TIPs at later dates. Over the last several years the WRAP has performed most of the technical analyses and policy recommendations to support the states on a regional scale.

Five transport region states have declared their intent to submit 309 SIPs. These states are AZ, NM, OR, UT, and WY. To date, no tribe has announced its intention to submit a 309 TIP.

As these 309 states have moved through their individual planning processes following the work of the WRAP, it is clear they would benefit greatly through continuing the cooperative relationships already established under the WRAP. Likewise, tribes that choose 309 would also benefit greatly from this ongoing collaboration. This would better enable each participant to take advantage of the work done by the other participants on their initial submittals, with higher assurance that the SIPs and TIPs would meet all requirements of the Regional Haze Rule and the Annex. Over the longer term, a coordinated approach provides a forum to facilitate ongoing communications among the participants, and a mechanism to meet particular implementation requirements, such as milestone tracking, monitoring information and data exchange.

Proposal:

The 309 states propose that the WRAP board create a standing committee, called the “309 Coordinating Committee.” This committee would be formed according to the WRAP Bylaws, II. E., which allows the formation of additional standing committees (see attachment). The committee would be organized as follows:

Membership –

One designated representative from each state and tribe that submits a plan under §309 (in the case of tribes, a declaration of intent to move ahead with submission of a plan would warrant membership). Additional state and tribal staff may participate in meetings of the committee, as appropriate. The WRAP will appoint Co-Chairs from the membership.

Additional members –

If issues arise which require participation of federal agencies or stakeholders, the committee at its discretion will extend membership to such federal representatives and stakeholders as appropriate. The WRAP will make these appointments for limited duration as long as the issue requiring federal or stakeholder membership is active.

Charge of the Committee –

To provide an ongoing forum for 309 states and tribes to facilitate communications and information exchange.

To provide a mechanism to achieve consistency in implementing requirements of §309 of the regional haze rule, including but not limited to implementation of: the emissions tracking system to evaluate stationary source compliance with the SO_2 milestones; the backstop market-trading program for stationary sources, if required; and emission tracking in clean air corridors, for fire and enhanced smoke management programs, and for mobile and area sources.

The committee will also make recommendations to the WRAP Board, as needed, toward improving implementation of programs contained in SIPs and TIPs adopted under §309, and evaluate the value and appropriateness of WRAP involvement in resolving disagreements between states or between states and tribes on 309 matters.

ATTACHMENT

(From WRAP bylaws, revised 7/23/02)

...

I. GENERAL GUIDELINES FOR STANDING COMMITTEES REPORTING DIRECTLY TO THE WRAP.

A. All meetings shall be open to the public, and should include an opportunity for those members of the public who are observing the meeting to comment on or provide suggestions relevant to the committee's work.

B. Whenever processes are directed to be stakeholder based, membership should represent a wide range of social, cultural, economic, geographic, relative population and technical viewpoints. To meet this goal, the following categories of representatives should be considered.

* Industry (focused on production sector but excluding the mobile source sector)

* Small business (focused on the service sector, including "green industry")

* Mobile sources (including vehicle manufacturers and transportation planners)

* Federal government

* Tribal government

* State government

* Local government

* Academia

* Environmental groups

* General public

In all cases it may not be possible or appropriate to include each of the categories in stakeholder processes. However, whenever a category is not included, an explanation for the exclusion should be recorded.

In selecting members for committees, both technical expertise and diversity of viewpoints must be considered in balancing committee membership to provide equity. It is not expected that each member of a committee be a technical expert in all aspects of the committee's work but rather, that all can contribute to the committee's overall goals.

II. TECHNICAL OVERSIGHT COMMITTEE (TOC), INITIATIVES OVERSIGHT COMMITTEE (IOC), AND OTHER COMMITTEES

…

E. Other Committees

1. The WRAP may establish other standing committees, forums or work groups. Membership on such standing committees, forums, or work groups shall consist of state and tribal representatives from the applicable region.

2. The committee shall extend membership to other regional stakeholders as appropriate. Members will be selected by the WRAP from letters of interest. Duration of the appointment shall coincide with the duration of the air quality issue.

3. The WRAP will appoint co-chairs of any standing committees. The co-chairs of any standing committees established will be members of the Coordinating Group.

Appendix A-7c. WRAP Report on Assessment of NOx/PM Strategies

WESTERN REGIONAL AIR PARTNERSHIP

Stationary Source NOx and PM Emissions in the WRAP Region:

An Initial Assessment of Emissions, Controls, and Air Quality Impacts

Final Report of the WRAP Market Trading Forum

October 1, 2003

Western Governors' Association
1515 Cleveland Place, Suite 200
Denver, CO 80202

NOTE: Section VI of this report is bound separately and available on the WRAP Web site at http://www.wrapair.org/forums/mtf/nox-pm.html

PREFACE

Regulatory Framework for Tribal Visibility Implementation Plans

The regional haze rule explicitly recognizes the authority of tribes to implement the provisions of the rule, in accordance with principles of federal Indian law, and as provided by the Clean Air Act §301(d) and the tribal authority rule (TAR) (40 CFR §§49.1– .11). Those provisions create the following framework:

1. Absent special circumstances, reservation lands are not subject to state jurisdiction.
2. Federally recognized tribes may apply for and receive delegation[1] of federal authority to implement CAA programs, including visibility regulation, or "reasonably severable" elements of such programs (40 CFR §§49.3, 49.7). The mechanism for this delegation is a tribal implementation plan (TIP). A reasonably severable element is one that is not integrally related to program elements that are not included in the plan submittal, and is consistent with applicable statutory and regulatory requirements.
3. The regional haze rule expressly provides that tribal visibility programs are "not dependent on the strategies selected by the state or states in which the tribe is located" (64. Fed. Reg. 35756), and that the authority to implement §309 TIPs extends to all tribes within the GCVTC region (40 CFR §51.309(d)(12)).
4. The EPA has indicated that under the TAR tribes are not required to submit §309 TIPs by the end of 2003. Rather, they may choose to opt-in to §309 programs at a later date (67 Fed. Reg. 30439).
5. Where a tribe does not seek delegation through a TIP, EPA, as necessary and appropriate, will promulgate a federal implementation plan (FIP) within reasonable timeframes to protect air quality in Indian country (40 CFR §49.11). EPA is committed to consulting with tribes on a government-to-government basis in developing tribe-specific or generally applicable TIPs where necessary (See, e.g., 63 Fed. Reg. 7263-64).

The amount of modification, if any, needed for this report to fulfill tribal needs may vary considerably from tribe to tribe. The authors have striven to ensure that all references to tribes in the document are consistent with principles of tribal sovereignty and autonomy as reflected in the above framework. Any inconsistency with this framework is strictly inadvertent and not an attempt to impose requirements on tribes which are not present under existing law.

Tribal Participation in the WRAP

Tribes, along with states and federal agencies, are full partners in the WRAP, having equal representation on the WRAP Board as states. Whether Board members or not, it must be remembered that all tribes are governments, as distinguished from the "stakeholders" (private interest) which participate on Forums and Committees but are not eligible for the Board.

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[1] Tribes also possess a more fundamental source of authority to regulate their environments, based on their inherent authority as sovereign nations, which predates the formation of the United States. However, in the context of air pollution regulation and visibility planning in particular, tribal authority will more likely be based on delegation of federal authority.

Despite this equality of representation on the Board, tribes are very differently situated than states. There are over four hundred federally-recognized tribes in the WRAP region, including Alaska. The sheer number of tribes makes full participation impossible. Moreover, many tribes are faced with pressing environmental, economic, and social issues, and do not have the resources to participate in an effort such as the WRAP, however important its goals may be. These factors necessarily limit the level of tribal input into and endorsement of WRAP products.

The tribal participants in the WRAP, including Board members Forum and Committee members and co-chairs, make their best effort to ensure that WRAP products are in the best interest of the tribes, the environment, and the public. One interest is to ensure that WRAP policies, as implemented by states and tribes, will not constrain the future options of tribes who are not involved in the WRAP. With these considerations and limitations in mind, the tribal participants have joined the state, federal, and private stakeholder interests in approving this report as a consensus document.

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Section VI Bound separately and available at ***http://www.wrapair.org/forums/mtf/nox-pm.html***

SECTION I:
EXECUTIVE SUMMARY

Background and Purpose

The primary purpose of this report is to provide the information necessary for western states and tribes to fulfill the requirements of Section 309(d)(4)(v) of the U.S. Environmental Protection Agency's (EPA) regional haze rule (40 CFR 51.309). Specifically, the rule states:

> *Provisions for stationary source NOx and PM. The plan submission must include a report which assesses emissions control strategies for stationary source NOx and PM, and the degree of visibility improvement that would result from such strategies. In the report, the State must evaluate and discuss the need to establish emission milestones for NOx and PM to avoid any net increase in these pollutants from stationary sources within the transport region, and to support potential future development and implementation of a multipollutant and possibly multisource market-based program. The plan submission must provide for an implementation plan revision, containing any necessary long-term strategies and BART requirements for stationary source PM and NOx (including enforceable limitations, compliance schedules, and other measures) by no later than December 31, 2008.*

The regional haze rule provides the nine western states within the Grand Canyon Visibility Transport Region (GCVTR) an opportunity to submit state implementation plans (SIPs) containing policies and programs recommended in the final report of the Grand Canyon Visibility Transport Commission (June 1996). Such plans must be submitted by December 31, 2003. GCVTR states electing not to submit SIPs under Section 309 must submit SIPs under Section 308 of the regional haze rule in the 2005-07 time frame. Indian tribes have the option to submit tribal implementation plans (TIPs) under either section at any time. Moreover, the TIPs may include reasonably severable elements of the rule. A map of the WRAP region, mandatory federal Class I areas addressed by the regional haze rule, and WRAP state and tribal members is provided in **Figure I-1**.

A major provision of Section 309 is the control of stationary source sulfur dioxide (SO_2) emissions. The provision quoted above – for a report on stationary sources of NOx and PM – is to ensure that states begin the process of evaluating other pollutants from stationary sources. Hence, this report is meant as a starting point for a potentially multi-year process of evaluating stationary sources and designing further control strategies where appropriate. At a minimum, this process must include the determination of best available retrofit technology (BART) for certain sources[1] and the resulting visibility improvements and may include an alternative (e.g., emissions trading) program achieving greater reasonable progress towards the national visibility goal of no man-made impairment.

[1] BART-eligible sources are those which belong to one of 26 industrial categories, have the potential to emit at least 250 tons per year of a visibility-impairing pollutant, and were put into place between 1962 and 1977.

Organization of Report

This report is required for the GCVTR states choosing to submit SIPs under Section 309 of the region haze rule, but since all states must ultimately address stationary source NOx and PM emissions from BART-eligible and potentially other stationary sources, the scope of this report goes somewhat beyond the nine states in the GCVTR and the limited number of BART-eligible sources in the WRAP region. For example, the air quality modeling evaluates the impact of emission changes within the GCVTR, but at all Class I areas within the contiguous WRAP region. Also, emission control technologies evaluated in Section VI were chosen on the basis of source types throughout the WRAP region, which do not differ substantially from those types within the GCVTR. They were also chosen on the basis of all existing source types, not just BART-eligible source types, partly because sources eligible for BART as a result of pollutants other than SO_2 have not yet been identified[2] and partly because an alternative program to BART could apply to a much broader universe of sources. By extending the scope of this report beyond the nine GCVTR states and beyond the BART-eligible stationary sources, it not only becomes applicable to a wider range of WRAP members and potential control strategies but serves to coordinate regional development of such strategies. It is also a more cost-effective approach than dealing with the nine GCVTR states separately.

As noted above, this report contains analyses and information to initiate a process for evaluating stationary sources of NOx and PM – a process required of all states and open to Indian tribes as well. The Executive Summary contains highlights of the report, but it is also where specific issues raised in Section 309(d)(4)(v), such as interpollutant trading, are directly and succinctly discussed. This is intended to help Section 309 states and tribes address the literal requirements of the rule.

Table I-1 shows how analyses within this report were designed to address the specific requirements of the rule. Emissions data can be used to assess emission control strategies and to evaluate the need for milestones by illustrating the relative significance of different source categories to total NOx and PM emissions, both now and in the future. Ambient monitoring data can be used to assess emission control strategies by illustrating where and how much nitrate and primary PM may contribute to actual visibility impairment. The conceptual model is intended to support this entire assessment and to provide a common, scientifically-founded understanding of western haze and the role of stationary sources in anticipation of a multi-year assessment of their importance and control options. The conceptual model is intended to provide a more complete framework than what can be provided alone by the air quality modeling and other assessments. Air quality modeling is used in a "sensitivity capacity" to assess emission control strategies, their degree of visibility improvement, and the need for milestones to prevent any future increase in emissions. A summary of current NOx and PM control technologies and their costs, trends, and secondary and multi-pollutant impacts can be used to assess emission control technologies and the need for milestones to support multisource and multipollutant programs. This summary is also a useful starting point for addressing the BART requirements in Section 308 SIPs and Section 309 SIP revisions. All these analyses are expected to be updated and improved by the WRAP before such SIPs are adopted.

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[2] The full universe of BART-eligible sources does not need to be identified until SIPs and SIP revisions are due in 2005-08, although this identification process is expected to begin in 2003.

Table I-1. Analyses Contained in this Report and Their Relation to the Requirements in Section 309(d)(4)(v) of the Regional Haze Rule.

Requirements of 309(d)(4)(v)	Emissions Data	Ambient Data	Conceptual Model	Air Quality Model	Control Technologies
Assess emission control strategies	X	X	X	X	X
Assess degree of visibility improvement that would result from such strategies		X	X	X	
Evaluate and discuss the need to establish milestones to avoid any net increase	X		X	X	
Evaluate and discuss the need for milestones to support potential future development of multipollutant and multisource market-based programs			X		X
Implementation plan revision by December 31, 2008					

Finally, emissions in Alaska are not presented because resources did not permit examination of a second emissions inventory database, nor are air quality modeling results presented for Alaska because the visibility modeling system for Alaska is currently under development. However, ambient monitoring data for Alaska are presented, and the conceptual model and control technology information are applicable as well.

Summary of Findings

Analysis of current and future emissions, ambient monitoring data, and very limited modeling results indicates that stationary source emissions of PM probably cause less than 2 percent of the region's visibility impairment, whereas stationary source NOx emissions result in nitrates[3] that probably cause about 2 to 5 percent of the impairment on the Colorado Plateau[4] and about 10 percent of the impairment in some areas of the Northern Plains, Pacific Northwest, and southern California. These findings may change as emission projections are updated and as ambient monitoring data from new sites is collected and analyzed, and especially as modeling capabilities are improved and as more data become available for the best and worst visibility days.

[3] NOx emissions may also increase other PM species.
[4] Some of the 20 percent haziest days, however, are dominated by nitrate.

Regardless of this or future regional technical analyses, the remedy embodied in reasonably attributable visibility impairment requirements under the regional haze rule is still available where BART-eligible sources of NOx and PM are found to have direct impact on specific mandatory federal Class I areas. Furthermore, when considering NOx and PM milestones, attention should be given to the reasonable progress goals in the regional haze rule, which generally entail steady and continuing emission reductions and no degradation on the best visibility days. Where stationary source NOx emission reductions are appropriate, substantial reduction may be feasible with commercially-available technologies for about $300 to $1,200 per ton.

Assessment of Emission Control Strategies for Stationary Sources of NOx and PM

Since this report is primarily a starting point for addressing stationary source NOx and PM emissions, the control of which would not be determined until the 2005-08 timeframe, specific emission control strategies including such elements as level of control, applicability, and emissions trading are not addressed. Rather, this report identifies significant issues in assessing and designing such control strategies and provides some preliminary emissions, monitoring, and modeling results.

Stationary source NOx emissions comprise about 25 percent of the WRAP NOx emission inventory. One byproduct of NOx emissions is nitrate aerosols. As described in Section III, during the 20 percent worst days on the Colorado Plateau, nitrate aerosols are responsible for about 6 to 18 percent of the man-made visibility impairment, although on some of these days they are responsible for as much as 40 to 60 percent. At some sites in the Northern Plains, Pacific Northwest, and southern California, nitrate aerosols are responsible for about 40 percent of the man-made visibility impairment during the 20 percent worst days. Assuming the contribution of stationary sources to nitrate is roughly equal to their proportion of the NOx emission inventory, then stationary source NOx emissions might be expected to contribute to about 2-5 percent of the Plateau's light extinction and to about 10 percent of the extinction in the Northern Plains, Pacific Northwest, and southern California.

Potentially increasing these contributions is the fact that stationary sources have unique emission characteristics which may disproportionately impact visibility (e.g., stack heights, transport distances, and proximity to Class I areas). Also, NOx is known to influence the formation of non-nitrate secondary fine particles, to alter the characteristics of primary coarse particles, and its future significance may depend on future changes in sulfur and ammonia emissions. On the other hand, total NOx emission in the WRAP region are expected to decrease by over 25 percent,[5] primarily as a result of federal controls on mobile sources, and NOx reductions may, in isolated instances, lead to local increases in nitrate concentrations.

To determine the effectiveness of stationary source NOx controls, it is therefore important to have an air quality model that can account for the processes above. The WRAP's current modeling system, while sufficient for analyzing the regional impact of some emission changes, is not predicting nitrate concentrations well enough to support a decision on whether or not

[5] Future NOx emissions will, of course, depend on uncertain activity levels (e.g., oil and gas development) and regulatory developments (e.g., new source review reforms).

stationary source NOx controls are an effective way at achieving reasonable progress – the results are simply too uncertain. Several improvements to the modeling system are underway, but until the model produces better nitrate results, other means of assessment will be necessary to determine the appropriate level of NOx control in future SIPs.

Given the model's current performance, its use in this report is limited to the summer months (July through September), when it is performing best for nitrate, but also when nitrate concentrations are lowest. Furthermore, its use is limited to two "sensitivity analyses" – a 50 percent stationary source NOx reduction and a 50 percent stationary source PM_{10} reduction. The purpose of the sensitivity analyses is to gauge how nitrate and other atmospheric constituents might respond to significant changes in emissions, albeit such responses may be conservative given the model's limited application to the July – September time period. Results are summarized in the next part of this Executive Summary and discussed in more detail in Section V of the report.

As advancements are made towards understanding the air quality impacts of stationary source NOx emissions, it is appropriate to investigate the potential level of control that can be achieved, and at what cost. Section VI of this report identifies 34 NOx control technologies. Most of these are commercially available, while others are near-available. Those for coal-fired boilers (by far the largest category of stationary source NOx emissions) typically achieve 30 to 50 percent NOx control at a cost of about \$300 to \$1,200 per ton.[6] Actual costs and emission reductions are highly dependent on boiler type, vintage, and configuration, fuel burned, and existing controls. For these reasons, it is important to have recent, extensive, and reliable data on the emission source population, some of which are lacking in the WRAP inventory, such as current control information, utility boiler heat rates, information on the process producing the emissions (e.g., from natural gas compressor stations), and utilization rates (e.g., from industrial internal combustion engines). Future WRAP emission inventories should include such information.

Visibility impairment may occur when a high portion of the NOx emissions are in the form of (or converted to) nitrogen dioxide gas (NO_2). This may be important in urban hazes and in some coherent plumes, but is typically negligible for regional haze.[7] For this reason, NO_2 is not included in the light extinction budget in the EPA's guidance for tracking reasonable progress.

Stationary source PM_{10} emissions[8] are currently 6 percent of the WRAP PM_{10} inventory and may grow slightly to 7 percent by 2018. However, the WRAP inventory does not yet include wind-blown fugitive dust emissions (currently under development), which will tend to decrease the apparent contribution of stationary source PM_{10} emissions. PM_{10} accounts for nearly all the man-made light extinction, but the amount attributable to primary stationary source emissions is difficult to determine. Since most of the coarse fraction (between 2.5 and 10 microns) is believed to be primary and only some of the fine fraction is believed to be primary, the percent of visibility impairment attributable to coarse particles should approximate the contribution of

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[6] One exception is selective catalytic reduction (SCR), which is capable of achieving 70 to 90+ percent control at costs of approximately \$1,200 to \$2,000 per ton.
[7] See, for example, Watson J., Visibility: Science and Regulation, J. of Air and Waste Manage. Assoc. 52:628.
[8] As explained in Section II of this report, the term "PM" used in Section 309(d)(4)(v) of the regional haze rule is construed as primary PM_{10} emissions.

primary PM_{10} emissions from all sources. As shown in Section III, this is approximately 10 to 20 percent (on average) across most of the WRAP region, with generally lower percentages in the Pacific Northwest and higher percentages in the southeast part of the region. Assuming the contribution of stationary sources to ambient primary PM_{10} is roughly equal to their proportion of the PM_{10} emission inventory, then stationary source PM_{10} emissions might be expected to contribute to less than 2 percent of the region's light extinction. Coupled with the fact that stationary source PM_{10} emissions are relatively well controlled in the West, there does not appear to be much potential in a stationary source PM control strategy for purposes of regional haze. PM_{10} emissions, however, appear to have a greater visibility impact per ton than NOx emissions, as shown in Section V. Also, some PM_{10} emission co-benefits may result from multi-pollutant technologies described in Section VI, so reductions in stationary source PM_{10} emissions could conceivably be part of a broader air quality management strategy and/or part of a broader strategy to achieve reasonable progress under the visibility regulations – e.g., to prevent degradation on the cleanest days.

Finally, the appropriate level of stationary source NOx and PM control, if any, should be informed by a comprehensive assessment, which may include some non-visibility impacts (to the extent they can be estimated within WRAP resources and with the WRAP's visibility-based tools) and the full costs and benefits of controls, not just those associated with facility compliance and visibility improvements. To this end, the WRAP is completing work on an economic analysis framework to conduct such analyses in a consistent and technically sound manner.

Degree of Visibility Improvement Resulting from Emission Control Strategies for Stationary Sources of NOx and PM

Due to the complex role of NOx emissions in the atmosphere, a regional-scale modeling effort is underway to more carefully assess the visibility improvement from potential control strategies. Given the model's current performance, its application in this report is limited to the June-September timeframe – when nitrate performance is best, but also when nitrate concentrations are lowest – and it is only used in a "sensitivity analysis mode", meaning two scenarios were modeled to gauge how nitrate and other atmospheric constituents might respond to significant changes in emissions: one in which emissions of NOx are reduced by 50 percent (412,000 tpy) from stationary sources in the GCVTR with emissions of NOx greater than 100 tpy, and an identical scenario for PM_{10} (98,000 tpy).

Current modeling results indicate that the stationary source NOx and PM_{10} emission reductions described above would reduce regional haze (in Mm^{-1}) by 0.5 percent and 0.4 percent, respectively, when averaged across all sites in the GCVTR over the June-September time period, although some areas would see an improvement of 2 to 5 percent on some days.[9] On a purely ton-per-ton basis, reductions in stationary source PM_{10} emissions appear to yield greater regional haze benefits than reductions in NOx emissions, since they produced almost the same visibility benefit at one-fourth the emission change.

[9] These results are similar to the more general assessment made in Section IV (see page IV-21).

The NOx emission reductions had the greatest impact in southern CA, where ammonium nitrate concentrations in Class I areas are predicted to decrease by 0.15 to 0.25 ug/m^3. A second area of reductions is predicted in the central-east Rocky Mountains, especially in north-central CO. Although the reductions are not as large as in southern CA (0.04 to 0.11 ug/m^3), they are larger than average across the domain and exhibit the largest percentage reduction (10 to 20 percent).

It is interesting to compare these results with those simulating the effects of the SO_2 backstop emissions trading program, or Annex. In the case of the Annex, an SO_2 emission reduction of 15 percent (132,000 tons) in the GCVTR produced a sulfate reduction of 4 percent averaged across all Class I areas in the GCVTR on the 20% worst modeled days. In the case of the NOx sensitivity run, a NOx emission reduction of 15 percent (412,000 tons) in the GCVTR produced a nitrate reduction of 5 percent averaged across all Class I areas in the GCVTR on the July-September modeled days. The nitrate reduction does not produce as much visibility benefit at most Class I areas because its concentrations are much smaller than the sulfate concentrations, but the response of nitrate to NOx reductions is similar in proportion to the response of sulfate to SO_2 reductions.

NOx changes appear to have very little effect on aerosol concentrations beyond changes in nitrate. Other species that could be indirectly affected – e.g., ozone concentrations and subsequent oxidation of SO_2 and organic gases into the particulate phase – do not appear influenced by the levels of NOx reductions (16 percent of the total inventory) assumed in this analysis.

The PM_{10} emission reductions had a maximum impact of about 0.1 to 0.5 ug/m^3, or about 4 to 8 percent. Compared to the NOx reduction scenario, reductions in ambient PM_{10} are more dispersed, with a greater number of local maximums. This may reflect the fact that there are a fewer number of large PM_{10} sources than large NOx sources and that much of the PM_{10} emissions are coarse particles, with shorter transport distances.

All modeling results in this report are subject to change after the modeling improvements described in Section V are implemented. Results may also change when compiled for the best and worst visibility and nitrate days throughout the year, as opposed to a three-month summer average. For reasons described in Section V, the three-month summer average probably tends to reduce the apparent impact of emission changes.

The Need to Establish Milestones to Avoid Any Net Increase in NOx and PM Emissions from Stationary Sources

Sensitivity modeling was also done to evaluate the impacts of a 25 percent simultaneous increase in stationary source NOx and PM_{10} emissions. The increase in nitrate formation was approximately half the magnitude of the decrease resulting from the NOx reduction scenario. However, the increase in PM_{10} (nitrates and primary particulates) and visibility impairment were about the same in the 25 percent increase scenario as in the two 50 percent decrease scenarios because both pollutants were increased simultaneously.

The need to establish milestones to avoid any net increase in NOx and PM emissions from stationary sources should be determined when more complete and accurate modeling results (and ambient data analyses) are available, prior to submittal of the Section 309 SIP revisions in 2007-08. In addition to the modeling results per se, consideration should be given to meeting the reasonable progress goals of the regional haze rule, which generally imply a steady and continuous reduction in emissions and a prevention of degradation on the best visibility days.

The Need for Milestones to Support Potential Future Development of Multipollutant and Multisource Market-Based Program

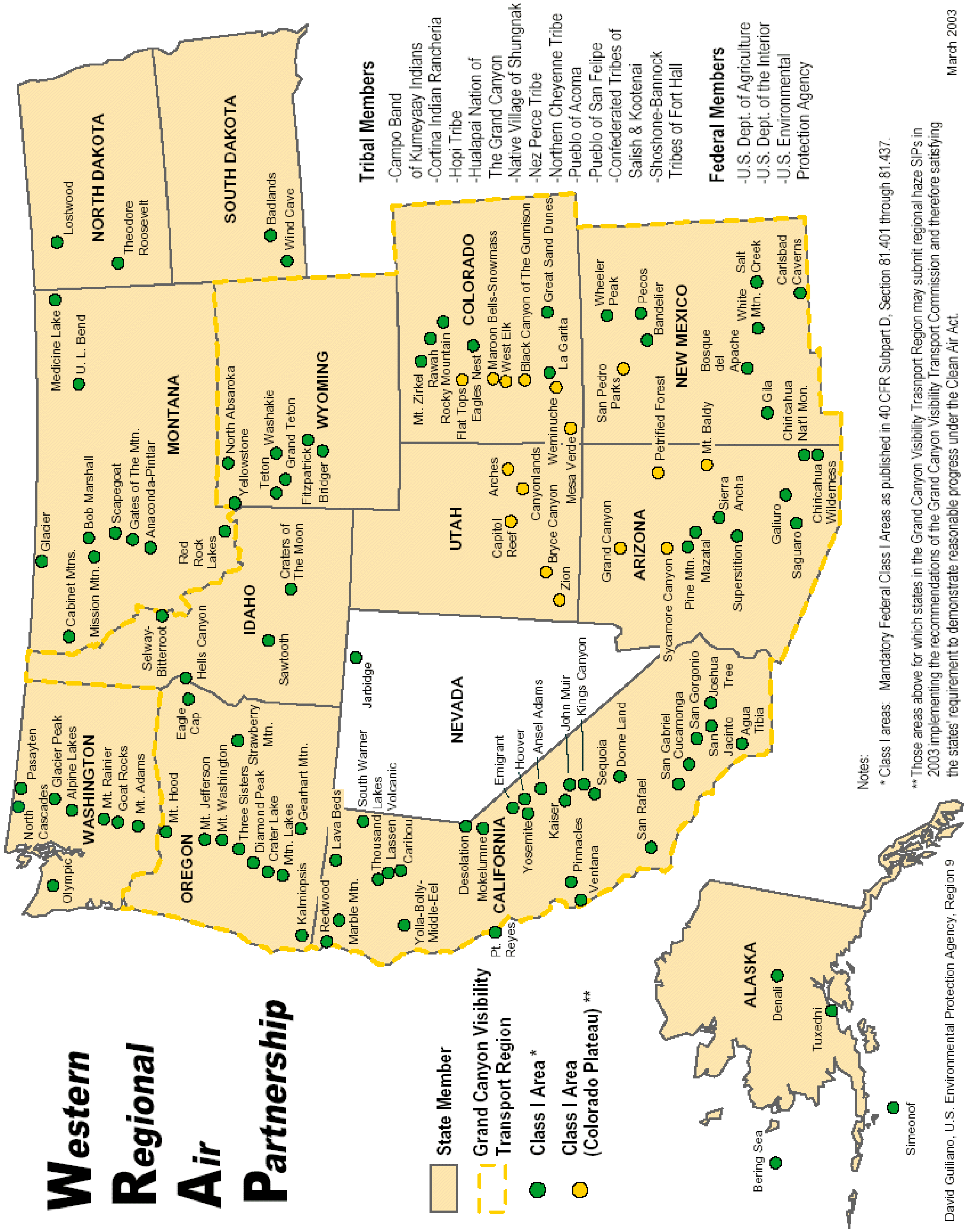
Milestones are not absolutely necessary to support potential multipollutant and multisource market-based programs. For example, a group of sources could theoretically comply with an SO_2 milestone by reducing emissions of other pollutants, and/or in other sectors, for which no milestones exist. Regardless, the key issues raised by such programs do not involve the milestones as much as the uncertainties associated with such emissions trading.

As discussed in Section IV, there are a number issues that must be addressed. Most of these relate to the visibility-improvement value of eliminating a ton of emissions. Different pollutants have different impacts on visibility on a per ton basis. Establishing an "equivalency ratio" to allow X tons of one pollutant to be reduced in lieu of Y tons of another would require significant analysis, and the certainty of such values may be suspect (especially for NOx) or insufficient to ensure a specific level of visibility improvement. Moreover, the equivalency ratio between two pollutants may vary across the region, between seasons, and possibly over time as the composition of the atmosphere changes. These same uncertainties (involving trades among pollutants) also pertain to trades among a single pollutant, most notably NOx, as nitrate concentrations are highly variable by season and location.

Trading across emission source categories poses a couple of additional issues. First, all categories would have to have sufficient emissions monitoring to validate emission credits, and monitoring of non-stationary sources is generally less accurate and verifiable than monitoring of stationary sources. Second, concentrated emissions from stacks may have different impacts than diffuse emissions at ground-level.

The uncertainties identified above could be reduced through further research, and the remaining uncertainties could be further addressed by limiting the emission trading markets to certain subregions, pollutants, or seasons where the equivalency ratios are fairly certain and stable. However, such market restrictions could limit the economic benefits the market is intended to provide. In short, some level of multipollutant and/or multisource market based program could be a feasible way of meeting the long-term national visibility goal, and several of the technologies described in Section VI of this report are capable of multipollutant reductions, but substantially more research should be performed before committing to such programs, especially in the 2007-08 timeframe.

Figure I-1. Map of the WRAP Region, Members, and Mandatory Federal Class I Areas.



SECTION II:
NOx AND PM EMISSIONS FROM STATIONARY SOURCES

Data Sources

The data presented in this section are based on "Version 1" of the WRAP stationary source emission inventory, downloaded from the WRAP website in June 2002 (filename wga_pt96.dbf). A second version of the inventory was released in October 2002, which contained a couple dozen corrections to point source coordinates, stack parameters, and source classification codes among the 214,000 records in the database. There were also some corrections to the NOx and PM emissions, which reduced the regional point source totals by two percent and six percent, respectively. A third version of the inventory was released in March 2003. This version contained minor NOx and PM emission changes in Pima and Navajo Counties (less than one percent of state-wide point sources) and NOx emission reductions in Nevada amounting to a 4,400 ton (or nine percent) decrease in the state-wide point source inventory. Discrepancies noted in Maricopa, Pima, and Pinal Counties by stakeholders in Arizona have not yet been incorporated into the WRAP database.

For the purposes of this regional-scale characterization of NOx and PM sources, the changes made to Version 1 of the stationary source inventory are essentially insignificant. The analysis, therefore, was not repeated. However, the analysis presented in Section VI is based on the most recent inventory since the analysis was begun after the Version 3 was available. This may cause slight discrepancies between the data presented here and in Section VI, but the conclusions are unaffected.

The term "PM" used in Section 309(d)(4)(v) of the regional haze rule has been construed in this report as primary PM_{10} emissions. Precursor emissions are not considered "PM" because they are explicitly referenced where appropriate throughout the rule, as is done with NOx in 309(d)(4)(v). PM_{10} was chosen over $PM_{2.5}$ because PM_{10} includes $PM_{2.5}$ and because all particles less than 10 microns have visibility impairing attributes. Moreover, many of the $PM_{2.5}$ emission estimates are derived from PM_{10} emission factors as opposed to direct $PM_{2.5}$ measurements – i.e., a certain fraction of the PM_{10} is assumed to be $PM_{2.5}$.

Emissions Summary

Table II-1 provides a summary of air pollutant emissions in the 13-state contiguous WRAP region (including Nevada but not Alaska). NOx emissions from stationary sources are expected to increase slightly, but due to decreases from other sources, their percentage of the total inventory is expected to grow from 22 percent to 33 percent to become the single largest source category. Stationary source PM_{10} emissions appear less important than NOx emissions, but they may contribute more to haze on a per ton basis, partly because not all NOx emissions are converted to particles and partly because stationary source PM emissions contain some elemental carbon, which is a highly-efficient light absorber. Compared to other source categories, stationary sources do not emit a large amount of PM_{10}, but their emissions may contribute more to haze on a per ton basis than other source categories because they emit particles primarily in the fine mode (less than 2.5 microns) and often through stacks, making them more likely to be transported to Class I areas. Future work should examine available information on the dispersion characteristics, size distribution, and chemical and optical properties of primary PM emissions from stationary sources relative to other types of sources.

Table II-1. Air Pollutant Emissions in the 13-State WRAP Region.

	1996				2018			
	NOx		PM10		NOx		PM10	
Emissions Category	tons	%	tons	%	tons	%	tons	%
Point	1,059,985	22%	196,005	6%	1,118,460	33%	247,071	7%
Area	352,623	7%	1,921,389	54%	449,559	13%	1,981,060	54%
On-Road Mobile	1,755,573	37%	59,098	2%	485,270	14%	46,139	1%
Off-Road Mobile	1,368,663	29%	103,069	3%	950,414	28%	91,412	2%
Wildfire	166,703	4%	755,537	21%	59,641	2%	270,307	7%
Prescribed Fire	16,688	0%	50,057	1%	338,627	10%	525,393	14%
Agricultural Fire	*	*	*	*	3,504	0%	8,894	0%
Paved Road Dust	0	0%	91,322	3%	0	0%	165,106	5%
Unpaved Road Dust	0	0%	370,762	10%	0	0%	326,042	9%
Total	4,720,236	100%	3,547,239	100%	3,405,475	100%	3,661,423	100%

* Not available

Figure II-1 shows the location and relative magnitude of stationary source NOx emissions in the WRAP region with emissions of NOx greater than 100 tons per year (tpy) on a plant-wide basis. The WRAP 1996 inventory contains over 6,700 point sources of NOx. Approximately 11 percent of these plants (763) emitted 100 tpy or more of NOx and were responsible for 94 percent of total stationary source NOx emissions. Approximately 150 of the plants are electric power plants.

Figure II-2 shows the location and relative magnitude of stationary source PM_{10} emissions in the WRAP region with emissions of PM_{10} greater than 100 tpy on a plant-wide basis. The WRAP 1996 inventory contains over 6,500 point sources of PM_{10}. Approximately 5 percent of these (338 plants) emitted 100 tpy or more of PM_{10} and were responsible for 82 percent of total stationary source PM_{10} emissions.

Figures II-3 and **II-4** identify and compare emissions from the major stationary source categories of NOx and PM_{10}, respectively. External combustion boilers (utility and industrial) are the largest source categories for both NOx and PM_{10}. Industrial internal combustion engines (mostly natural gas fired) is another substantial source of NOx emissions. This category may warrant more attention since it is not inventoried with the same rigor as electric utility sources. The major source categories of PM_{10} are more diverse in character than those for NOx, including such broad categories as mineral products, chemical manufacturing, and primary metal production. This part of the inventory may also warrant further investigation since many of the emissions might be fugitive. Categorization of fugitive emission, in addition to source classifications, may vary across states. Further information on stationary source emissions, especially on the largest sources (boilers and internal combustion engines), is provided in Section VI.

Figure II-1. Stationary Source NOx Emissions > 100 tpy in the WRAP Region (1996).

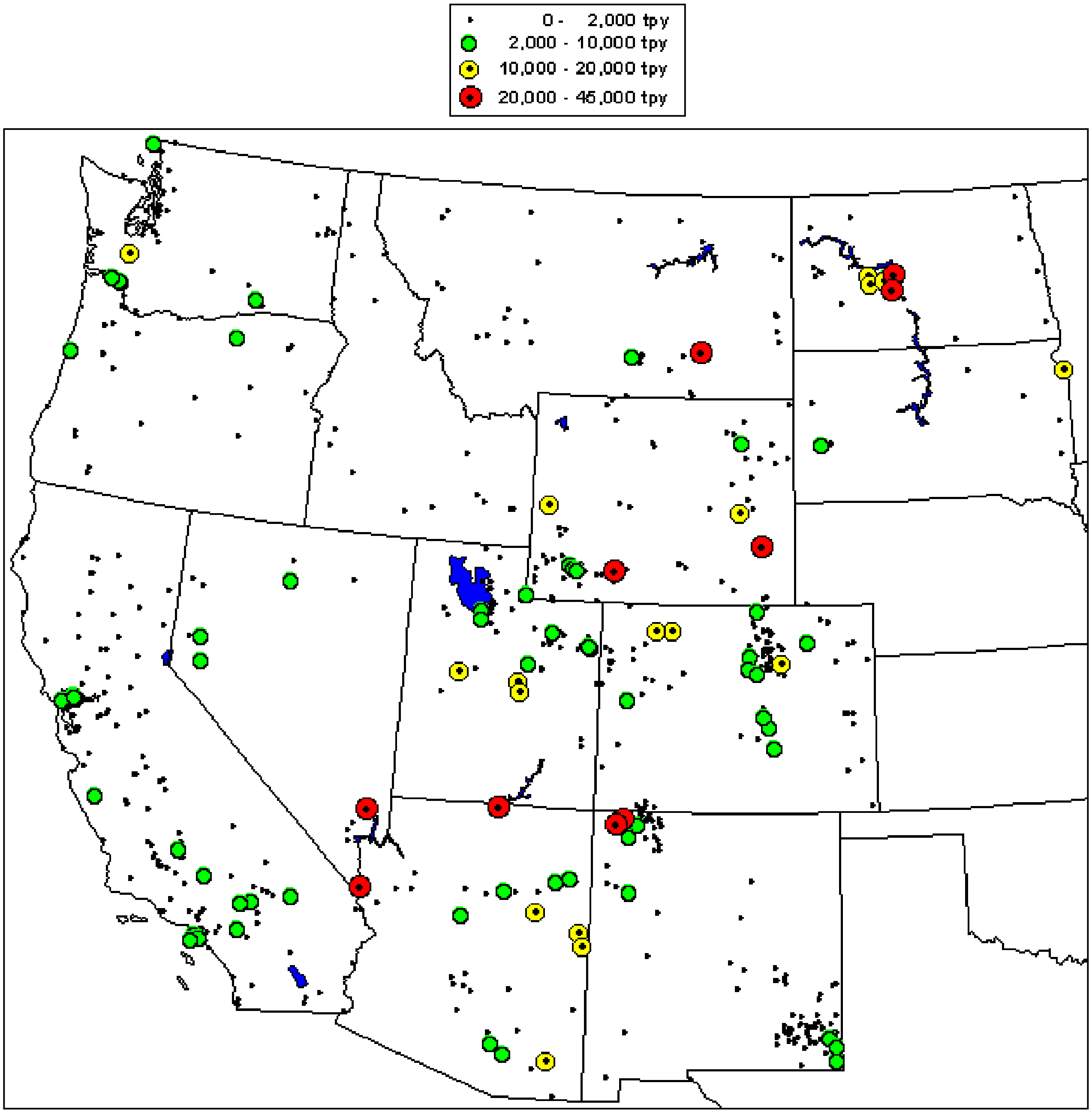


Figure II-2. Stationary PM_{10} Emissions > 100 tpy in the WRAP Region (1996).

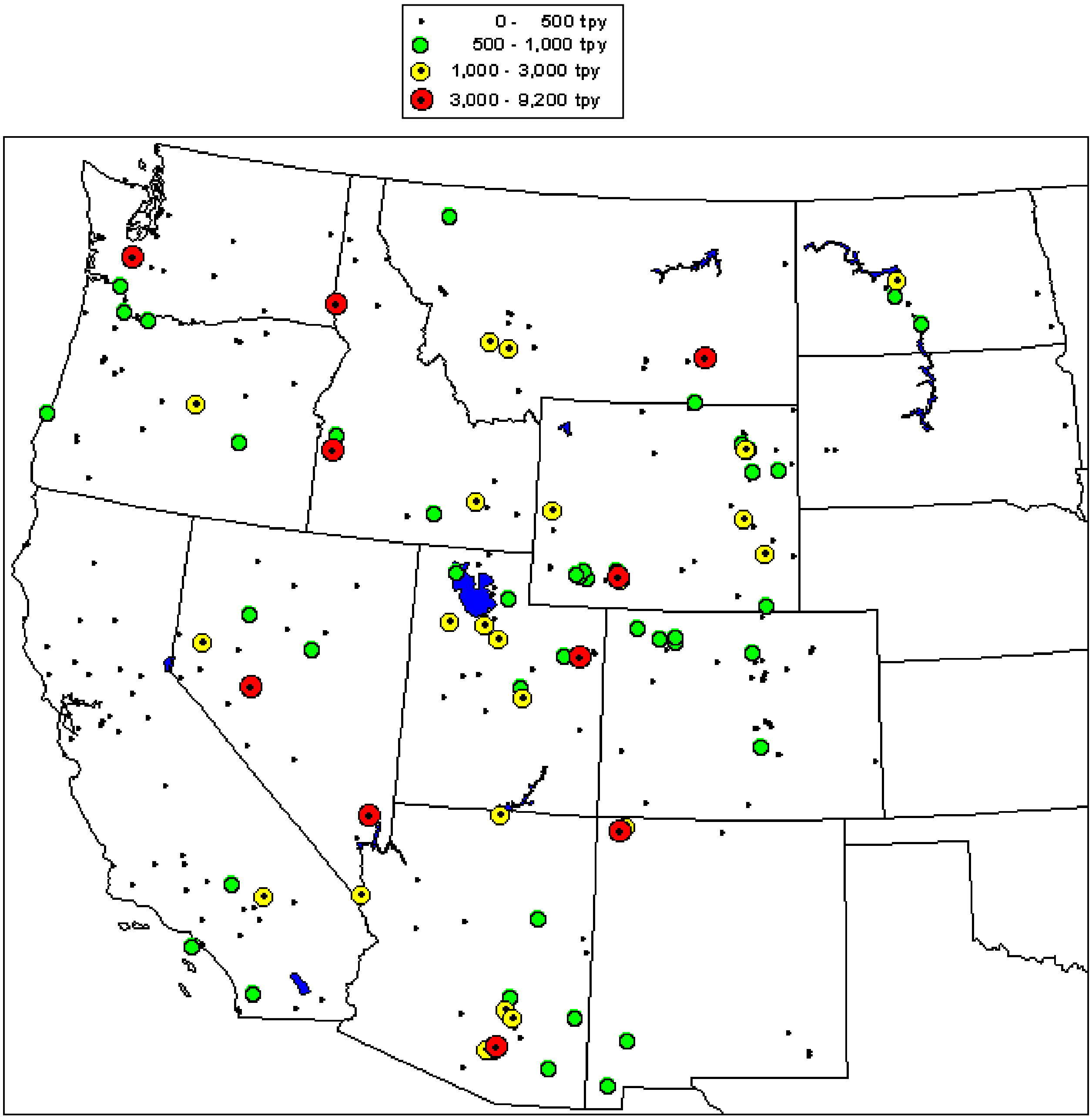


Figure II-3. Categorization of Stationary Source NOx Emissions > 100 tpy in the WRAP Region (1996).

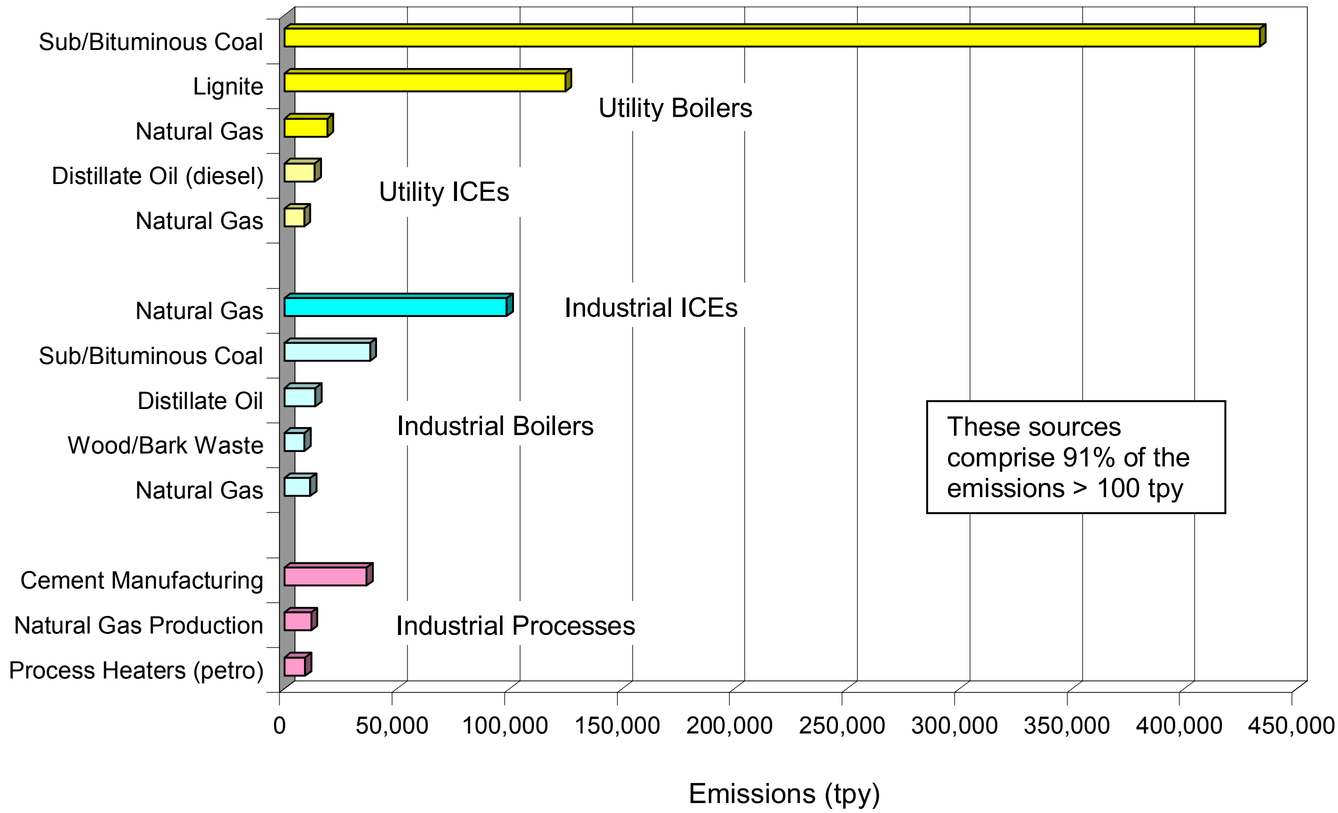
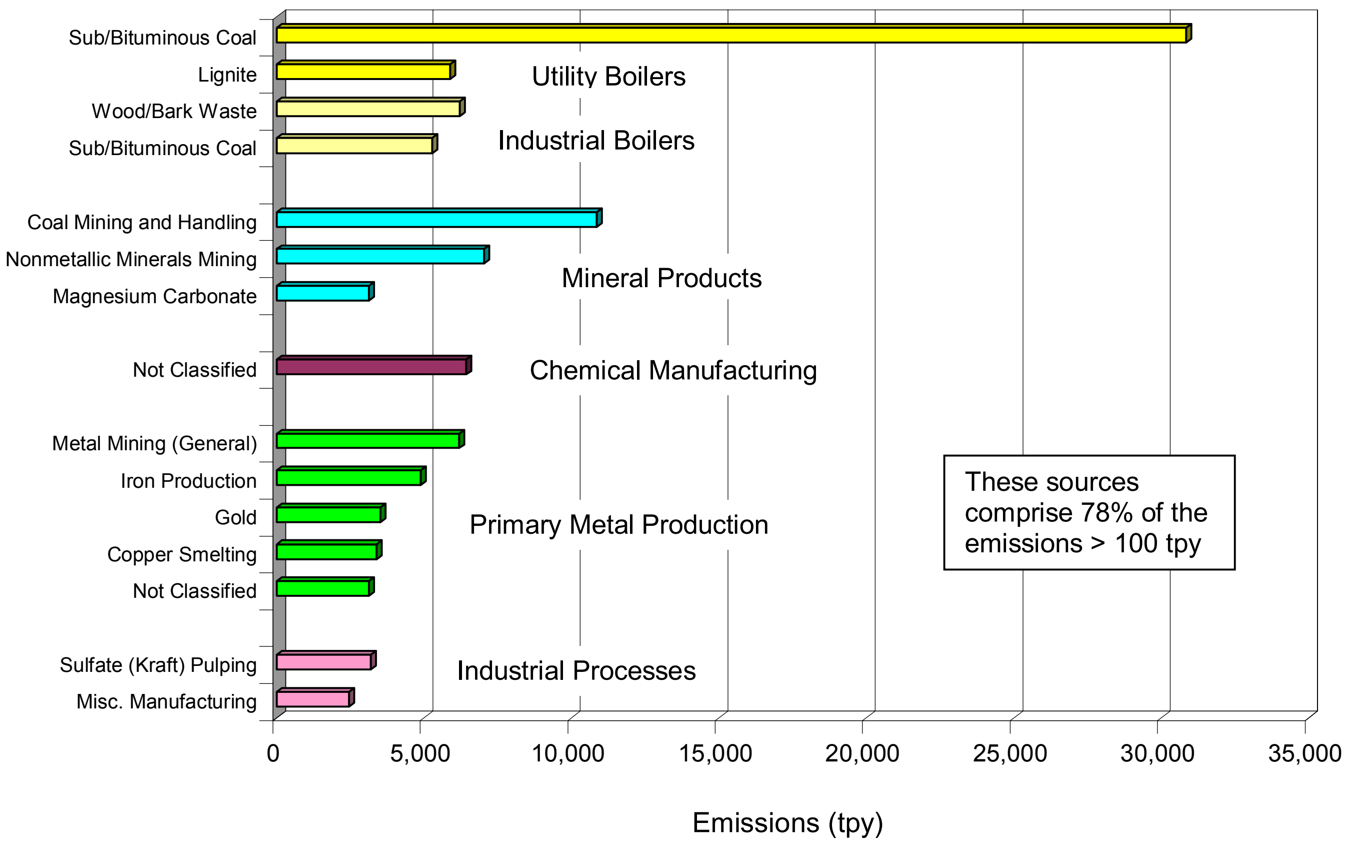


Figure II-4. Categorization of Stationary Source PM_{10} Emissions > 100 tpy in the WRAP Region (1996).



SECTION III:
NITRATE AND PM AMBIENT CONCENTRATIONS

Figures III-1 through III-11 show spatial patterns of ammonium nitrate (NH4NO3) and PM and historical trends in PM at IMPROVE monitoring sites in 1996 and 2001. The maps and data were downloaded from the VIEWS website (http://vista.cira.colostate.edu/views) on May 20, 2003. At that time, maps were only available for annual and seasonal averages, but some are now available for the best and worst visibility days. Hence, all the maps in this section except one indicate annual averages. Also, because the legends are auto-scaled, they are not the same in each map. For example, the value indicated by a yellow contour in Figure III-1 (1996) is not the same as the value indicated by a yellow contour in Figure III-2 (2201).

IMPROVE sites are located in rural settings, typically within Class I areas. They are not representative of more heavily polluted urban areas and tend to represent air quality at regional scales. Due to the size of the IMPROVE monitoring network, the maps for 1996 include data from less than a third of the western Class I areas. The maps for 2001 include data from about two-thirds of the western Class I areas, and additional monitors have been established since then.

Figures III-1 and III-2 show the annual average NH4NO3 concentrations in 1996 and 2001, respectively. Concentrations are typically less than 0.6 ug/m^3, with some areas in southern CA and the Columbia River Gorge exceeding 1.5 ug/m^3.

Figures III-3 and III-4 show the percent of aerosol-caused[10] annual average light extinction due to NH4NO3 in 1996 and 2001, respectively. This percent is typically less than 14, with some higher areas in the Pacific Northwest and Northern Plains, and especially in southern CA (exceeding 20 percent). Since some aerosols – principally organic carbon and "soil" and "coarse" aerosols – have substantially strong natural sources, the percent contribution of NH4NO3 to *man-made* haze is somewhat greater than indicated in Figures III-3 and III-4. A rough estimate of the contribution to man-made impairment can be obtained by assuming half the organic carbon, soil, and coarse aerosols are naturally caused. Removing these natural contributions from the light extinction budgets would raise the percent contribution of NH4NO3 by approximately 20 percent in each of the regions noted above (Colorado Plateau, Pacific Northwest, Northern Plains, and southern California).[11] For example, where NH4NO3 may contribute to 15 percent of the aerosol-caused light extinction in these areas, it would contribute to about 18 percent of the man-made light extinction.

Data recently provided on the VIEWS website indicates that the percent contribution of NH4NO3 to light extinction on the 20 percent worst days, as shown in **Figure III-5**, is slightly greater than the percent contribution on average, as shown in Figure III-4. Moreover, a cursory examination of daily data collected on the Colorado Plateau in 2001 indicates that some of the 20 percent worst days are dominated by NH4NO3. Some examples are provided in **Table III-1**. Such episodes should be quantified and studied more thoroughly in future WRAP work.

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[10] Aerosol-caused light extinction excludes natural (Rayleigh) scattering by air molecules.
[11] See Table 3.3 in Malm, William C. et al., Spatial and Seasonal Patterns and Temporal Variability of Haze and Its Constituents in the United States, Colorado State University, May 2000.

Table III-1. A Sample of Hazy Days in 2001 Dominated by NH4NO3 on the Colorado Plateau.

Class I Area	Date	Light Extinction[a] (Mm^{-1})	NH4NO3 Contribution	2001 Average Light Extinction[a] (Mm^{-1})	2001 Average NH4NO3 Contribution
Bryce Canyon	01/16/01	35	55 %	16	11 %
	01/28/01	28	49 %		
Canyonlands	01/04/01	23	55 %	14	15 %
	01/19/01	31	48 %		
	01/22/01	33	55 %		
San Pedro	01/07/01	16	50 %	11.5	10 %
	02/09/01	14	31 %		
	12/21/01	13	36 %		

[a] Over and above natural (Rayleigh) scattering by air molecules (10 Mm^{-1}).

Finally, NH4NO3 exhibits a strong seasonal pattern. When averaged across the 32 IMPROVE sites operating in 1996-1999, the light extinction due to NH4NO3 is about 10 percent on an annual basis and about 17 percent in the winter.

Figures III-6 and III-7 show the annual average PM_{10} concentrations in 1996 and 2001, respectively. Specifically, the values are reconstructed total mass – that is, speciated fine mass plus gravimetrically-determined coarse mass (PM_{10} - $PM_{2.5}$). (Gravimetric PM_{10} was not available from the VIEWS website.) PM_{10} concentrations are typically below 8 ug/m^3, with some areas in the Columbia River Gorge, Northern Plains, and southern CA exceeding 10 ug/m^3.

Figures III-8 and III-9 show the percent of aerosol-caused annual average light extinction due to coarse particulate matter (between 2.5 and 10 microns) in 1996 and 2001, respectively. Since most of the coarse fraction is believed to be primary and only some of the fine fraction is believed to be primary, the percent of visibility impairment attributable to coarse particles should approximate the contribution of primary PM_{10} emissions from all sources to visibility impairment. As shown in the figures, this is approximately 10 to 20 percent across most of the WRAP region, with generally lower percentages in the Pacific Northwest and higher percentages in the southeast part of the region.

Figure III-10 shows trends in (gravimetric) PM_{10} concentrations during average visibility days at 27 western IMPROVE sites. Data for the best and worst visibility days are available, but only data for average visibility days are shown for comparability with the maps in Figures III-1 through III-7. The values shown are 5-year rolling averages, meaning that the value shown for 1993 represents data collected from 1989-1993. The full names of the sites shown in Figure III-10 are provided in **Table III-2**.

At most sites, there appears to be a gradual decline in PM_{10} concentrations on days with average visibility, with exceptions at Chiricahua, Grand Canyon, and Guadalupe Mountain. On the worst visibility days, however, there is less of a decline, if any, at most sites. Compare, for example, the trend at the sites shown in **Figure III-11** with the first trend chart shown in Figure III-10.

Note that the trends, even when averaged over 5-year periods, can sometimes be affected by one or two extremely high events, typically associated with wildfires or dust storms. Trends in NH4NO3 concentrations and the percent of light extinction due to NH4NO3 are not available because of a measurement bias in data collected prior to June 1996. These data, however, are sufficient for showing the spatial patterns in Figures III-1 through III-7.

Figure III-1. Annual Average NH4NO3 Concentrations at IMPROVE Sites (1996).

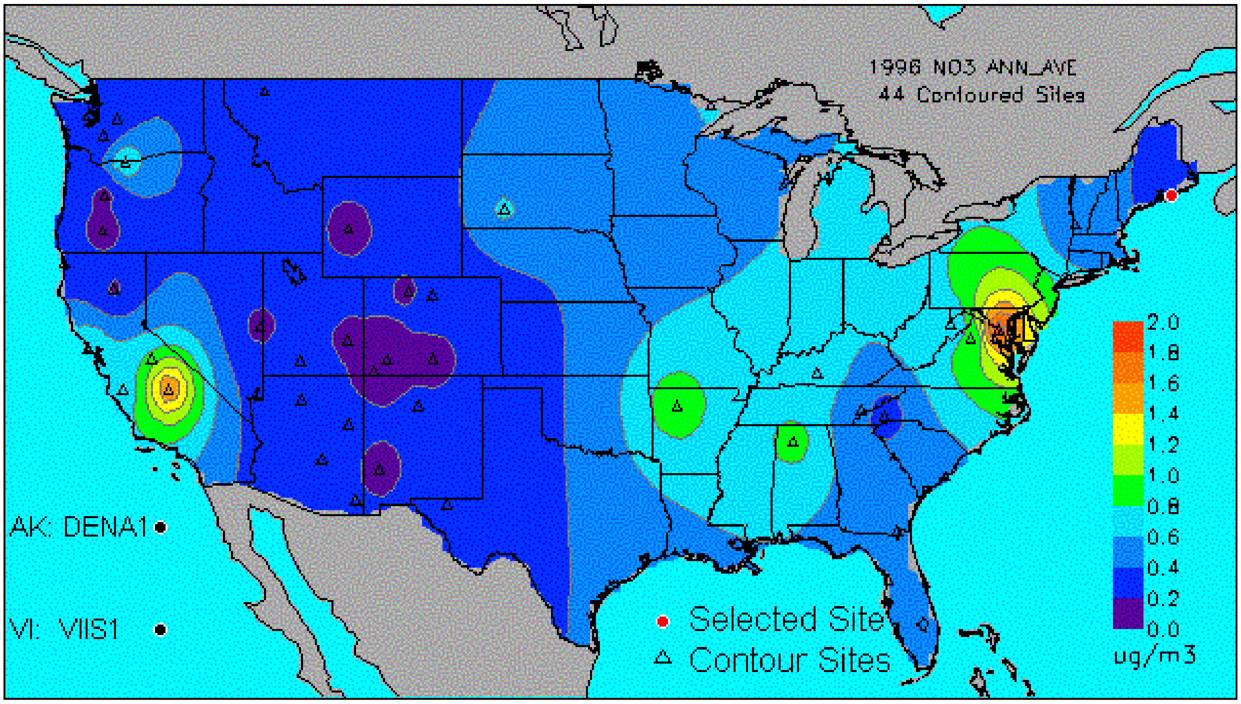


Figure III-2. Annual Average NH4NO3 Concentrations at IMPROVE Sites (2001).

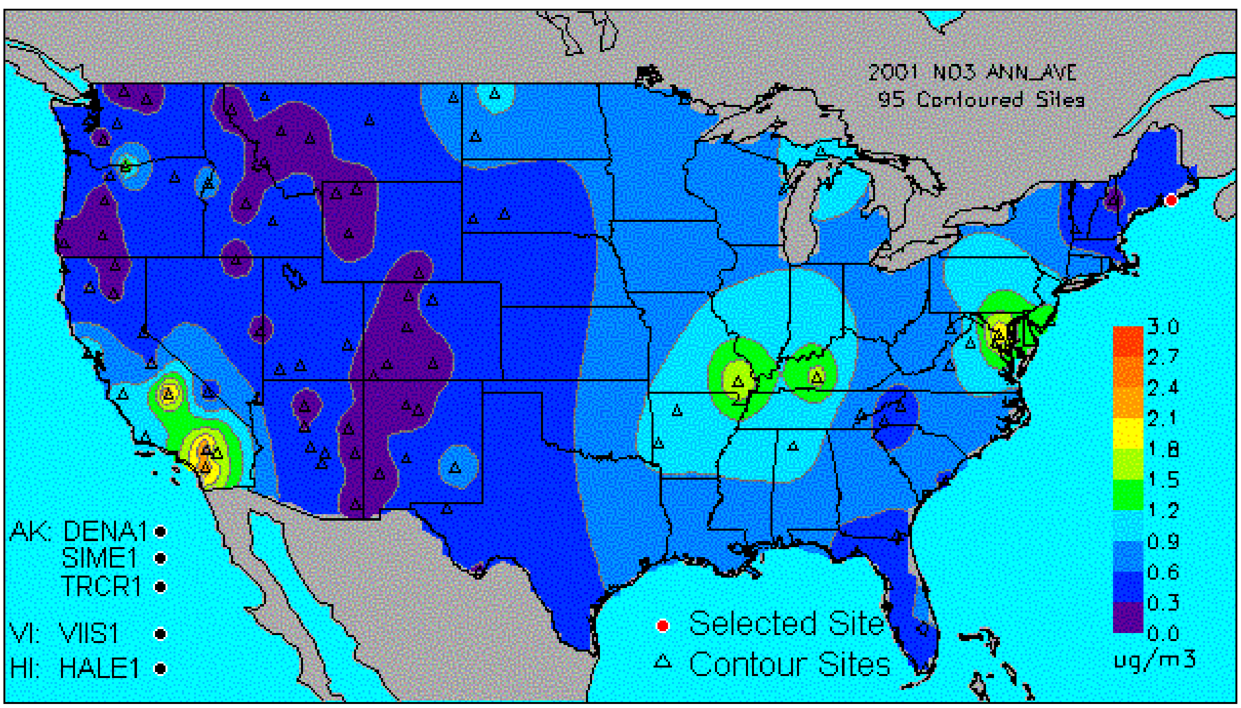


Figure III-3. Percent of Annual Average Aerosol Light Extinction Due to NH4NO3 at IMPROVE Sites (1996).

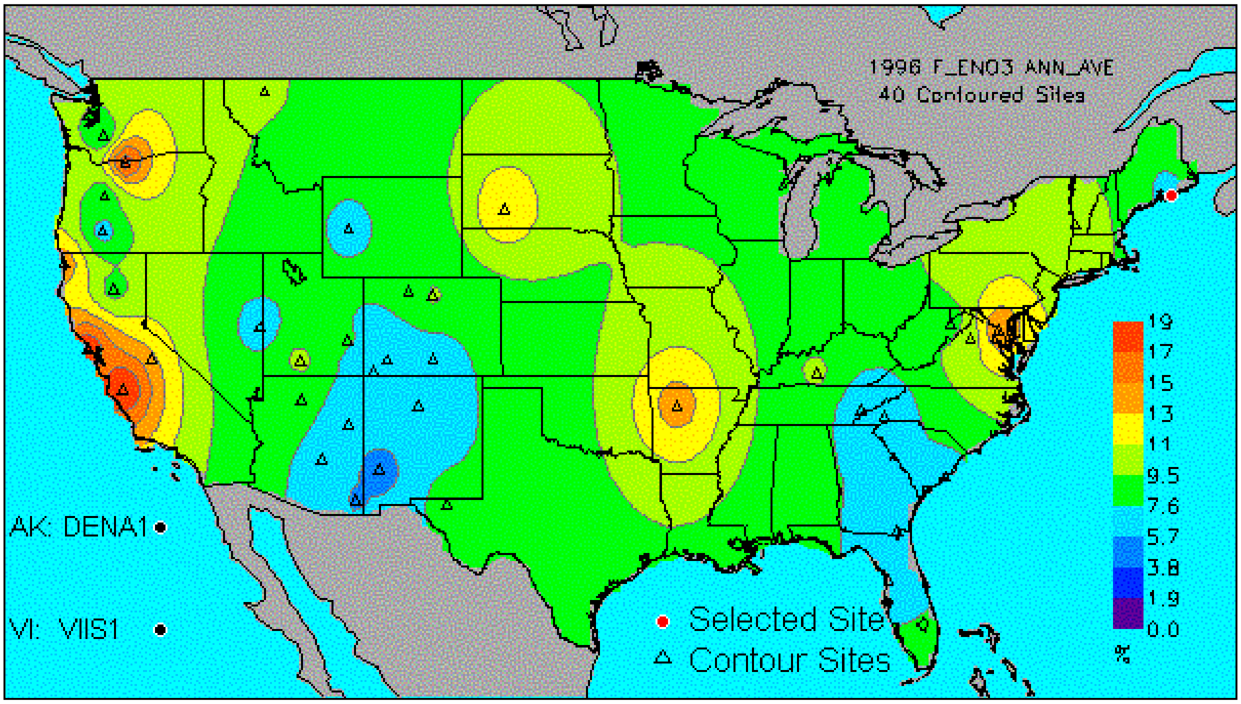


Figure III-4. Percent of Annual Average Aerosol Light Extinction Due to NH4NO3 at IMPROVE Sites (2001).

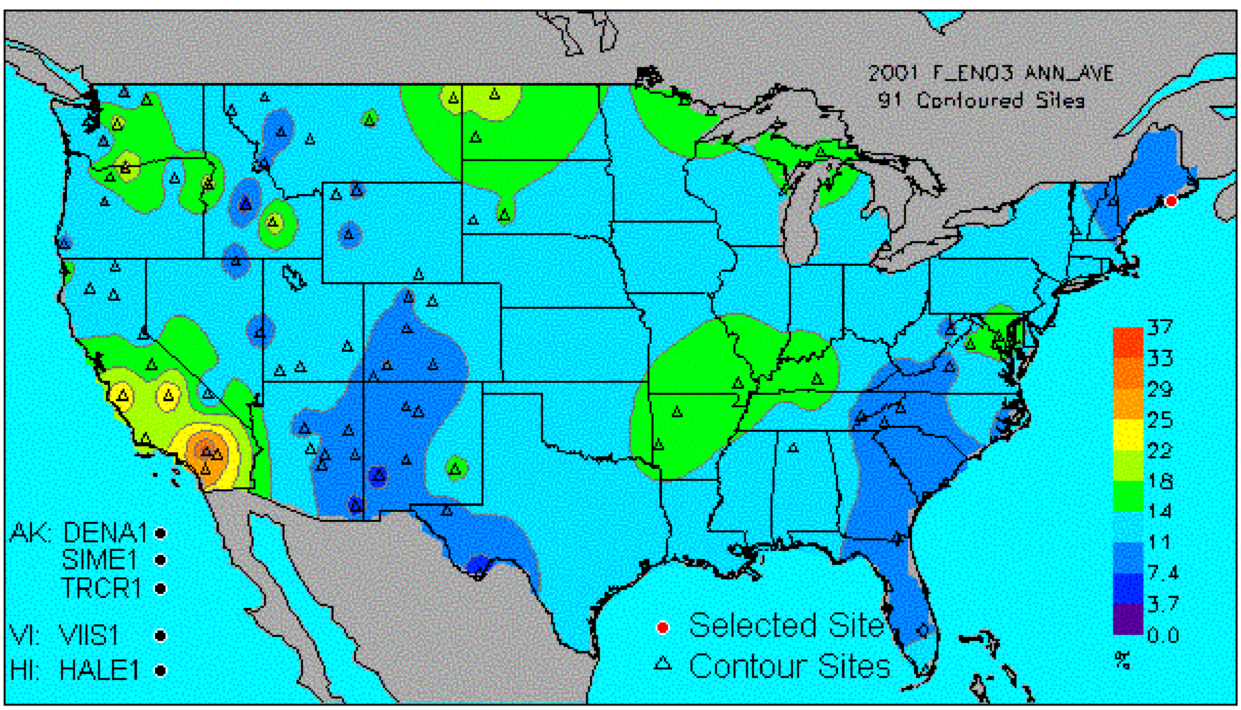


Figure III-5. Percent of Aerosol Light Extinction Due to NH4NO3 at IMPROVE Sites on the 20 Percent Worst Days (2001).

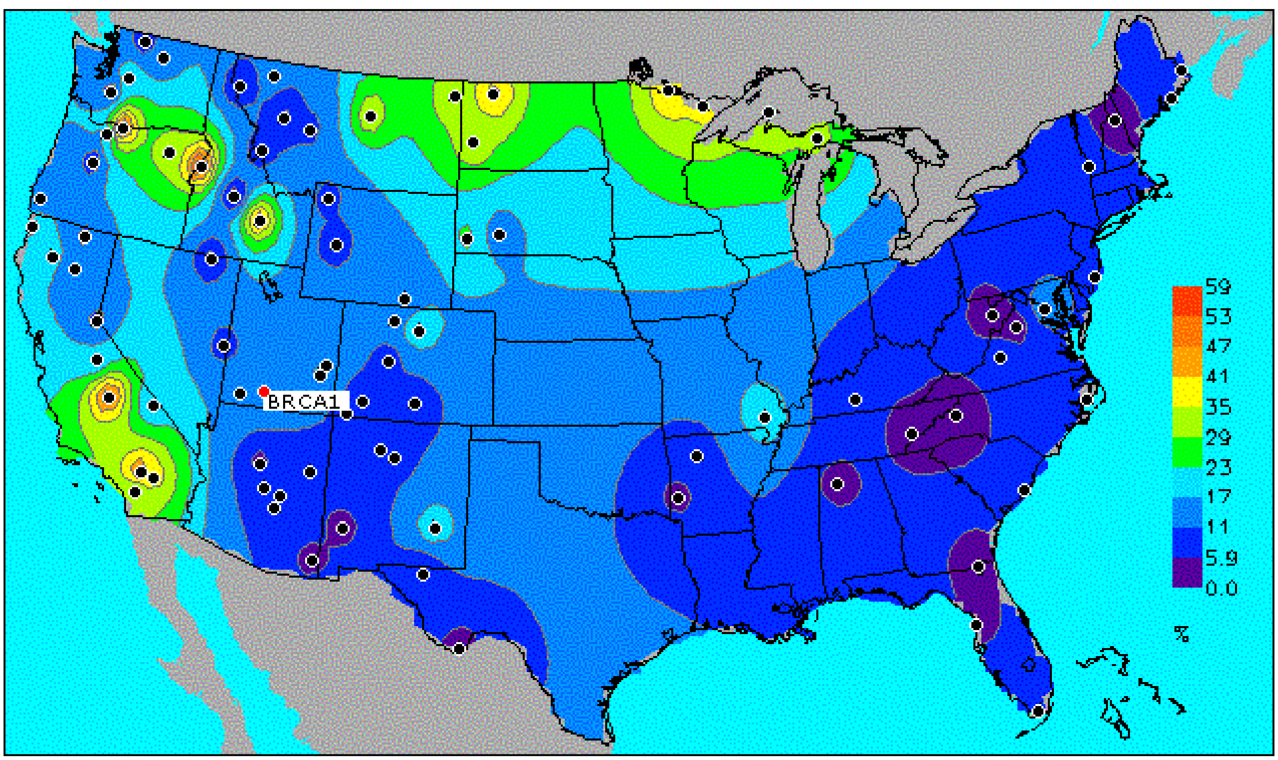


Figure III-6. Annual Average PM_{10} Concentrations at IMPROVE Sites (1996).

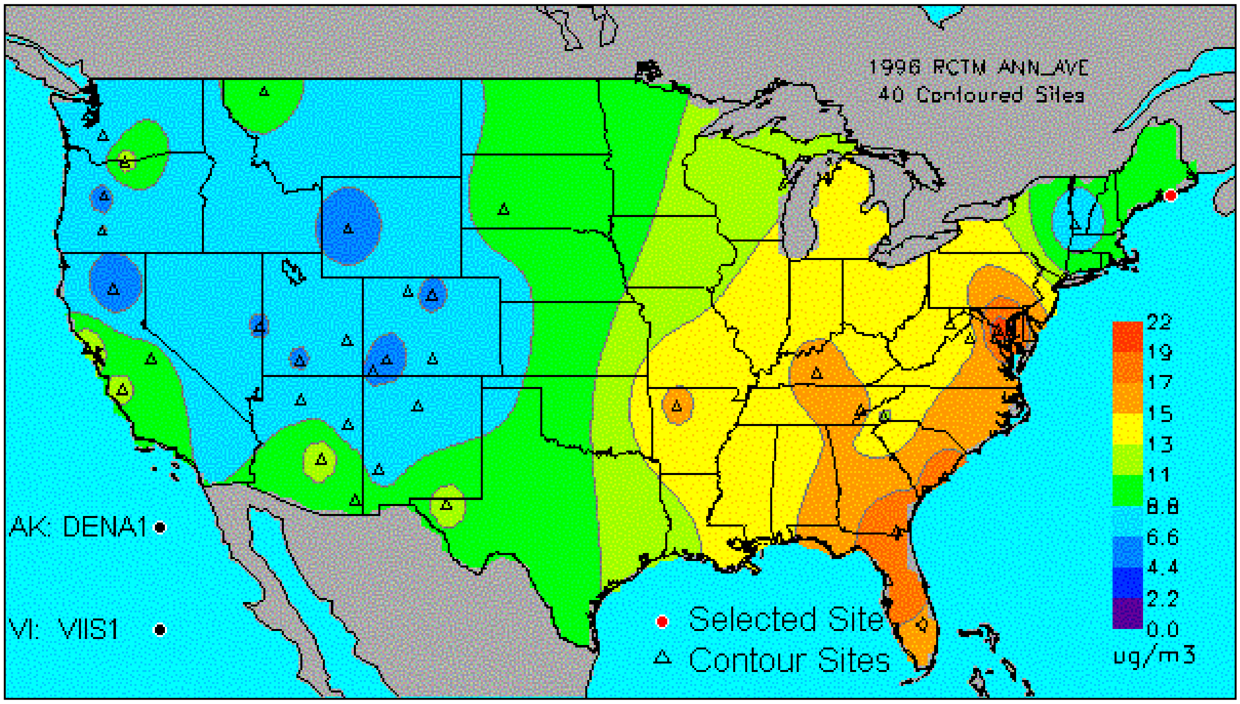


Figure III-7. Annual Average PM_{10} Concentrations at IMPROVE Sites (2001).

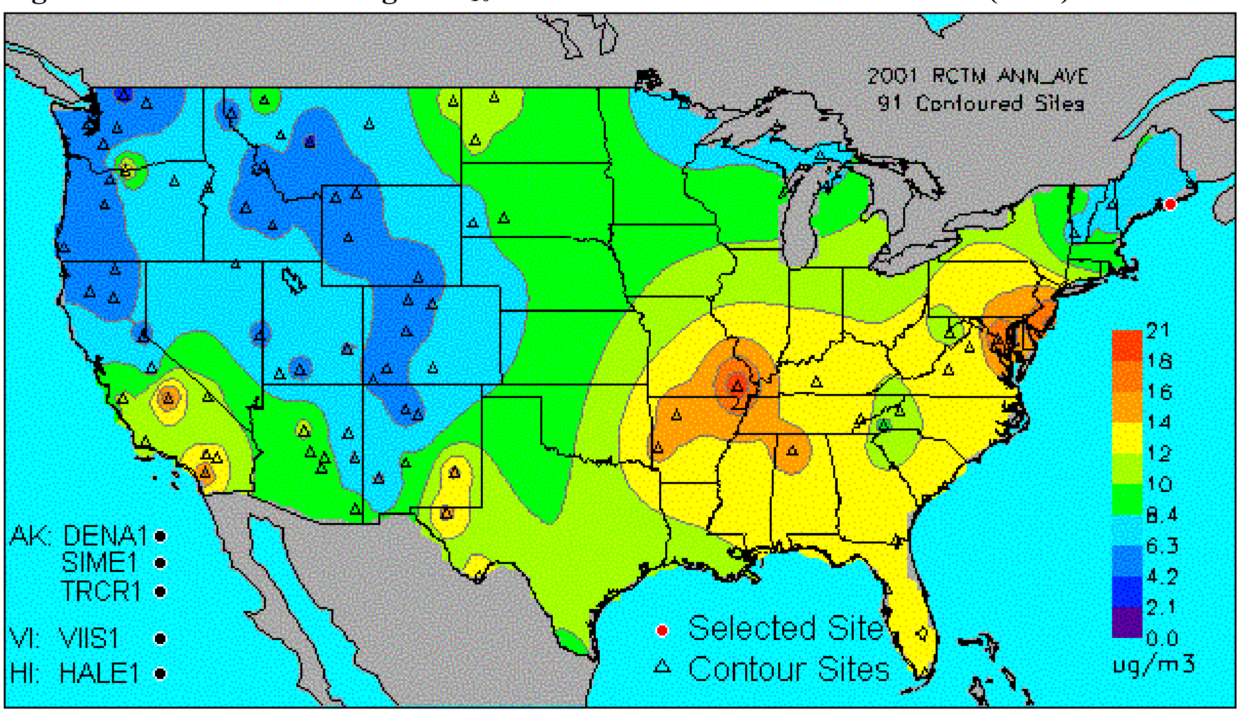


Figure III-8. Percent of Annual Average Light Extinction Due to Coarse Particulate Matter at IMPROVE Sites (1996).

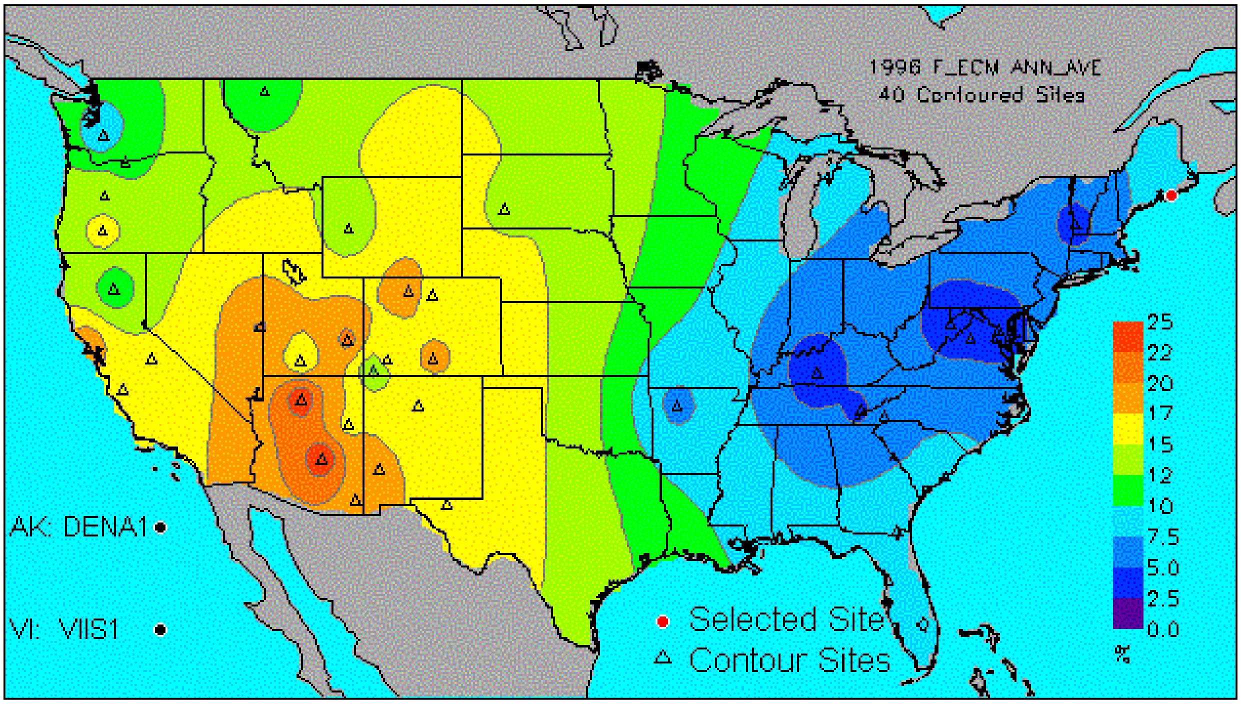


Figure III-9. Percent of Annual Average Light Extinction Due to Coarse Particulate Matter at IMPROVE Sites (2001).

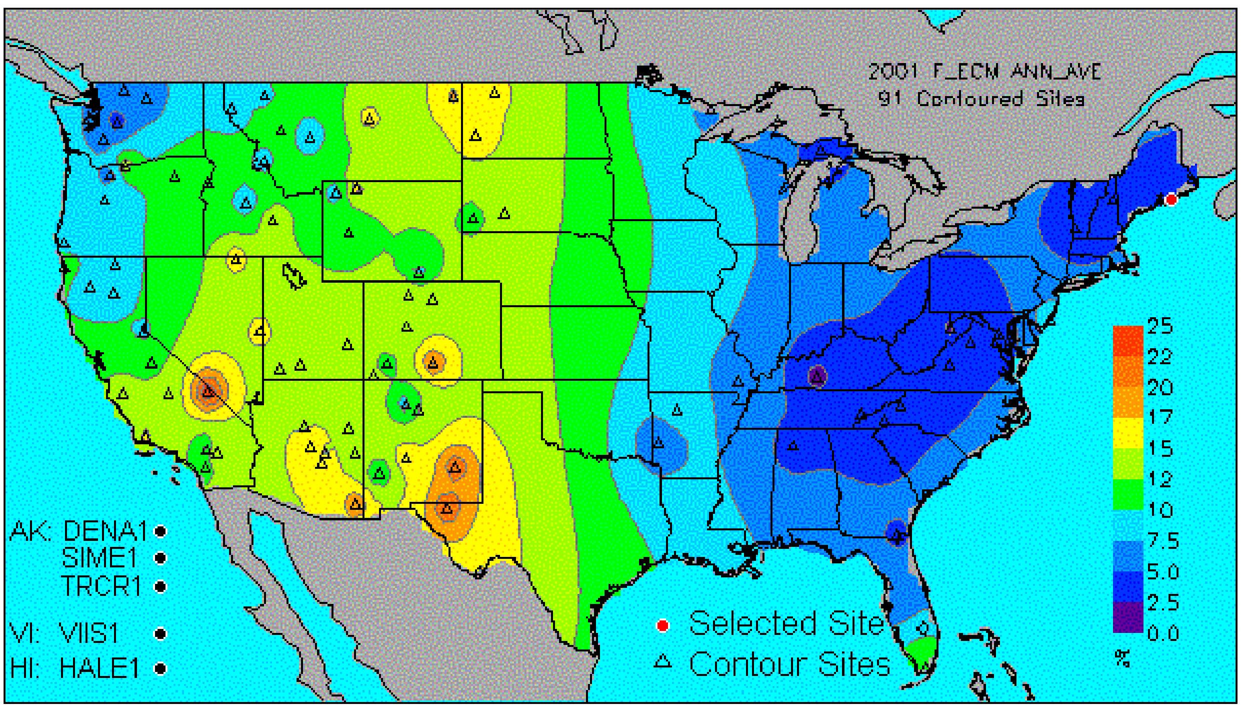
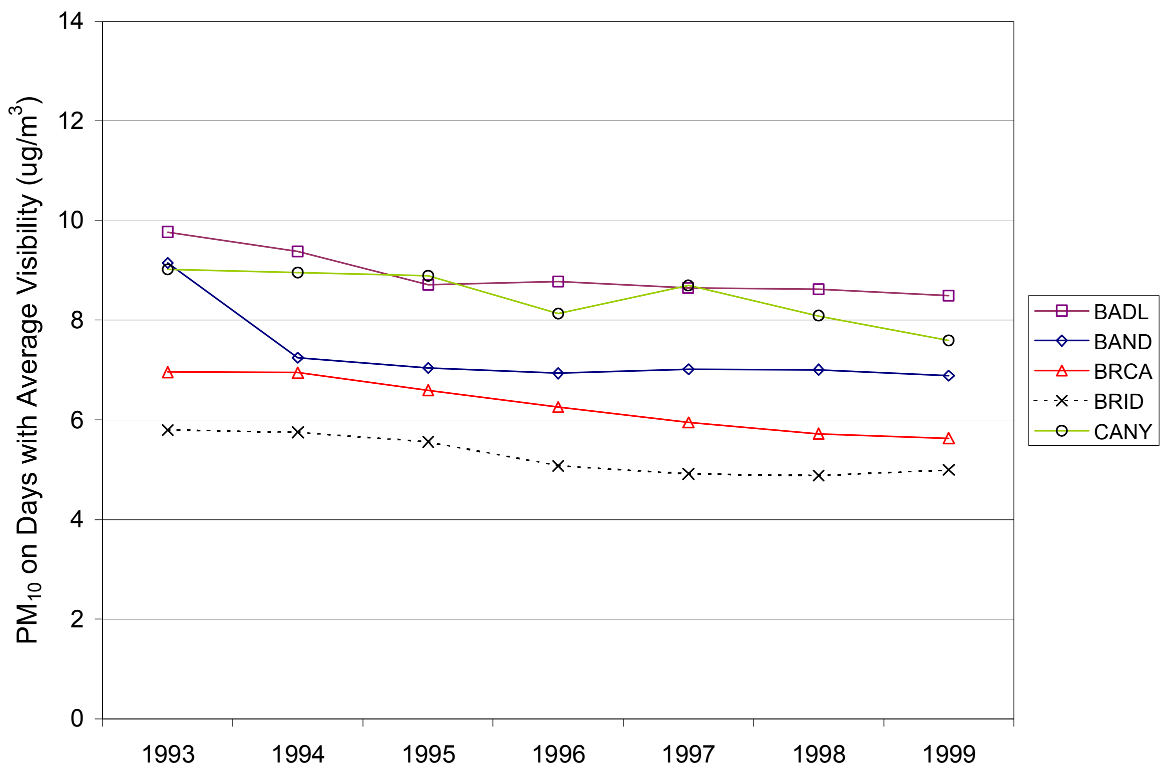
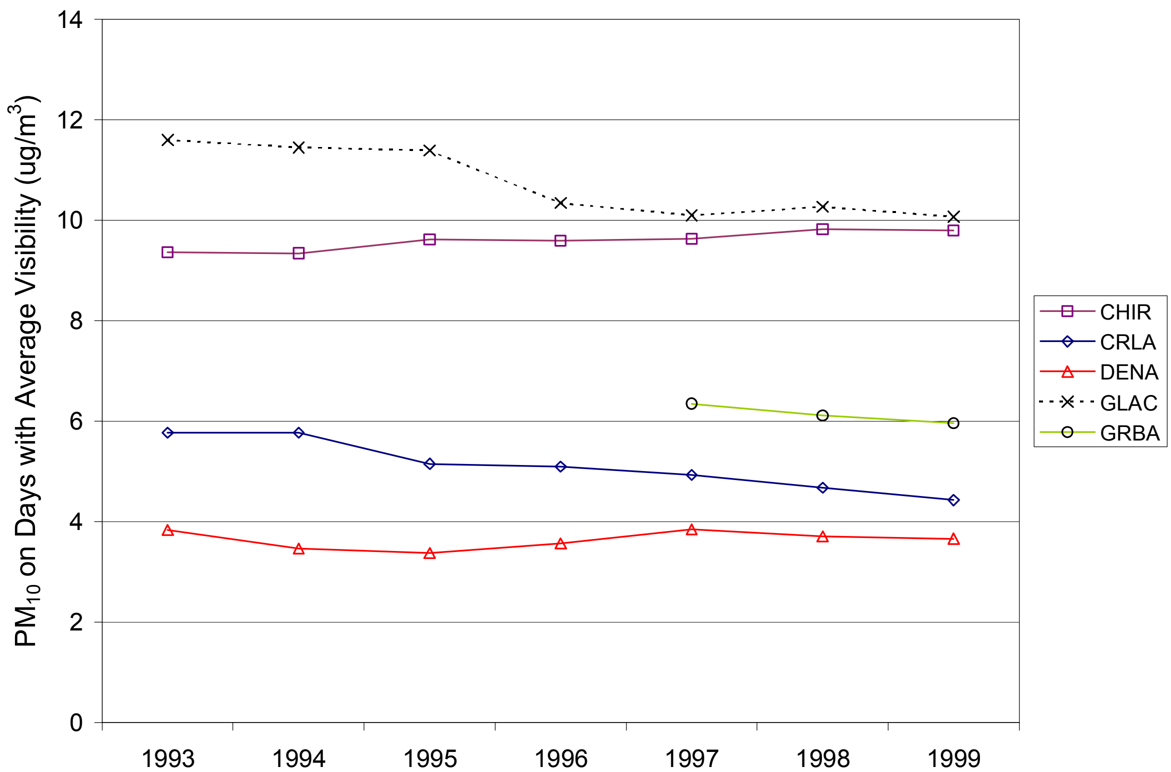


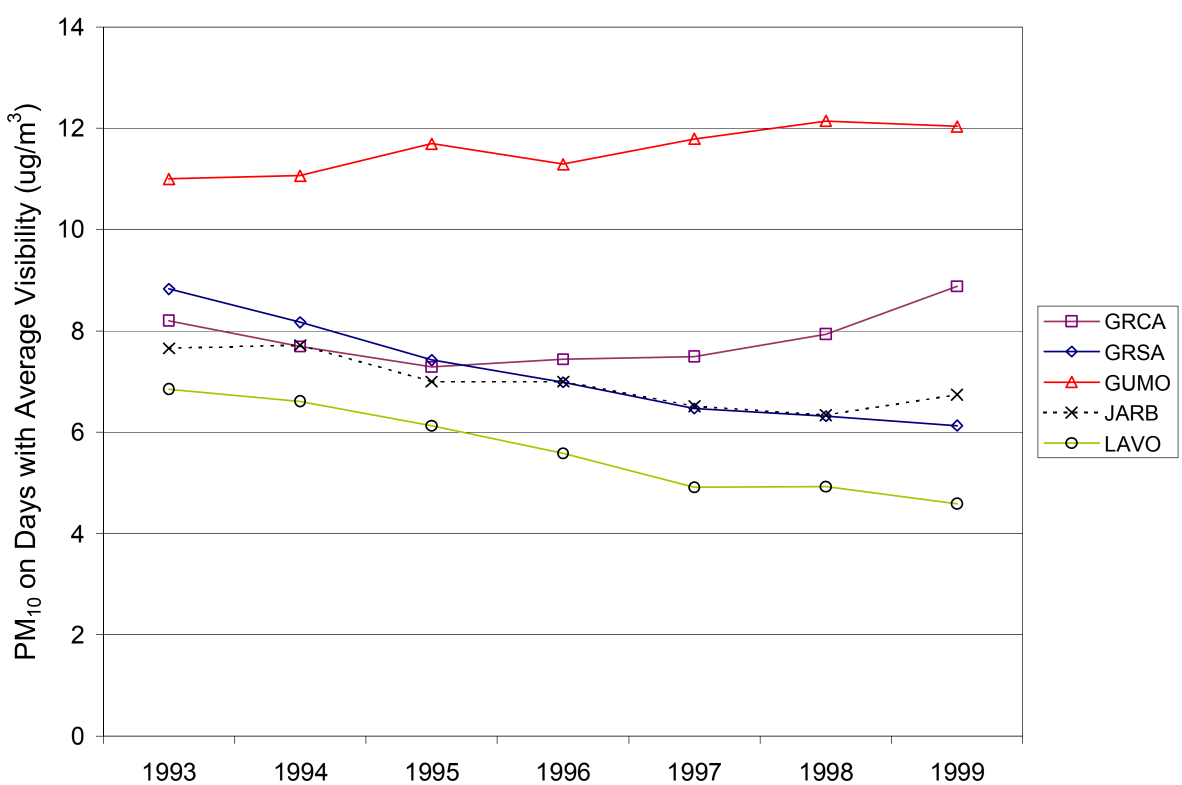
Table III-2. Name of IMPROVE Sites Shown in Figure III-9.

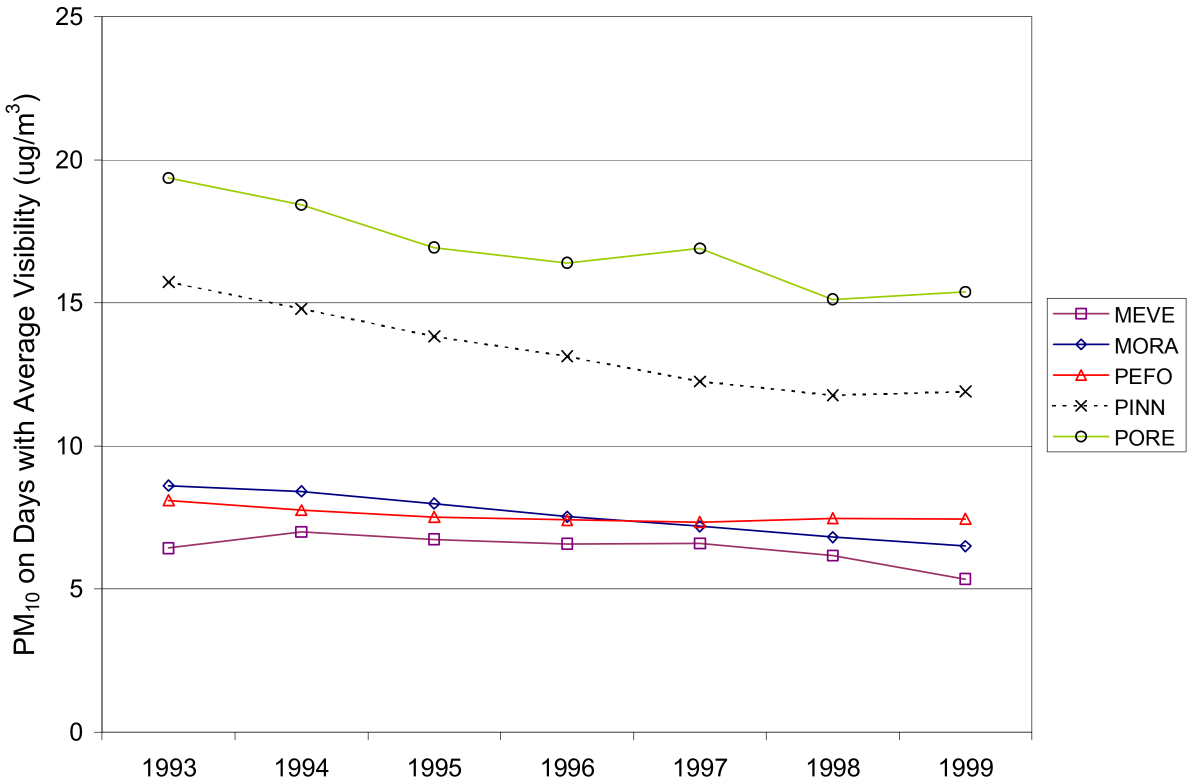
Code	Site Name	Code	Site Name
BADL	Badlands	LAVO	Lassen Volcanic
BAND	Bandalier	MEVE	Mesa Verde
BRCA	Bryce Canyon	MORA	Mount Ranier
BRID	Bridger	PEFO	Petrified Forest
CANY	Canyon Lands	PINN	Pinnacles
CHIR	Chiricahua	PORE	Point Reyes
CRLA	Crater Lake	REDW	Redwood
DENA	Denali	ROMO	Rocky Mountain
GLAC	Glacier	SAGO	San Gorgonio
GRBA	Great Basin	TONT	Tonto
GRCA	Grand Canyon	WEMI	Weminuche
GRSA	Great Sand Dunes	YELL	Yellowstone
GUMO	Guadalupe Mountain	YOSE	Yosemite
JARB	Jarbidge		

Figure III-10. Trends in PM_{10} Concentrations at Western IMPROVE Sites on Days with Average Visibility.

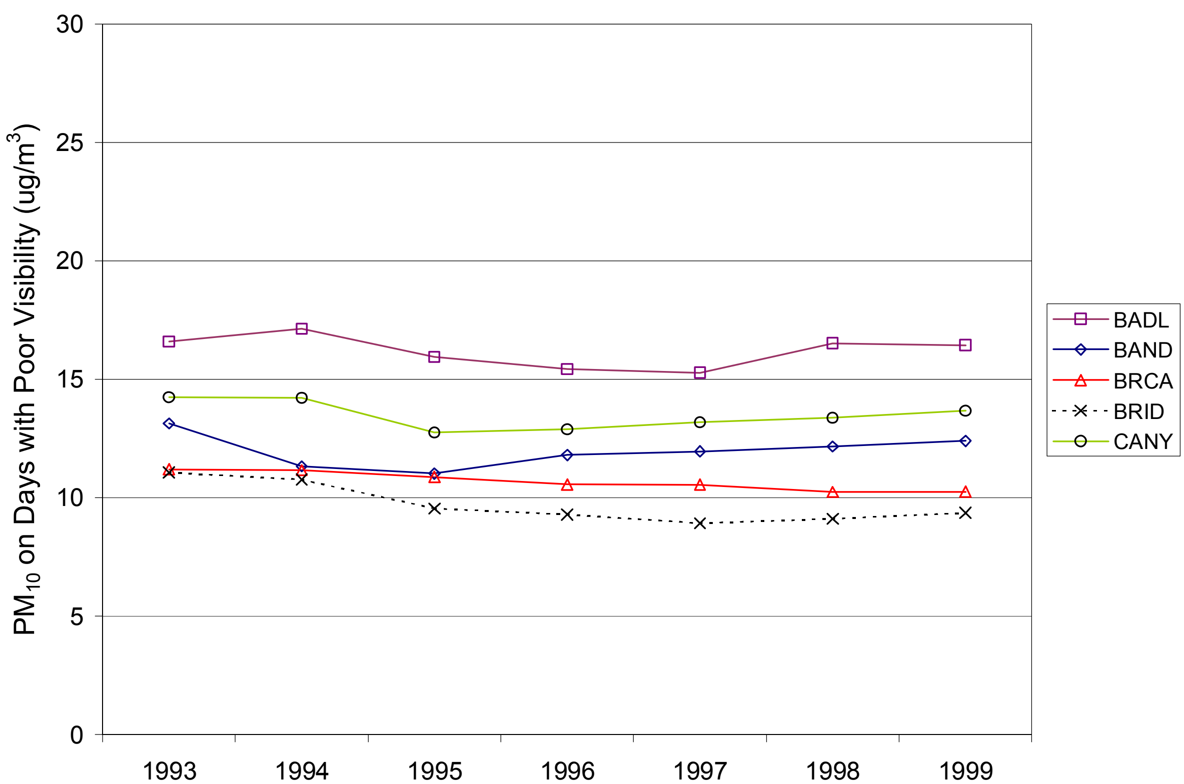



PM$_{10}$ on Days with Average Visibility (ug/m^3)
0
2
4
6
8
10
12
14
1993
1994
1995
1996
1997
1998
1999
CHIR
CRLA
DENA
GLAC
GRBA


PM$_{10}$ on Days with Average Visibility (ug/m^3)
0
2
4
6
8
10
12
14
1993
1994
1995
1996
1997
1998
1999
GRCA
GRSA
GUMO
JARB
LAVO

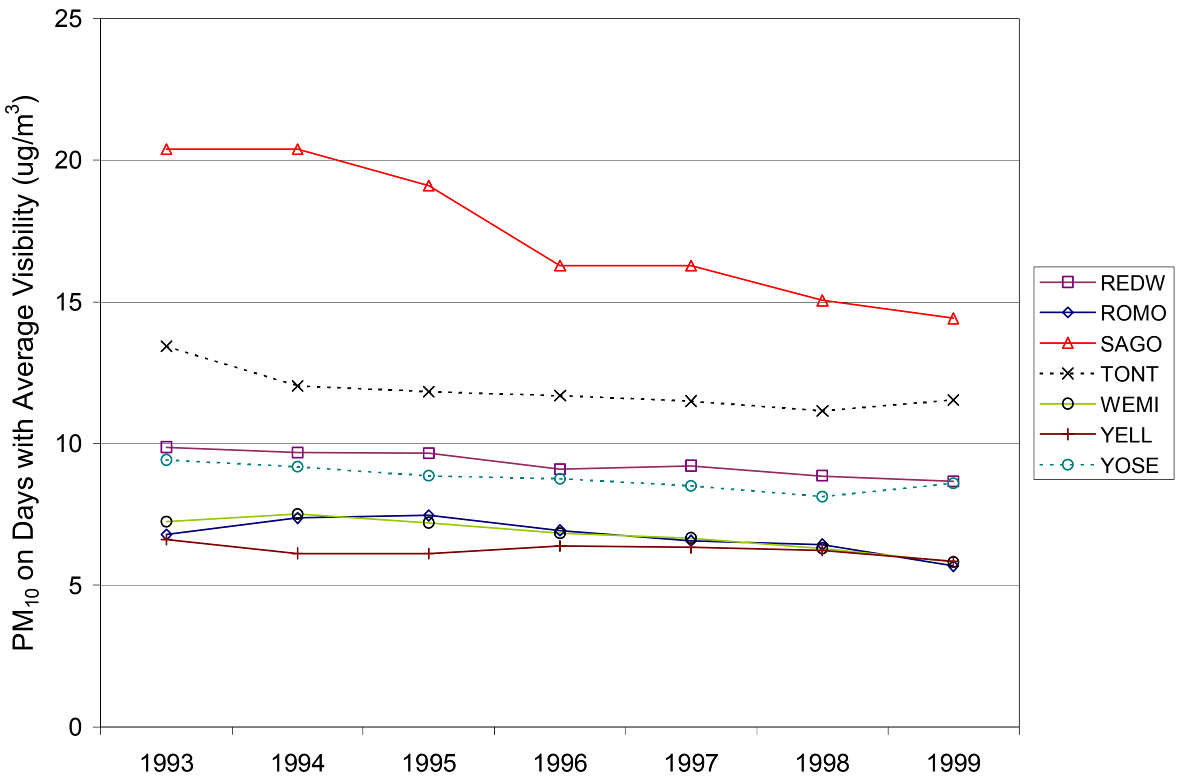


PM10 on Days with Average Visibility (ug/m3)
25
20
15
10
5
0
1993
1994
1995
1996
1997
1998
1999
MEVE
MORA
PEFO
PINN
PORE



PM10 on Days with Poor Visibility (ug/m3)
30
25
20
15
10
5
0
1993
1994
1995
1996
1997
1998
1999
BADL
BAND
BRCA
BRID
CANY

Figure III-11. Trends in PM_{10} Concentrations at Western IMPROVE Sites on Days with Poor Visibility (Worst 20 Percent).



SECTION IV:
A CONCEPTUAL MODEL OF REGIONAL HAZE IN THE WEST AND THE ROLE OF STAITIONARY SOURCE NOx AND PM EMISSIONS

Introduction

The objective of this report is to provide a foundation for better understanding the dynamics of PM in the West, with particular attention to the nitrate and primary component that may be due to point source emissions. Further, the report explores how stationary source NOx and primary PM controls might impact FPM levels. As part of that, the utilization of a trading system is discussed. The report sets up a detailed framework to understand the issues by developing a conceptual model of PM formation, atmospheric dynamics, and impacts in the West. Next, the report discusses the likely effectiveness of PM and NOx controls on PM levels in the West and the relationship with visibility. This section also deals with issues involving emission trading. The final two sections discuss potentially useful computer simulations and a summary.

Overview of PM in the West

The area covered by the Western Regional Air Partnership (WRAP) includes a large fraction of the continental United States. In an air quality management context, this area has very different air quality characteristics. In part, this is due to the diversity in the source characteristics of the region, ranging from large coastal California cities to very sparsely populated and isolated regions. In the former, the emissions are dominated by mobile sources, disperse human activities, and a variety of industries. In the latter, natural sources (e.g., fire, dust, and biogenic emissions) and large point sources (e.g., electricity generating units) can dominate. Similarly important are the meteorological and topographical differences: e.g., rainy and cool coastal areas in the Northwest, dry mountainous regions further inland, and deserts in the Southwest. Pollutant levels and characteristics vary accordingly. Not only do the relative levels of pollutants vary, but the composition and source contributions change as well. This is especially seen in the particulate matter composition. In Los Angeles, nitrate (and the associated ammonia) is a major contributor. Outside of California, nitrate is usually a relatively minor contributor, though the Columbia Gorge and Seattle areas find somewhat elevated levels (Malm et al., 2003).

Unlike gases, particulate matter is characterized not only by its composition, but by the particle size as well. From a regulatory standpoint, particulate matter is divided in to three fractions: fine, coarse and very coarse. To a degree, these capture how the particulate mater size distribution is considered from a scientific perspective, which is broken in to four modes of ascending size: nucleation, Aitken, accumulation and coarse modes. The nucleation mode is the very fine fraction where new particles are formed from nucleation of vapors. Recently, as part of the Supersite experiments, regional nucleation events have been seen. These particles then grow into the Aitken mode, which also contains primary emissions from combustion sources, and finally the accumulation mode. The accumulation mode is aptly named as the smaller particles grow in to this mode, but the growth out of accumulation mode particles into the coarse mode is very slow. Recent interest has grown over another possible division of PM: ultrafines (having particle diameters less than about 0.1 um). There is relatively less information about ultrafine PM.

Fine particulate matter (FPM) is often measured as PM2.5, or particulate matter with an aerodynamic diameter less than 2.5 micrometers (um). Some measurements of FPM have used other cut points, but there is a natural cut point at 2.5 um between the accumulation and coarse modes. On a mass basis, FPM is dominated by PM in the accumulation mode. Thus, coarse particulate matter is the fraction with particle diameters greater than 2.5 um. Given the historical measurements of PM10, coarse PM is often taken as the fraction between 2.5 and 10 um. The fraction above 10 um can be considered as very coarse, and is included (along with the other fractions) in total suspended particulate matter (TSP) measurements. The reasons for using these ranges have to do with the somewhat distinct dependence of the various size fractions on source, their atmospheric dynamics and impacts. Also, if one looks at a size distribution of PM, these modes become apparent. Characteristics of the coarse fraction are that the particles are mechanically generated (e.g. from road dust, construction, mining, etc.) and have relatively shorter atmospheric lifetimes due to settling and deposition, particularly for the very coarse particles. FPM can be mechanically generated (FPM can be present as the tail end portion of emissions that are mostly coarse) or from chemical conversion (SO2 oxidation to sulfate, combustion generation of soot, etc.), the latter often dominating. FPM also has a longer lifetime in the atmosphere as it deposits relatively slowly, though rain can rapidly remove much of the FPM. Ultrafines are due to emissions from combustion sources and chemical reactions in the atmosphere. Like FPM, ultrafines deposit slowly, but have a limited atmospheric lifetime as ultrafines because they grow due to condensation and coagulation.

While size differences are important, so are species differences. Sulfate is almost solely a secondary species, formed from the oxidation of SO2 (e.g., from coal-fired EGUs and other combustion processes). This may take place in the gas phase or from heterogeneous reactions. Sulfate is found in the fine fraction. Sulfate tends to be one of the largest components of FPM in the rural West, and still a major fraction in urban areas. Average levels are about 1 ug/m^3 in rural western areas. Nitrate is also a secondary component, resulting from the oxidation of NOx to form nitric acid gas, which then undergoes gas-to-particle conversion. NOx emissions are dominated by combustion sources, though there is a small fraction from biogenic emissions. Nitrate is also primarily in the FPM range, though tends to have a somewhat larger average particle diameter than the sulfate. A fraction of the nitrate is found in the coarse mode, indicative of gaseous nitric acid reacting with preexisting CPM (Malm et al., 2003). In the West, typical levels of measured nitrate outside of and not downwind of urban areas and central California tend to be low, averaging well less than 1 ug/m^3. In the Los Angeles basin, nitrate levels can exceed 25 ug/m^3, and significantly impact areas downwind. Care should be taken in interpreting measured nitrate levels as the techniques used are subject to artifacts (both positive and negative).

Organic carbon (OC) is the most complex part of the PM in many ways. First, it is comprised of many different species. Further, it can be primary or secondary, and biogenic and anthropogenic in origin. Again, OC is primarily FPM. Levels are highest in the cities or in areas with biomass burning (e.g., due to wild or planned fires), and there is growing evidence of the importance of secondary OC (Brown et al., 2000).

Elemental carbon (EC), or black carbon, is due to incomplete combustion, and appears to be primarily from wood burning and diesel vehicle emissions, though other sources contribute, and the actual fraction due to diesel vehicles is under study. Given the sources, EC is highest in urban areas, and a relatively small component of FPM in rural locations. While small on a mass basis, EC does absorb light, so can contribute more significantly to visibility degradation.

Metals, metal oxides and other crustal materials are due to a wide variety of sources, largely wind blown dust, as well as combustion, cement manufacture, etc. These are largely in the coarse mode, though a fraction is found as FPM, generally as the tail end of the size distribution of the coarse PM, or from combustion sources. In the non-coastal states of the West, the soil fraction is between about 20-30% of the FPM (Malm et al., 2003).

FPM has come to attention as an important fraction of the total particulate matter because of its potential impacts. FPM has been suspect of impacting human health, and recent and continuing studies tend to provide further support. (Less information is available for ultrafines). FPM also exists in a size range (e.g., similar to the wavelength of visible light) that effectively scatters and absorbs light, decreasing visibility, which is of particular concern in the West with its many national parks, forests and wilderness areas. Coarse particulate matter is of less concern (though still some) due to its shorter lifetimes, apparently reduced health effects and it is less effective, on a mass basis, of scattering light.

FPM levels in the West go from very low, with some of the lowest annual averages found in the US, to very high, with the Los Angeles area experiencing some of the highest. Other areas in the West experience isolated events of high PM (e.g., due to dust storms and fires) but annual average levels tend to be low. In much of the West and other parts of the country, the FPM is dominated by organic carbon and sulfate, while nitrate is typically a more minor constituent. While levels of these components, as well as FPM in general, are usually lower than in the east, the sources appear to be similar: sulfate comes from fuel combustion, particularly coal fired power plants and organic carbon comes from biomass burning and secondary formation. Of interest, recent results from the BRAVO study using molecular markers (Brown et al, 2002) suggest that a significant fraction of the organic FPM is secondary, as do similar studies in the Southeast. Carbon 14 dating of the organic matter in the Southeast (Edgerton, 2002) further suggest that the secondary organic is biogenic, which, given the emissions in the Big Bend area, would likely be the case there. Unlike most other areas, in Los Angeles and the Central Valley of California nitrate is a significant contributor, along with organic carbon and some sulfate.

Literature Review

Particulate matter dynamics has been an on-going research topic for decades. In-depth treatments of atmospheric particulate matter are contained in Seinfeld and Pandis (1998) and Friedlander (1977). The impact of PM on visibility has likewise been studied for years, with early work by van de Hulst (1957), and on-going study from the IMPROVE (Interagency Monitoring of Protected Visual Environments) program begun in 1985 (e.g., http://vista.cira.colostate.edu/improve/, and Malm, 2000, and references there in). Early studies of nitrate dynamics and response to emissions controls include Stelson and Seinfeld (1982) and Russell and Cass (1984).

In the WRAP area, particulate matter studies have been conducted for years. One could group them in to urban vs. pristine area studies, or a second split could be California studies and the rest of the west. The urban vs. pristine area consideration is typified by studies with different considerations, e.g., in urban areas health and attaining the National Ambient Air Quality Standards are often the drivers, while in pristine areas, visibility is of primary importance. The latter distinction, between California and other areas in the west, is made on a couple of bases. First, California has been very active in conducting air quality studies, in part because of the severe air quality problems in that state. Second, as presented in the regional conceptual model discussion below, particulate matter in regions in California is compositionally distinct from what is found over much of the West.

Outside of California, the primary information that is available concerning PM in the West is derived from the IMPROVE program (e.g., Malm, 2000), and a number of studies focusing on specific areas. IMPROVE is an ongoing study of visibility in Class I areas in the U.S. most notably national parks. Amongst its objectives are to monitor the composition of particulate matter in protected environments and identify sources. Other, more regionally focused studies include the Big Bend Regional Aerosol and Visibility Observational (BRAVO) study (see Green et al., 2000, Brown et al., 2002) those associated with the Grand Canyon and Colorado Plateau (e.g., Grand Canyon Visibility Transport Commission, 1996 and project MOHAVE: Lowenthal et al., 2000), Mt. Zirkel (e.g., Watson et al., 2001), the Denver Brown Cloud, which included the Northern Front Range Air Quality Study (NFRAQS) (e.g., Watson et al., 1998). The Grand Canyon studies were directed primarily at assessing how nearby power plants (in particular, the Navajo Generating station) impact visibility in areas on the Colorado Plateau, which includes a number of Class I areas, including the Grand Canyon, which had experienced days with decreased visibility. BRAVO is assessing the sources of particulate matter and visibility degradation in the Big Bend area of Texas, and NFRAQS studied visibility in the area around Denver. While not focused on PM in the West, the Southern Appalachians Mountains Initiative (SAMI) study (SAMI, 2002) is relevant here because it addressed many of the same issues, except for the focus on Class I areas in the southeastern United States.

Within California, a number of programs are available for providing information on particulate matter in various regions. First, a number of Class I areas in the state do have IMPROVE monitors, which provide both a long term record of PM composition, as well as a means of comparing, directly, levels in California with those in other states. In addition, California has conducted a number of additional, intensive efforts, most notably in the Los Angeles area and the Central Valley. In the Los Angeles (or South Coast) Basin, two studies are of particular note: the Southern California Air Quality Study (SCAQS) and the Southern California Ozone Study, 1997 (SCOS97). There have been a number of additional studies as well, notably those by Cass and coworkers (e.g., Hildemann et al., (1984); Gard et al., 1998), and the current studies associated with the Supersite (e.g., Sioutas et al., 2003). In the Central Valley, the San Jaoquin Valley/Atmospheric Utility Signature Prediction Experiment (SJV/AUSPEX), the California Regional Particulate Matter Air Quality Study (CRPAQS) and the Fresno Supersite are providing detailed information on the air quality and sources in that region. The two Supersite studies, however, are more focused on urban air quality, and less focused on visibility in protected areas.

A number of publications and reports discuss the results of the IMPROVE program, documenting the composition and trends and their relationship to visibility. A recent manuscript by Malm et al. (2003) presents the annual average fine particulate matter composition in each of 30 IMPROVE regions. In general, sulfate levels in the West are significantly below those in the East. Ammonium nitrate is high in southern California and the Lower Central Valley, with very low concentrations most other locations in the West (generally less than 0.5 ug/m^3 except in isolated spots, Malm et al, 2003). It should be noted that ammonium nitrate is actually not measured, but inferred from the nitrate measurements. As they note, nitrate can also be found in other forms, some of which are thermally stable (e.g., from the reaction of nitric acid with soil or sea salt, Malm et al., 1994; Gard et al., 1998). Organic carbon, regionally, typically runs between 0.5 and 2 ug/m^3. Elemental carbon levels are low, typically below 0.5 ug/m^3 on average, but can be an important component in terms of visibility reduction. A recent trends report from IMPROVE (Malm, 2000, also see Sisler et al., 2000 and Malm et al., 2002) shows that trends in PM levels are mixed throughout the West. For example, Sisler et al., (2000) found that of the western sites where a significant trend was found, not quite two thirds reported improvements. In some cases, decreases of one component (e.g., sulfate) were off set by another (e.g., organic carbon), as found at Jarbridge Wilderness area. At the Guadalupe Mountains NM, organics are going down, but nitrate and fine soil are going up, with no real change in visibility.

In the Mt. Zirkel Visibility Study (Watson et al., 2001), the major components that impaired visibility were found to be sulfate, organic carbon and crustal material, similar to the results form IMPROVE monitors in the region. Nitrate was a small contributor. Greater amounts of nitrate were found during the NFRAQS study, presumably because of the more concentrated sources of oxidized nitrogen in an urban area, and the proximity of confined animal operations.

Given the use of regional PM modeling, it is instructive to compare the modeling conducted here with similar studies, in particular BRAVO and SAMI, as well as other applications of PM regional models. In the SAMI study, the Urban-to-Regional, Multiscale (URM) model was used (Odman et al., 2002), and used the Decoupled, Direct Method (Yang et al., 1997) to assess source impacts and response to controls. They also assessed the response of PM levels to emissions changes corresponding to varying levels of controls. Results of their modeling was used to calculate the expected changes in visibility, stream health and ozone damage (SAMI, 2002). Model simulations led to FPM mass having an normalized error of under 50%. Sulfate and elemental and organic carbon simulations also found errors on the same order, but nitrate predictions were high. Seigneur (2003) recently completed a report discussing regional modeling applications of CMAQ and REMSAD, two of the more commonly used regional PM models. The focus of this review was the model performance in the BRAVO, WRAP, Southeast US and various EPA studies. In general, model performance in the studies outside of the WRAP found PM predictions with a normalized error of 35-90%. Nitrate predictions had the largest error.

SAMI air quality modeling dealt with many of the same issues being addressed currently by the WRAP (Odman et al., 2002). Specific issues addressed were quantifying the relationship between emissions and various air quality endpoints, including PM levels, deposition and ozone. PM results, which were by species, were used for visibility calculations. Specific results of relevance here include:

- PM reductions were sub-linear to controls, and that the degree of sub-linearity increased as PM concentrations decreased. For example, when sulfate concentrations were highest, a 10% reduction in SO2 emissions resulted in an approximately 8-9% reduction in sulfate. At lower sulfate levels, the same 10% reduction led to a smaller percentage change. For nitrate, the sub-linear response was greater. A 10% reduction in NOx led to about a 5% reduction in nitrate, averaged over the year.

- Reductions in sulfate led to an increase in nitrate levels.

- Increases in ammonia led to an increase in nitrate.

- Nitrate formation was generally ammonia-limited.

These findings are important both individually and collectively. Over the next few years, SO2 emissions are expected to decrease and ammonia emissions are expected to increase, both leading to increases in nitrate. SAMI results suggest that these increases will be relatively small, but non-zero. However, in many locations, they offset the 27-63% reductions in NOx, such that nitrate actually increased. It is difficult to translate how similar changes will impact the WRAP regions, particularly since the WRAP regions are more heterogeneous. However, the preliminary results from the CMAQ modeling suggest that nitrate formation is ammonia-limited in a large part of the West. The sub-linear response suggests that controls will not get as much reduction as might originally be expected. However, the greatest fractional improvements will occur on the most heavily impacted days.

A final reference that provides a good overview of the issue is the NARSTO Assessment (NARSTO, 2003). It provides a more thorough discussion of many of the issues contained here, as well as conceptual models of PM dynamics in a number of areas of the United States.

Conceptual Model of Primary PM and Nitrate Dynamics in Western Airsheds

Here, conceptual models are developed to help elucidate the dynamics of both primary and nitrate PM in various western airsheds, starting with primary coarse and fine PM, which are not as involved with gas-to-particle conversion and less complicated. Note, secondary species can condense on primary PM, so even primary species can impact the formation and properties of secondary material.

Coarse PM is typically emitted by mechanical processes, e.g., grinding operations, transport of solid materials, road dust and wind blown dust. Further, CPM is typically emitted near the ground, not from tall stacks. In part, this is due to controls on large point sources. CPM has a relatively short lifetime, on the order of a few hours, though particles at the upper end of the coarse mode will have very short lifetime. For wind blown dust, this is much of the mass. Primary CPM can be attacked by nitric acid, and because of the shorter lifetime, act as a sink of nitrate PM. Given total primary CPM emissions of 70 tons per year (tpy) (1/2 of the total PM10 emissions), one can develop a first order estimate of the contribution to total PM in the region by dividing by the approximate volume of the boundary layer in the WRAP area (~10^{15} m^3), and multiply (~1 hr) by the lifetime. This leads to an average contribution of large point sources to PM of 0.005 ug/m^3, a small fraction, again, on average. However, high levels of CPM are often very episodic (dust storms) or very local: i.e., within a few km of the source. Further downwind, the emissions have deposited and been diluted.

A portion of the CPM can be secondary, e.g., due to reaction of nitric acid on the surface of the aerosol, or condensation. Measurements suggest that a non-insignificant fraction of the nitrate in the regions outside of the California valleys is coarse. As discussed below, the existence of CPM nitrate is important from a control point of view. CPM nitrate is less likely to be reduced from reductions in ammonia as compared to FPM nitrate.

From this conceptual model of CPM, driving points are:

- CPM is predominantly primary, with a fraction due to gas-to-particle conversion, e.g., by the reaction of nitric acid with pre-existing particles,

- CPM has a relatively short lifetime,

- CPM can act as a sink for nitrate, and

- CPM is typically episodic, often occurring during periods with large amounts of windblown dust.

Primary FPM is emitted, often as a combustion by-product, in to the atmosphere, where it undergoes transport, growth, deposition, rain-out and a variety of other processes. The size of such emissions are typically in the ultrafine region, though from some processes the average particle size can be larger, e.g., as fine and coarse PM (e.g., cement manufacture). If emitted as an ultrafine, the small particles will likely grow in to the accumulation mode via condensation of other compounds to it (primarily) and coagulation with other particles, staying as FPM.

Primary FPM is transported very efficiently, essentially as a gas, since its sedimentation velocity (the rate at which it falls due to gravity) is very slow. As such, it will follow the prevailing winds and be distributed vertically and horizontally due to atmospheric turbulence. Removal of FPM occurs due to wash-out (e.g., rain and snow) and dry deposition. Dry deposition is slow, slower than many gases, due to the slow transport of FPM across the fluid dynamic boundary layer near solid surfaces (gases diffuse much more rapidly than particles) and low sedimentation velocities. As an example, for a 1 um particle, the deposition velocity is on the order of $5x10^{-4}$ m s^{-1}. Using a boundary layer height (e.g., the well mixed portion of the atmosphere near the earth's surface) of 1000m, this leads to an atmospheric lifetime of about 3 weeks, and the particles will be transported out of the region before depositing. Larger particles will deposit somewhat faster as their sedimentation velocity is higher (the particles are heavier), and very small particles will as well since they diffuse faster. With such long lifetimes, wash-out can be very important, particularly in areas that have frequent rains. Depending on the intensity of the rain, FPM can be very effectively removed, such that the lifetime of the FPM is very directly linked to the frequency of rain. Without rain, FPM is generally transported out of the airshed or, as will be discussed for nitrate, be lost due to some other process. The lifetime due to transport in the region is on the order of 10 days. Using this, along with assuming that one half of the primary PM emissions from stationary sources (Seignuer et al., 2003) are fine, one calculates that the average primary FPM levels would be on the order of 1 ug/m^3. This is somewhat above what is measured as crustals in most locations, and more in line with the measured organic carbon. However, organic carbon would be due more to wood boilers and internal combustion engines. Using just those emissions, the average contribution to the organics would be less than 0.1 ug/m^3. This is in line with source apportionments that suggest a large fraction of the organic carbon is due to biomass burning and other processes (e.g. Maykut et al., 2003). The stationary source emissions estimates would suggest that primary FPM from stationary sources may have a regionally significant impact, though this calculation is conservative and does not take in to account rainout and other loss processes.

If the primary FPM is emitted from the stack of a large point source, it will be transported in the plume with the gaseous pollutants and can undergo somewhat more rapid growth due to the concentration of condensable compounds. It may also be transported above the well mixed boundary layer, delaying the dry deposition loss mechanism, at least temporarily. When the mixed layer grows to capture the plume, the FPM will be diffused downwards. Given the cloud heights relative to the typical effective plume height, washout will typically remove FPM from plumes.

During transport, primary FPM can grow. Growth will depend upon the particle size and composition. Of particular importance is the hygroscopicity of the compounds in the particles. Some compounds will readily absorb water, such that in a humid environment, they will grow significantly, e.g., doubling in size. If the compound is hydrophobic, they will undergo more slow growth due to condensation of other compounds. Water is not the only compound that will be selective as to which particles are most readily absorbed. Semi-volatile organic gases can have a preference for particles with similar-structured organic matter already present. $SO_2(g)$ can be absorbed in to particles that already contain water, and then oxidized to form sulfate. Nitric acid will prefer non-acidic particulate matter. Important here is to recognize that a primary particle will interact with its environment, and end up as having both primary and secondary components. From a visibility standpoint, this is important since the growth can make the particles more efficient at degrading visibility. While the argument could be made that the condensable species would find some other process to form particulate matter without direct emissions (e.g., nucleation, followed by condensation), there is an abundance of water that would not necessarily do so. Further, as compounds such as sulfate condense on primary FPM, they can become more hygroscopic. Since primary emissions of FPM can undergo atmospheric growth, it is not directly apparent that decreases in FPM emissions will lead to the same level of decrease in FPM in the atmosphere. Indeed, greater reductions may be realized if the nuclei provided by the primary FPM is a limiting factor in the formation of secondary FPM. On the other hand, the observed effects may not be as enhanced since the condensable species will find other particles.

From this conceptual model of primary FPM, driving points are:

- FPM has potentially long lifetimes in the atmosphere,
- Wash-out is an important loss mechanism,
- Ultrafine primary FPM can grow in to a size range that is efficient at scattering light,
- Hygroscopic FPM can pick up water and become diffusive, and
- Even if emitted from tall stacks, primary FPM can be diffused downwards to the surface.

Particulate nitrate dynamics is significantly more complex than for primary PM because of the added chemistry and gas-to-particle/particle-to-gas conversion. While there is a small amount of primary nitrate emissions, most of the particulate nitrate in the troposphere starts out as NO_x which was emitted from a combustion process. NO_x, which is well known for its role in the formation of ozone, can be oxidized to nitric acid via two important pathways. During the day, NO_2 is oxidized by the hydroxyl radical:

$$NO_2 + OH \longrightarrow HNO_3$$

This reaction is responsible for most of the nitric acid formation. A second route takes place mostly at night. First, NO_2 is oxidized by ozone to the nitrate radical, NO_3:

$$\mathrm{NO_2 + O_3 \longrightarrow NO_3 + O_2}$$

(The nitrate radical should not be confused with the nitrate ion, NO_3^-). Next, the nitrate radical reacts with NO_2 to form dinitrogen pentoxide, N_2O_5:

$$\mathrm{NO_2 + NO_3 \longrightarrow N_2O_5}$$

N_2O_5 then reacts with water to form two nitric acid molecules:

$$N_2O_5 + H_2O \longrightarrow 2HNO_3$$

This reaction is slow in the gas phase, but can occur rapidly on the surface of a particle that contains water. However, the rate of this reaction is very uncertain, and it is believed that the rate used by CMAQ in the past may be too high (Dennis, 2003, personal communication), leading to an over prediction of PM nitrate. NO_3 photolyzes very rapidly, and during the daytime it is found at very, very low levels, blocking this formation route when the sun is up.

The nitric acid gas formed from the above reactions can dry-deposit out, be washed out, or undergo gas-to-particle conversion. Nitric acid reacts very rapidly with surfaces, and deposits out rapidly. It's lifetime to dry deposition is on the order of a few hours. Nitric acid is also very soluble, and is removed effectively by rain.

In terms of particulate matter formation, nitric acid is a strong gas and can attack pre-existing particles, being adsorbed or displacing other compounds present. For example, nitric acid gas can displace chlorine in a sea salt-derived particle, leading to sodium nitrate and HCl(g). Likewise, it can react with alikilinic crustal material to form PM nitrate (e.g., Malm et al., 2003). In both such cases, the particulate nitrate formed is in the coarse fraction because the original particle was in the coarse mode. In many regions, the route to forming FPM nitrate is via the gas phase reaction between nitric acid and ammonia (NH_3):

$$HNO_3(g) + NH_3(g) \longrightarrow NH_4NO_3(\text{aerosol})$$

followed by gas to particle conversion. The reaction is reversible, and the ammonium nitrate can thermally decompose. The forward and backward reactions are fast enough such that the two reactions are often considered to be in equilibrium:

$$HNO_3(g) + NH_3(g) \xleftrightarrow{K} NH_4NO_3(\text{aerosol})$$

where K is the equilibrium constant. Thus, the fraction of nitrate formed is very sensitive to the abundance of ammonia available, as probed later. In areas with substantial quantities of ammonia, large amounts of nitrate can be formed (e.g., in areas with confined animal operations). In areas with relatively little ammonia, or where the ammonia available is bound as ammonium sulfate (or ammonium bisulfate), very little nitrate is present. Another factor is that the equilibrium constant is very temperature dependent, and at higher temperatures, the gas phases of the two compounds is preferred. The equilibrium makes the formation of ammonium nitrate very nonlinear. In some cases, e.g., in an environment rich in ammonia but with little nitric acid, the ammonium nitrate levels are governed almost solely by the available nitrate (e.g., nitric acid formation), and ammonia reductions will have little impact. If ammonia is low, it is the controlling species

Surprisingly, nitrate levels, locally, may go up when NOx emissions are decreased. This is analogous to the disbenefit found in the response of ozone to NOx emissions. Regionally, NO_x reductions will reduce ozone because NO2 is needed to form ozone. However, locally, reducing NO_x can lead to local increases in ozone for two reasons. The most easily understood is that NO_x is primarily emitted as NO, which titrates ozone. This is important at night. During the day, NO_2 reacts with the hydroxyl radical, significantly lowering OH levels. This decreases the rate of VOC oxidation, which reduces the rate of NO oxidation to NO_2, which reduces ozone formation. Most of the hydroxyl radical formed comes from ozone photolysis, so lower ozone reduces OH formation. Thus, there is a positive feedback. NO_x emissions increases decrease ozone, decrease OH, and decrease the rate at which NO_2 is oxidized to nitrate, locally. Regionally, more nitric acid will be formed. In the SAMI study, this appeared to be a second order effect.

Complicating the nitrate formation issue is the presence of other condensed phase species, in particular sulfate. As noted above, ammonium nitrate formation is very sensitive to the availability of ammonia. SO_2 oxidation, which is faster in the summer when hydroxyl levels are highest, leads to the formation of sulfuric acid, H_2SO_4. Sulfuric acid reacts with ammonia to form ammonium bisulfate [$(NH_4)HSO_4$], and if enough ammonia is present, ammonium sulfate

[$(NH_4)_2SO_4$]. Ammonia will preferentially react with sulfate to form the above two species before reacting with nitric acid to form ammonium nitrate. As such, the presence of sulfate will reduce the amount of ammonia available to form ammonium nitrate. In many cases, there is so little free ammonia that ammonium nitrate is not formed. On the other hand, nitric acid that has reacted with sea salt or crustal material to form sodium/calcium nitrate does not require ammonia, so there can be some aerosol nitrate even in high sulfate areas, though typically not as much as in high ammonia/low sulfate areas.

The interaction between sulfate, nitric acid and ammonia has implications for the "lifetime" of nitrate in the atmosphere as sulfate is reduced: decreasing sulfate will make more ammonia available to form PM nitrate, reducing nitric acid gas levels. The PM nitrate deposits much less rapidly than nitric acid, so the total abundance of nitrate in the atmosphere will increase. Thus, decreasing sulfate levels may lead to somewhat more nitrate than is expected from just considering the amount of nitric acid currently available to form PM nitrate.

Sulfur dioxide reductions will lead to the reduction of sulfate particulate matter, and hence, can lead to more ammonium being available to form ammonium nitrate, leading to what is referred to as the "rebound effect". In this case, the sulfur dioxide controls will not lead to the expected (or desired) reductions in particulate matter because as sulfate decreases, nitrate increases due to the availability of ammonia in a condition where nitrate formation was ammonia limited. This was found to be true in the SAMI study to a limited degree.

One issue that should be addressed is the impact of certain NOx controls on increasing ammonia emissions, e.g., SCR and SNCR. Compared to other sources of emissions, such controls would represent a very small fraction of the total ammonia emissions. However, in the plume, the ammonia emissions might be high enough to lead to an increase in ammonium nitrate, and hence impact visibility in concentrated plumes.

Washout is very important to nitrate levels. Not only will rain remove the nitrate aerosol, but will also remove nitric acid gas and ammonia very effectively. Clouds can also increase the oxidation of SO2 to sulfate, which captures ammonia, and is also washed out. Some of the lowest FPM levels are found following a rain storm.

From this conceptual model of PM nitrate, driving points are:

- PM nitrate formation is due to both gas and heterogeneous reactions forming nitric acid from nitrogen oxide emissions, followed by gas-to-particle conversion,

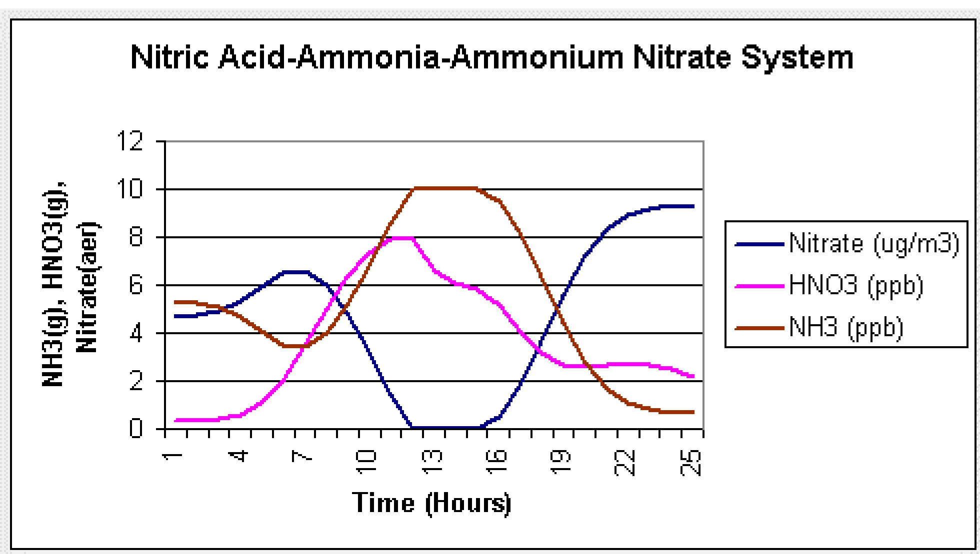
- FPM nitrate is largely due to reaction with ammonia, while CPM nitrate is due to reactions of nitric acid on a preexisting particle,

- Reducing ammonia can reduce nitrate formation in areas that are "ammonia limited", but may have little impact in areas where there is an abundance of ammonia, and

- NOx controls can reduce nitrate in areas where ammonium nitrate formation is nitrate limited, as well as areas where nitrate is formed from the reaction of nitric acid on pre-existing particles.

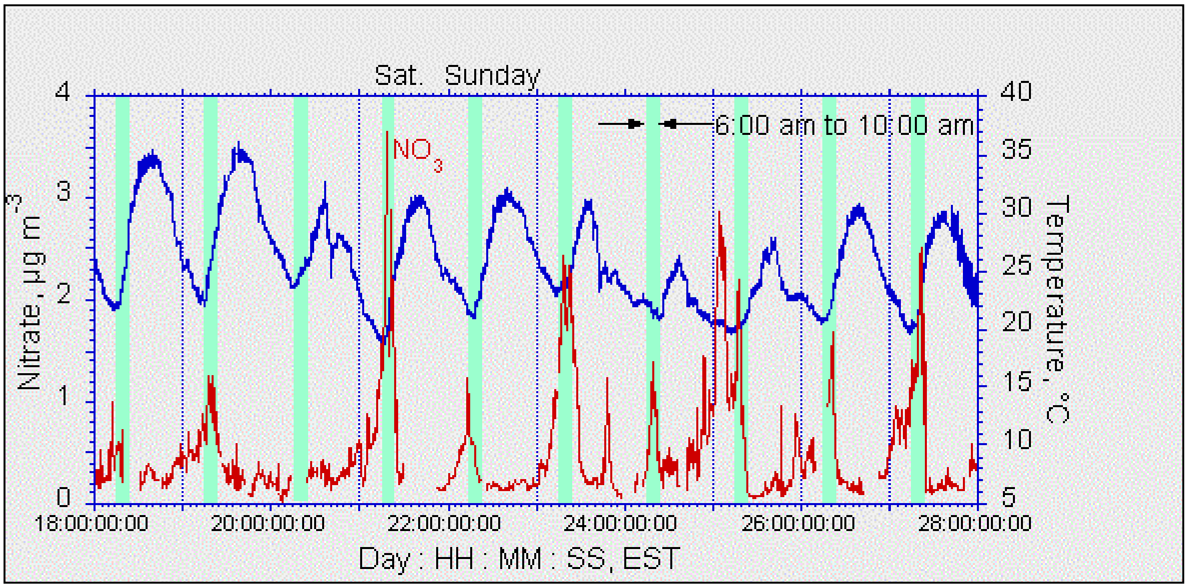
This conceptual model is diagrammed in the figure below. It should be noted that this figure, or the discussion above, does not have all of the complexities leading to nitrate formation. The atmospheric chemistry involves hundreds of compounds, and thousands of reactions. Describing the physical processes is equally complex. The systems of equations governing the pollutant evolution are non-linear. Pollutants evolve spatially and temporally. For such reasons, complex computer models are generally used to study the details of the pollutant dynamics. However, a good picture of the system dynamics, and an understanding of the importance of various processes can be developed from a simplified, zero-dimensional model.

While very simplified, a zero-dimensional model can be used to demonstrate the important features and resulting formation and loss of particulate nitrate. In this case, the model includes the formation of nitric acid, peaking during the day, an increase in temperature during the day, going from 10 to 30 C, the increase in the equilibrium constant with temperature, deposition of nitric acid, and a constant level of ammonia/ammonium. The result is that the highest levels of PM nitrate occur at night and the early morning, going to zero during the hottest parts of the day. Nitric acid peaks during the day when all of the ammonium nitrate has dissociated. Most of the nitrate deposits during the day since nitric acid is so reactive with surfaces. In the SAMI project, the deposition of oxidized nitrogen due to nitric acid was about an order of magnitude higher than for PM nitrate, due both to the higher nitric acid levels and deposition velocities.



One of the important features of this system is that while ammonium nitrate does not deposit rapidly, nitric acid does. Thus, an ammonium nitrate aerosol will disappear relatively rapidly in a continual, two-step process: the nitric acid gas deposits rapidly as a gas. The ammonium nitrate will thermally decompose to replace the lost nitric acid. The nitric acid released will then deposit out, etc.. At higher temperatures, i.e., when a significant amount of the nitrate is in the gas phase, this process can be rapid. In cold areas, almost all of the nitrate will be bound as ammonium nitrate, and the thermal decomposition is slow, so the process is inhibited.

A multi-day observation of aerosol nitrate levels is shown in Figure 2, along with the temperature trace. As shown, nitrate goes up in the morning due to NOx oxidation along with low temperatures. As the temperature increases, the nitrate decreases and goes to near zero during the day. While not shown, sulfate also increases during the day, scavenging ammonia and further decreasing nitrate levels.



Particles and Visibility

As noted previously, particles can degrade visibility. The three primary mechanisms are Mie, Rayleigh and Geometric scattering, and absorption. Only a few types of particles absorb visible light effectively. Most notably is elemental carbon. Mie scattering occurs from a complex interaction between light waves and particles of a size similar to the wavelength of light (visible light ranges from about 0.2 to 0.8 um). Larger particles scatter and block light. Air molecules also scatter light (Rayleigh scattering), limiting visibility on even the cleanest days.

Visibility, or visual range, x_v, is often calculated using the Koschmeider formula:

$$x_v = \frac{3.912}{b_{ext}}$$

where b_{ext} is called the extinction coefficient, and is generally given in Mm^{-1}. The extinction coefficient is calculated by accounting for all of the processes scattering and absorbing light. While very complex formulas have been derived, a useful parameterization that corresponds to he air quality data usually available from IMPROVE and other sites is:

$$b_{ext} = 3f_T(RH)([Sulfate]+[Nitrate]) + 4f_{org}(RH)[Organic] + [Soil] + 0.6[CPM] + 10[LAC]$$

where $f_T(RH)$ is a function to account for sulfate and nitrate absorbing water ($f_{org}(RH)$ is a similar function for organic material), [Sulfate], [Nitrate], [Organic] and [Soil], are the measured masses of the corresponding fine PM constituents, and [LAC] is the measured mass of the "light absorbing carbon" similar to EC, (depending on measurement technique). The latter term accounts for absorption. At relative humidities (RH) above 40%, $f_T(RH)$ is greater than one, going up to above 5. However, $f_{org}(RH)$ is taken as one. Given this, one sees that, on a mass basis, sulfate and nitrate are usually more effective at scattering light than organics, soil and CPM. LAC is very effective at absorbing light, and a small amount can lead to significant light extinction. Another measure of visibility impairment is the deciview (Pitchford and Malm, 1993). It is proportional to the log of the extinction coefficient and relates to the perception of haziness. Given the non-linear nature of the relationship between deciviews and extinction coefficient, but the linear relationship between extinction and PM composition, for the purposes of this report, it is easier to consider extinction.

Regional Conceptual Models

The above description of the formation and fate of primary FPM and nitrate was done for a general case, without consideration of regional differences in either the processes impacting primary FPM and nitrate. In the West, many such regions exist. To provide a better understanding of how such differences manifest themselves, four sub-regions of the WRAP are identified based on their meteorological and FPM characteristics. The four regions are: wet coastal, dry mountainous, southwest desert, and California valleys. Wet coastal regions include the coastal regions starting in northern California to the Olympic Peninsula, and include the coastal mountains. The dry mountainous sub-region includes the Rockies, the Sierras, and other drier mountainous areas. The southwest desert region would include non-mountainous areas in Arizona, New Mexico, Colorado and Nevada. California valleys include the Los Angeles basin and the surroundings (including the mountainous and desert areas downwind) and the Central Valley and surrounding mountains. A fifth case, considered separately, but not as a separate region, "in-and-near,"., i.e., those regions that have significant sources of PM either directly within or nearby. For example, a Class I area near a major city or facility with very large emissions, or if the activities within a Class I area led to significant emissions. The IMPROVE investigators have dissected the west in to 15 regions, which is more than is needed for developing the conceptual models as done below. However, which "IMPROVE" regions fall in to each of the four given below are noted.

Wet, Coastal Subregion

This subregion occurs along the Pacific coast and the Puget Sound, in to the coastal mountains and the Cascades. As such, it includes the IMPROVE Pacific Coastal and Cascade Mountains. As the name implies, this region tends to be wet, and is known for rain, and can also experience intense coastal storms. The temperatures tend to be cool. There are a few population centers in this region (e.g., Portland and Seattle).

PM levels in the coastal region tend to be low, e.g., on the order of a 3-4 ug/m^3 average over the year (Malm et al., 2003). Average levels of nitrate and primary FPM are very low: 0.2-0.8 ug/m^3, though nitrate is higher in the Puget Sound and Columbia Gorge areas (Malm et al., 2003). The rain removes FPM and its precursors and coastal winds ventilate the region. The cloudiness of the area inhibits the rate of oxidation of NO2 to nitric acid. There are relatively fewer sources of FPM and precursors in the region. Higher levels of FPM are experienced in the population centers. In the Class I areas, FPM tends to be primarily sulfate and OC, with little nitrate and primary material. Biomass burning (e.g., forest fires) appears to be a major contributor in some areas, as suggested by high OC levels, particularly during some very high events. In terms of the general conceptual model, discussed above, particulate nitrate can be formed from the reaction of nitric acid with sea salt. Ammonium nitrate formation in the area appears to be limited by the presence of both free nitrate and ammonium. On the other hand, the cool temperatures promote converting what little available nitric acid and ammonia is available in to ammonium nitrate. Without further investigation (e.g., longer term, detailed modeling) it is difficult to tell how nitrate will respond to controls, but it is likely that the formation is limited by NOx emissions, not ammonia. Results from the WRAP modeling suggest that part of Oregon is ammonia sensitive (Tonneson, 2003).

The days with the most severe visibility impairment appear to be impacted most heavily by organics (particularly during severe episodes) and sulfate.

Dry, Mountainous Subregion

This region includes the more inland mountains, and would contain the Sierra Nevada, Wasatch, Northern Rocky, Sierra-Humboldt and Central Rocky Mountain IMPROVE regions. These areas are much drier than the coastal mountains. While not immune to rain and storms, they are less frequent, particularly during the summer. Temperatures tend to get hotter during the summer. During the winter, temperatures can get quite low. The area has a relatively low population density, and few major source regions, though is relatively agricultural. Major point sources include utility boilers, and smelting operations. Confined animal operations can lead to areas of very high ammonia. Forest fires, particularly in the northern mountainous areas (e.g., Montana and Idaho) and the Sierras can lead to very large PM concentrations during episodes. In such cases, OC dominates mass.

FPM levels in this region are low, around 2-5 ug/m^3 in Class I areas. Again, cities have higher levels. Nitrate and primary FPM levels are a small fraction of the total (0.1 to 0.4 ug/m^3, except in the regions of the Sierra Nevada that are influenced by emissions in the Central Valley), particularly during the some of the most polluted events that are dominated by sulfate. Given the low levels of nitrate, and the likely higher ammonia emissions, nitrate formation is likely limited by nitric acid formation from NO_2. Simulations by UCR tend to suggest a mixture of sensitivities (Tonneson, 2003).

The days with the most severe visibility impairment appear to be impacted most heavily by organic matter or sulfate, though some events have very high levels of coarse mass as well. Nitrate tends to be a relatively small contributor, which is to be expected when sulfate is high. Because the measurements can not distinguish as to the source of primary PM, it is not immediately apparent as to the source of the coarse mass, but given the episodic nature, it is likely that the primary PM is natural in origin.

Southwest

This region includes the far eastern part of southern California, Arizona, New Mexico, southern Colorado and Nevada. IMPROVE regions corresponding to this region are the Great Basin of Nevada, the Colorado Plateau and Sonoran Desert. The Southwest has features similar to the Dry Mountainous subregion, being dry and having low FPM levels. It differs in that temperatures tend to be higher, and there is a greater abundance of major point sources of NOx and FPM. Biogenic sources in much of the southwest are very small, but appear to be a major component of the OC nonetheless (Brown et al., 2000). Ammonia emissions are less dense, though crustal material can be higher from wind blow dust as this area finds higher soil concentrations than the others (Malm et al., 2003).. While more detailed modeling is needed, it would appear that the higher levels of sulfate measured, and the apparently lower levels of ammonia emissions, would make this area ammonia limited much of the time.

The days with the most severe visibility impairment appear to be impacted most heavily by sulfate, OC and nitrate, though some of the events with the lowest visibility have very high levels of coarse mass, likely associated with dust storms. There are periods with very high levels of OC, indicative of major biomass burning events (forest fires).

California Valleys

This subregion is the most distinct of the four, and includes California's Los Angeles Basin and the Central Valley, and the areas most directly impacted by transport from these regions (e.g., downwind of Los Angeles and the mountains directly along the valley, including part of the Sierra Nevada). This region is relatively dry and warm. There are periods of significant stagnation. Most importantly, this region has greater emission densities of the pollutants impacting nitrate PM, in particular both NOx and ammonia. These characteristics lead to substantially higher FPM levels, especially for nitrate. Nationally, this region has the highest nitrate levels.

Of all the regions, most is known about the dynamics of PM here due to a history of studies being sponsored by the state of California, industries and others. In Los Angeles, the high nitrate levels are due to the large emissions of NOx, e.g., from mobile sources, confined animal operations leading to high ammonia emissions, low ventilation rates concentrating both sets of emissions, and plentiful sun, oxidizing the NO2. In parts of the basin, e.g., before the air masses pass over the confined animal operations, nitrate formation is ammonia limited. Further downwind, the formation becomes nitrate-limited as there are plentiful ammonia emissions and the nitric acid continues to deposit out. The highest nitrate levels are found in the fall when the sunlight still leads to rapid oxidation of NO2, winds are light, there is little rain, and the temperatures are lower favoring the formation of ammonium nitrate. On hot summer days, the ammonium nitrate thermally decomposes, though large amounts of nitrate can be present during the cooler hours.

The Central valley shares some of the characteristics of the LA basin, but has some unique features. First, the sources of NOx differ, having a larger non-mobile component, and being less dense. There are widespread agricultural and animal operations leading to ammonia emissions throughout the valley. There can be long stagnation events with fog and very little ventilation. During these stagnation events, nitrate levels can build.

An interesting study of the NOx-nitrate relationship was recently completed for the San Joaquin Valley using a box model (Stockwell et al., 2000). They found that for each gram of NOx emission, approximately 0.6 grams of nitrate is formed. This is a high ammonia region, so while those results are in general agreement with field measurements in the region, the extrapolation of those results elsewhere is limited.

For both areas, the days with the greatest visibility impairment are high in nitrate, OC and sulfate, with episodes of coarse material.

<u>In and Near</u>

A few Class I areas lie very near a major source region (e.g., a city) or specific source (e.g., a major highway, mining operation or power plant). In this case, the PM levels can be higher than experienced by the rest of the region, and have a different composition. Examples that are near source regions include San Gorgonio (downwind of Los Angeles) and Casa Grande and Tonto National Monuments near Phoenix. In this case, the PM takes on a characteristic that is a blend between these in the urban area and the regional background. For example, this can lead to elevated nitrate, as particularly found in San Gorgonio, and organic and elemental carbon. For areas near major sources, the PM can be enriched in the compounds being directly emitted by the source. Secondary pollutants, particularly sulfate, take longer to form, so there is less of a direct impact, but some enrichment is likely (e.g. Grand Canyon Visibility Transport Commission, 1996; Pitchford et al., 1999). Pollutant dispersion reduces the apparent source impact relatively rapidly, so after a few 10s of km, the impact from that source is reduced by an order of magnitude or so. This is particularly true for CPM which also deposits rapidly. Also, human activities within a protected area (e.g., driving, fires, etc.) can contribute to locally higher PM levels. However, these sources are outside of the subject of this study, do not appear to be a significant contributor to visibility degradation regionally, and are not dealt with further here.

Particulate Matter Modeling

Currently, the most scientifically well-founded approach to assessing how future emissions changes will impact air quality is to use a physically and chemically comprehensive air quality model that describes the evolution of pollutants in the atmosphere. Such models (actually, multiple models are used) are complex, and are run on fast computers. The WRAP is now using such an approach. In particular, the WRAP is using the Models-3 suite of models, including SMOKE for emissions, MM5 for meteorology and CMAQ for air quality, including particulate matter. MM5 is one of the most widely used meteorological models, and CMAQ is an increasingly popular air quality model.

MM5 solves the equations governing the motions of the atmosphere. These equations are very complex and non-linear, and sensitive to boundary and initial conditions. The model uses a variety of parameterizations to simulate various processes. For some processes, MM5 has more than one choice of parameterization since no one approach appears to be universally best. This, in part, shows the complexity of meteorological models, and that modeling errors can be expected. Errors can grow with time, degrading performance in longer simulations if nothing is done to constrain the growth. For this reason, data assimilation is used where observations are used to adjust the results as the fields evolve. As such, the model results are sensitive to model inputs (including initial and boundary conditions), model parameterizations and errors in the data used in the assimilation. While MM5 often achieves very good performance, there are events where good performance is elusive.

CMAQ is a comprehensive chemical transport model, developed primarily by the US EPA and funding from that agency. It represents the state-of-the-science in most aspects, and has been developed for use by the modeling community. Its use by the community is, in part, to help it evolve and continuously improve. CMAQ contains processes describing gas phase chemistry, aerosol dynamics, dry and wet deposition, pollutant transport and more. A common configuration of CMAQ uses CB-IV, a rather older, simplified chemical mechanism, though versions exist with RADM-II and SAPRC-99, two of the newer, most comprehensive and well tested mechanisms.

All three models have been used in a variety of efforts in the past. MM5 and CMAQ, the two predictive models, have been able to show good performance, at least for some species, though performance can vary from site to site and study to study. Since CMAQ uses the results from MM5, poor performance by MM5 can lead to similarly poor performance from CMAQ. However, even with ostensibly good performance from MM5, CMAQ may not perform well due to poor emissions inputs and/or problems with CMAQ itself, e.g., how it treats various processes. Further, here, CMAQ is being applied using a 36 km grid resolution. Such large grids are not appropriate for assessing the impact of a point source of CPM on nearby areas because of the rapid deposition of the larger particles, and the artificially large dilution of the emissions over the 36x36 km grid.

Model Performance Issues

Confidence in using such a model is derived from successful evaluation of the results. What constitutes good model performance varies by pollutants, and for FPM there is no standard criteria. Recent modeling efforts have found errors for sulfate to be within about 50%, OC within a similar range, and nitrate within about 100% (Seignuer, 2003).
However, current model performance found for the WRAP effort suggests poor model performance for some species, particularly nitrate (up to a factor of 10 high in the winter, but some days with essentially no nitrate formation simulated in regions where nitrate is monitored to be present). It is difficult to assess the model performance for primary FPM from stationary sources since the measurements and the model results are not able to support such an evaluation. How does poor model performance affect the use of the results, in particular for quantifying the likely impact of emissions changes?

First, it is important to understand the likely reasons for the poor nitrate performance. It is unlikely that the NOx emissions estimates are very far off, so other problems likely exist. Ammonia emissions are much more uncertain, and can be part of the problem. Also suspect is the deposition rate used for nitric acid (too low) and the nighttime, heterogeneous oxidation of

NOx to nitric acid (too high), both leading to higher levels of nitrate. The reasons for having too little nitrate during the summer (e.g., no nitrate is sometimes predicted when some is observed) may be because the nitrate present is particulate nitrate formed from nitric acid attacking pre-existing particles to form a thermally stable form of particulate nitrate (e.g., soil material and salt), slight overestimates in the amount of sulfate formed or underestimates in the ammonia emissions. Monitoring has found that a significant amount of the nitrate in Class I areas outside of southern California is larger FPM or coarse, suggesting that it is formed from nitric acid attacking pre-existing aerosol forming a thermally stable form of nitrate. If this is the reason for the discrepancy, and that ammonium nitrate is not present, then the modeled sensitivity to emissions reductions will be very different than would occur. In particular, an area that might appear to be ammonia limited from the modeling, may be nitrate-limited, and most sensitive to NOx emissions.

A large error indicates that either the sensitivity to emissions changes is in error, or there is a large error in the emissions. If the latter were true, the model results could be used to scale observed levels to get a reasonably good approximation of how the ambient levels would respond. The decision was made, in advance, in SAMI to use scaling, even for the species where very good performance was found. Note, if performance is perfect, the same results are found if one uses scaling or the model results directly. Thus, the approach is asymptotically correct.

If model performance is poor, scaling the observations with model results becomes more questionable. Given the very large errors found for nitrate, the low correlation between observed and simulated levels, and that NOx emissions are relatively well known (probably well within a factor of two), the modeled sensitivity of nitrate levels to NOx emissions could be well off. Indeed, the very low observed nitrate, versus that simulated, suggest that much of the time the model is in a different regime than the actual atmosphere (e.g., the case where the two species, ammonia and nitric acid, are in sufficient supply to form aerosol nitrate vs. the case where one or both are at concentrations low enough to negate ammonium nitrate formation, and what little nitrate found is due to reactions of nitric acid with a crustal material or sea salt). Performance is worst during the winter, but during the summer there are days where no nitrate is predicted, though some is observed. In this case, NOx controls will not lead to any change in predicted nitrate, so scaling will not show any benefit. Given the performance problems, it is difficult to suggest if the sensitivity of either the annual nitrate levels, or the nitrate levels on the days with the most limited visibility, is adequately represented by the model.

One issue concerning the use of scaling is that it does not account for spatial inhomogeneities in the controls. For example, control at a specific source, even though it is a very small fraction of the total inventory, will have an enhanced local impact, though little impact further away. This issue can be dealt with by using the model to develop source-receptor relationships, and use those results to help guide the scaling.

For primary fine and coarse PM, the response of ambient PM is likely to be quite linear (though not totally due to particle growth), so scaling should work relatively well, as long as the issue of spatial inhomogeneities in the emissions controls is adequately addressed. This can be relatively easily tested using a single model simulation.

At present, the simulations have not been conducted to provide a complete source apportionment of the PM. By this, one means exercising the model to show how each source (or group of sources) impacts PM at specific receptors (e.g., the Class I areas). Such a calculation can be very helpful in suggesting controls. Further, it is important to understand the magnitude of the problem with which we are dealing, and how to interpret model results and observations. In particular, this is important for primary PM. At most Class I areas, FPM is dominated by secondary species (nitrate, ammonium, sulfate and a fraction of the OC), and primary EC and OC. Other compounds are a relatively small contributor to both FPM mass and visibility. One question, for which the model can be used to help understand, is if a significant fraction of the PM is from stationary sources. If not, i.e., that stationary sources are a small fraction of the primary PM at Class I areas, and that primary PM is a small fraction of the total PM, reductions in primary PM emissions will have a rather small impact.

Effectiveness of PM and NOx Controls on PM levels and Visibility in the West

As discussed above, nitrate is a major contributor to PM levels and visibility extinction in a few areas of the West, notably in California, and to a lesser amount the Columbia Gorge. In the southern half of California, nitrate can be the major constituent. In most other areas, nitrate is found at relatively small concentrations, around 5-20% of the total FPM. Likewise, point source primary emissions of PM, both coarse and fine, are a small contributor, regionally, as well. Thus, controls on point source emissions of NOx and PM will have a relatively limited effect on both PM and visibility in much of the West, <u>all else being equal</u>. The latter clause is important because, as SO2 emissions are reduced, and ammonia emissions increase (as is forecast in many areas), aerosol nitrate may become a more significant contributor, as was found in SAMI.

In and around the California valleys, nitrate formation appears to be nitrate limited. As noted above, Stockwell et al., (2000) found that one gets, roughly, about 0.6 grams of nitrate (as ammonium nitrate) per gram of NOx emissions. This would suggest that, in these areas, NO_x controls will reduce nitrate levels. The exact level of benefit will have to come from either analysis of the measurements or modeling after performance improves. The California inventory suggests that about 478 tons per day (tpd), or about 14% of the 3441 tpd statewide, of NOx come from stationary sources. Assuming that stationary sources have a similar impact on nitrate formation (SAMI results suggest this is not totally true, Odman et al., (2002)), this puts an upper bound on the likely benefits of around 15%, and the results of the SAMI study suggest that the actual impact on nitrate mass is more around 7%. This translates in to approximately 2% of the total FPM in areas around Los Angeles where nitrate makes up about 30% of the total FPM and 1% in areas of California, such as the Sierras east of the Central Valley where nitrate is about 15% of the total FPM. In other areas, the stationary source contribution, on average, would be smaller, on average. Three considerations would increase the importance somewhat: on days with the worst visibility in these areas, nitrate makes up a larger fraction of the total (in some cases, over 50%) on days with the highest levels of nitrate, a greater fractional response to NOx reductions is suggested and if the receptor is directly downwind of a major point source, the impact would be increased. The first two considerations might lead to an increased impact of up to 5%. The latter consideration would be very site and meteorology dependent.

Elsewhere in the West, nitrate levels are relatively small: usually less than a ug/m^3, and from 5-10% of the total PM. The days with the worst visibility tend to be dominated by one of three cases: high CPM and crustal (indicative of dust storms), high organic and elemental carbon (which can indicate forest fires) or high sulfate, which tends to be elevated much of the time, and increases during stagnation. Thus, unless the increasing ammonia and decreasing sulfate lead to significant nitrate increases, stationary point sources will lead to only about 2% (or less) of the visibility extinction, except in areas significantly impacted by major sources. SAMI modeling suggested that there will be small additional benefits of NOx controls in reducing sulfate due to decreased sulfur dioxide oxidation. Thus, NOx controls will have a relatively small impact on PM and visibility in the West.

The impacts of primary PM controls on point sources are more difficult to assess at this time since the available data is less specific as to the fraction of PM from point sources. As noted above, CPM has such a short lifetime that reductions will have a small impact on PM levels and visibility, except very near the source. Primary stationary source FPM, while longer lived, still appears to be relatively minor, contributing less than 0.1 ug/m^3, so controls on FPM would also have a minor impact on PM levels and visibility. This is in line with the results from studies such as those conducted at Mt. Zirkel (Watson et al., 1996). Total removal would lead to a decrease in extinction of about 0.4 Mm-1, or less than about 0.5% of the total extinction on a day with relatively bad visibility of about 20 miles.

The above analysis suggests that primary PM and NOx controls will have limited impact on visibility in the West in the near term, except in areas of California and areas directly impacted by specific stationary sources being controlled. Near-field impacts of sources needs to be conducted on a site-by-site basis. However, as sulfate levels come down, the impact of NOx controls will increase, both because nitrate levels will increase and due to the non-linear relationship between visibility and extinction. Locations whose visibility is currently dominated by sulfate may find that nitrate becomes the species of concern. Looking towards the future, it is prudent to identify the types of controls and mechanisms to increase their cost effectiveness.

Emissions Trading

Emissions trading is viewed as an economically efficient approach to air quality management, as has been experienced through the acid rain program. However, when trading pollutant emissions, the economic efficiencies tend to decrease as limits are placed on trading, e.g., spatially, temporally, across sectors, and across pollutants. There are issues associated with each. Allowing spatially diverse trades can shift emissions reductions and the resulting air quality improvements.

Temporal trading can lead to decreased (or enhanced) benefits. For example, sulfate tends to be higher in the summer due to more rapid oxidation. If the trading results in greater reductions during the winter, average sulfate levels may decrease less than if the reductions were more uniform. On the other hand, if the SO2 reductions are greater in the summer, the benefits could be enhanced. This may be more critical for nitrate which, as discussed above, is very sensitive to temperature, and is thus found predominantly in the winter. Primary emissions would not be affected as much.

Trading across source sectors may be impacted by (1) the spatial and temporal trading concerns identified above, (2) that sources can emit at different elevations above the ground, and (3) that different sectors do not have the same PM characteristics. Emissions from a tall stack are in to a very different environment than a more dispersed ground level source. First, elevated emissions, e.g., from utilities, tend to be very concentrated in NOx, and the plumes can stay very NOx rich for significant distances. Ground level sources tend to be more disperse and in to environments with higher levels of VOCs. In recent field experiments, this has been found to have an impact on ozone formation efficiencies (e.g., Ryerson et al., 2001). Recent modeling has also found this to be the case for ozone and acid deposition, and nitrate FPM (Odman et al., 2002), though the differences were not as large as that measured for ozone. For primary FPM, this is likely a small impact, though ground level FPM emitted in populated areas would likely lead to a greater exposure than if emitted higher up. It is likely that the spatial and temporal issues are of greater concern. A final concern is that trading primary PM emissions between sectors can lead to a different type (e.g., predominant size) of PM being emitted. For example, utility emissions are likely going to be more fine than, say, cement production or mining emissions (as well as being emitted at different levels). CPM deposits faster, and impacts visibility less. Thus, removing a ton of CPM would not have the same benefit as removing a ton of FPM, all else equal. In this way, trading primary PM emissions between sectors is much like trading pollutant types, with the issues discussed below.

Scientifically, the most challenging type of trade is across pollutant types, e.g., SO2 for NOx, primary PM for NOx, etc. This is because it is difficult to quantify how much of one pollutant can be traded for another and have equal air quality benefits. The possibility of displacement reactions further clouds how such trades can be weighted. For example, reducing SO2 will lead to sulfate aerosol reductions. However, this can free up ammonium to react with nitric acid, leading to increased nitrate. While this was found to be the case in SAMI modeling, the "rebound effect" was not large. Finally, the different species will have different impacts, e.g., in terms of visibility reduction. For example, each fraction of the PM has a different impact on visibility per mass. Nitrate and sulfate have a greater impact, on a per mass basis, than soil or CPM. Further, sulfate and nitrate both have a greater impact on visibility at higher humidities, other constituents do not, generally leading those two constituents to have a bigger impact on visibility on a per mass basis than (say) organics. Conversely, elemental carbon is very effective at absorbing light. If one can correctly account for the relationships between emissions and the resulting concentrations, it is straightforward to account for the visibility impairment differences, though the relationships can change with time. For example, as SO2 emissions are reduced in the future, and ammonia emissions increase, the area could become more sensitive to NOx emissions. Thus, one ton of NOx reduction may become more valuable in relationship to one ton of primary FPM.

A final issue is that reducing NOx emissions will impact both secondary sulfate and OC formation. This is because NOx is central to the formation of ozone and increasing the oxidizing capacity of the atmosphere. Modeling as part of SAMI suggested that this secondary effect is small, but non-zero, impacting mainly the formation of sulfate. Typically, reducing NOx also reduced sulfate formation slightly, but in some locations NOx reductions led to small sulfate increases due to increasing H2O2 formation and the heterogeneous oxidation of SO2, as well as increasing OH levels. In general, these secondary impacts will slightly enhance the effects of NOx emissions reductions, but can be ignored for now due to the larger uncertainties in quantifying the NOx-aerosol nitrate system response.

Given the complexities, the question arises is, if emissions trading is to be done, how should trading equity be established. If the trades are somewhat restricted to the point that there are no obvious resulting inequities (e.g., limited spatially and not across pollutants, and that there is little likelihood that there would be little temporal or elevation differences), policy makers could likely proceed without the use of some more extensive approach. However, this would severely restrict the market and the associated economic benefits. Dealing with the issues identified is ideally tackled using a comprehensive air quality modeling effort, such as is being done by the WRAP. In this case, the model could be exercised to identify the appropriate trading ratios and the inequities resulting from various trades.

A major problem at this time, as discussed above, is that confidence in a model's use can only be developed through successful evaluation and good model performance for the species of interest. In the case of the WRAP modeling, nitrate performance was poor, and it would be difficult to use such results to assess how to make trades equitable, e.g., to develop trading ratios across pollutants. While less of an issue, using the model to assess trading SO2 for FPM is also difficult because of the rebound effect. When model performance is such that the WRAP is comfortable that the model is adequately capturing the physics and chemistry affecting pollutant evolution of the compounds of interest, then the model, presumably, can be used to determine how to make trades equitable. Note, this does not mean that performance for all species has to be good. Having poor performance for crustal species would not significantly impact the use of the model for comparing SO2 and NOx trades.

Given the successes achieved from emissions trading, it is important to identify model performance problems such that trading guidelines can be established in a sound fashion. None of the issues identified above are "show stoppers". However, given the level of uncertainty in the modeling results at present, inter-pollutant trading would have the potential to jeopardize visibility improvements in the region.

Suggested Model Simulations

At present, a few sensitivity simulations have been conducted using CMAQ. While conducted, in part, to understand model performance, they are providing insight into PM dynamics in the West. In particular, the cases where NH_3 emissions are being changed to find areas that are most sensitive to NH_3 emissions. Such sensitivity calculations are key to addressing trading issues and identifying effective control strategies.

After model performance is judged to be adequate, a number of calculations are suggested. A first set of calculations is to conduct a comprehensive source apportionment by source type (e.g., point, area and mobile), pollutant (SO2, NO_x, NH_3, CPM and FPM), and location (e.g., state or region). The resulting matrix (a total of about 45 sensitivities) can be used to guide trading, assessing the impact of transport, identifying important source regions to pristine areas, and guiding control simulations. While 45 simulations may appear prohibitive, various tools exist to facilitate the process. For example, SAMI used DDM-3D. The results of these sensitivities should be stratified into days with very good and poor visibility, and the annual average. The aggregation of days will tend to suggest a more local impact of sources than looking at a typical day.

A second set of simulations would be to explore specific control issues, e.g., the imposition of certain sets of controls. A particular interest would be to explore future PM levels as the NO_x and SO2 emissions are decreased, but NH_3 emissions increase. The interest would be to assess if there is the possibility of increased nitrate formation due to the higher NH_3 and lower sulfate in spite of lower NOx emissions, as was found in the SAMI study. In some areas, this may lead to nitrate replacing sulfate as the major contributor to visibility reduction, greatly increasing the impact of NO_x controls on visibility.

A third calculation would look at how SCR or SNCR controls would impact visibility in a point source plume. The ammonia in such a plume might lead to locally increased ammonium nitrate formation. While, regionally, ammonia emissions from such control technologies are small compared to animal waste decomposition and fertilizer, on a very local scale there may be increased PM formation. Such a calculation may require a finer grid being employed in locations to capture the finer scale impacts of the plume where, presumably, both NO_x and NH_3 would be elevated.

Summary

The states that are part of the WRAP have a very diverse chemical/PM “climatology”, represented by extremes ranging from the dry, high nitrate areas in Southern California to the wet, low PM northern coastal mountains, to the dry mountains and deserts inland. Typically, the major constituents of the visibility-impairing PM are fine PM sulfate, OC and, at times, nitrate, though there are episodes of high coarse material.

Doing a simple, approximate, mass-lifetime balance on coarse PM emissions from primary sources suggests that, on average, primary CPM emissions from point sources will contribute a very small fraction of the total PM. This is borne out in the observations. Near the source (within a few 10s of km), however, the sources may be significant. FPM is much longer lived than CPM, and is predominantly secondary, being composed primarily of sulfate, OC and nitrate.

Primary FPM from point sources is estimated to be a small contributor to FPM mass and light extinction on a regional basis. First, the total amount is small relative to other components of the FPM. Second, it has a lower impact, on a per mass basis, than other constituents. Third, periods of highest extinction do not appear to have significant amounts of point source-derived, primary FPM as compared to the other components, particularly CPM during dust storms, organic and elemental carbon during fires, sulfate during stagnation events, and nitrate in areas of high ammonia.

Nitrate is formed from emissions of NO_x that react to form nitric acid, which then can undergo gas-to-particle conversion. Much, but not all, of the nitrate is fine, and higher observed concentrations are formed from the reaction between nitric acid and ammonia to form ammonium nitrate. A fraction of the nitrate will be formed from nitric acid attacking pre-existing PM (coarse or fine). Ammonium nitrate levels can be reduced by either reducing nitric acid formation or ammonia emissions, with the greatest sensitivity to reducing the precursor that is least abundant (on a mole basis). Thus, some parts of the region will be ammonia-limited, others will be nitrate-limited (e.g., areas with high ammonia, such as near confined feeding and intense agricultural operations). The fraction that is formed from nitrate attacking pre-existing PM will not be very ammonia sensitive, responding more to NO_x controls. Modeling currently suggests that much of the domain is ammonia-limited (in terms of nitrate formation). However, CMAQ does not include the capability to simulate the nitric acid attacking pre-existing PM, so this may be an artifact. What this suggests is that it is important to get model performance to the point where one is confident that the nitrate formation mechanisms are quantitatively reliable.

In areas where nitrate formation is nitric acid-limited, NO_x controls will generally reduce PM (with a few local exceptions). However, one ton of emissions reductions will not lead to one less ton of PM being formed. NO, NO_2 and nitric acid all deposit out (dry or wet). Indeed, nitric acid deposits very rapidly, and simulations suggest that most of the mass will be removed this way. The WRAP model can develop the response of nitrate PM to NOx emissions.

Trading emissions of primary FPM from one source to another would be relatively straightforward compared to other types of trades. The relative height of emission will have little impact on far downwind receptors. As with trading any type of emissions, trades across sources in very different locations may lead to one area receiving greater air quality benefits than another. Trading emissions of point source CPM would be especially sensitive to location in that the major impact is very near the source, dropping dramatically within 10 km.

NOx emissions trading to reduce PM formation would be more complex. First, as noted above, some (if not most) regions are likely ammonia-limited, so NOx controls will have relatively smaller impacts on nitrate than might be expected. Second, the oxidation of NOx to nitric acid will depend on emission height and the intensity of emissions (e.g., the concentration of NOx in a plume). Third, reducing NOx will slightly impact the formation of sulfate and OC. Further complicating the issue is that an equitable trade (in terms of visibility) today may not be equitable in the future. Again, trading across large spatial areas may lead to issues in terms of which areas benefit most.

Trading between pollutants is more involved yet, and a major concern is that the relationship between NOx emissions and nitrate formation is not well quantified at present. As model performance improves, there is no reason that it would not be practical to use the model to set trading relationships between pollutants. In so doing, one must account for the differing impact on visibility on a mass basis and the response to humidity.

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SECTION V:
SUMMARY OF AIR QUALITY MODELING RESULTS

Context

The modeling performed for this report is best described as a "sensitivity analysis." The intent is to get a preliminary assessment of the general atmospheric response to changes in NOx and PM emissions from stationary sources. A secondary objective is to "practice" this type of modeling to get a better understanding of the key technical issues and to identify the most effective ways at evaluating and displaying model results. The results presented here are the best available predictions at this time, but forthcoming improvements to the modeling system may affect the results in ways that alter the policy implications. For this reason, results are discussed in a fairly broad and qualitative manner – i.e., spatial patterns and relative changes. As the modeling system improves and specific strategies are contemplated, additional emission scenarios will be designed and modeled.

Modeling System

The WRAP's regional-scale air quality modeling system used to support other aspects of the Section 309 plans was also used to provide information for this report. A description of the modeling system – in addition to model performance statistics, input files, and detailed model results – is available at http://pah.cert.ucr.edu/rmc.

Emission Scenarios

Three emission scenarios were simulated:

- A 50 percent decrease in NOx emissions from plants with NOx emissions > 100 tpy,
- A 50 percent decrease in PM_{10} emissions from plants with PM_{10} emission > 100 tpy, and
- A 25 percent increase in NOx and PM_{10} emissions from all stationary sources.

The first two scenarios are meant to address the regional haze rule's requirement to "assesses emissions control strategies for stationary source NOx and PM, and the degree of visibility improvement that would result from such strategies." As discussed in Section VI of this report, many commercially-available technologies (and various combinations of such technologies) are capable of achieving a 50% or greater NOx emission reduction without having to switch fuels. Hence, the 50% reduction, although intended primarily to gauge the general atmospheric response to NOx reductions, is not an unreasonable level of control to assume for this exercise in terms of technical feasibility. Again with technical (and administrative) feasibility in mind, emission reductions were limited to plants with emissions greater than 100 tpy, similar to the approach in the Annex. The third scenario is meant to address the rule's requirement to "evaluate and discuss the need to establish emission milestones for NOx and PM to avoid any net increase in these pollutants from stationary sources within the transport region." Hence, a 25 percent increase from all stationary sources was assumed to simulate potential growth in the economy and/or disproportionate growth in high-emitting sectors such as energy development, fossil-fueled electricity generation, and mineral processing.

For reasons implied in the rule, the emission changes in the scenarios described above were limited to the nine-state GCVTR[12]. Also, the emission changes were applied to the 2018 inventory, which includes reductions expected from full implementation of the Annex. This provides a basis for comparing results to other strategies being modeled by the WRAP.

Model Performance and Future Improvements

Nitrate concentrations are poorly predicted by the current modeling system, especially in the winter. For this reason, results for nitrate (and all other species) for the NOx and PM sensitivity runs are only presented for the three month period of July – September.

Several aspects of the modeling system are being improved and evaluated, which should improve confidence in future model predictions, both in the summer and winter. These improvements and evaluations involve the chemical mechanisms, the ammonia inventory, a more robust meteorological database (2002 vs 1996), enhanced grid resolution (12 km vs 36 km), plume-in-grid capabilities, the introduction of an inventory for wind-blown dust emissions, and better temporal allocation and chemical speciation of point and area source emissions. A source apportionment mechanism is also expected to be included with the model.

Model Results

As stated above, results are presented in a fairly broad and qualitative manner – i.e., spatial patterns and relative changes. Relative (percent) changes are of particular interest because their errors are believed to be smaller than those of the absolute concentrations. It is not clear how the seasonal limitation of this analysis (July – September) may affect the relative changes, but it is likely to reduce them to some extent. First, nitrate concentrations tend to be lower in the summer than in the winter, especially in areas where nitrate concentrations are highest and the potential for change the greatest. Second, results are averaged over a full three-month period. Typically, visibility effects are measured by averaging conditions over the worst 20 percent of the days observed per year at an ambient monitoring site, which is approximately 22 days. But in this analysis, because it is limited to the July-September timeframe, the results are averaged over 92 consecutive days and do not represent a measure of the worst conditions, again when the potential for change is the greatest. Thus, while there are many uncertainties surrounding the model's nitrate predictions, the limitation of this study to July – September will tend to limit the apparent impacts from the NOx (and to some extent) PM_{10} emission changes.

On a ton-per-ton basis, reductions in stationary source PM_{10} emissions appear to yield greater regional haze benefits than reductions in NOx emissions. For instance, when stationary source PM_{10} emissions are reduced by 98,000 tpy (a 50 percent reduction from GCVTR facilities > 100 tpy), the average summer-time visibility improvement across all Class I areas in the GCVTR (in Mm^{-1}) is about 0.4 percent. When stationary source NOx emissions are reduced by

[12] In 1996, stationary sources in the GCVTR emitted about 75 percent and 83 percent of the NOx and PM_{10} emissions, respectively, in the13-state WRAP region.

412,000 tpy (a 50 percent reduction from GCVTR facilities > 100 tpy), the visibility improvement is only somewhat greater, at 0.5 percent.[13] Hence, on a purely technical basis (without considering existing controls, costs, or other implementation issues), reductions in PM emissions might be more effective at improving regional haze than reductions in NOx emissions.

Nevertheless, the 50 percent NOx reduction scenario tends to produce slightly greater regional haze benefits than the 50 percent PM_{10} reduction scenario. This is because stationary sources comprise 33 percent of the total NOx inventory but only 7 percent of the total PM_{10} inventory. So even though much of the NOx is never converted to the particulate phase, the sheer volume of NOx emission reductions relative to PM_{10} reductions and the fact that nitrate (mostly in the fine mode) scatters light more efficiently than primary PM (mostly in the coarse mode) make the NOx reduction scenario more meaningful in terms of regional haze benefits than the PM_{10} reduction scenario. The fact that stationary source NOx emissions are not as well controlled as stationary source PM_{10} emissions in the West actually lends some relevance to the outcome that NOx emissions are altered more in the sensitivity analysis than PM_{10} emissions.

For the three-month summer period examined in this analysis, NOx changes have very little effect on aerosol concentrations beyond changes in nitrate. Other species that could be indirectly affected – e.g., ozone concentrations and subsequent oxidation of SO_2 and organic gases into the particulate phase – do not appear influenced by the levels of NOx reductions (16 percent of the total inventory) assumed in this analysis. This finding may change after implementing all the model improvements noted above, but since nitrate currently appears as the largest responder to NOx changes, and given the information above regarding the NOx and PM scenarios, the maps, tables, and discussion below place somewhat more emphasis on nitrate and the results of the 50 percent NOx reduction scenario than on other species and scenarios.

Figures V-1 and V-2 show the model-predicted 2018 base case (Annex included) surface-layer concentrations of ammonium nitrate (NH4NO3) and $PM_{10,}$ respectively, averaged over the three month period of July-September. The values in these maps should not be construed as the *expected* ammonium nitrate and PM_{10} concentrations in 2018, which are determined by scaling the ambient monitoring data by the relative changes predicted by the model. Rather, these maps are intended to provide a sense of the spatial variability and span of concentrations, which are useful for interpreting the following maps of relative (percent) changes – e.g., a high percentage change in a low-concentration area may be less meaningful than a moderate percentage change in a high concentration area.

Figures V-3 and V-4 show the absolute and percentage change, respectively, in NH4NO3 concentrations from a 50 percent reduction in stationary source NOx emissions from facilities in the GCVTR greater than 100 tpy. The largest absolute changes occur in southern CA, where concentrations in Class I areas are predicted to decrease by 0.15 to 0.25 ug/m^3. A second area of reductions is predicted in the central-east Rocky Mountains, especially in north-central CO. Although the reductions are not as large as in southern CA (0.04 to 0.11 ug/m^3), they are larger than average across the domain and exhibit the largest percentage reduction (10 to 20 percent).

[13] In some Class I areas, the visibility improvement can be two to five percent on some days.

It is interesting to compare these results with those simulating the effects of the SO_2 backstop emissions trading program, or Annex. In the case of the Annex, an SO_2 emission reduction of 15 percent (132,000 tons) in the GCVTR produced a sulfate reduction of 4 percent averaged across all Class I areas in the GCVTR on the 20% worst modeled days. In the case of the NOx sensitivity run, a NOx emission reduction of 15 percent (412,000 tons) in the GCVTR produced a nitrate reduction of 5 percent averaged across all Class I areas in the GCVTR on the July-September modeled days. The nitrate reduction does not produce as much visibility benefit at most Class I areas because its concentrations are much smaller, but the response of nitrate to NOx reductions is similar in proportion to the response of sulfate to SO_2 reductions.

Figures V-5 and V-6 show the absolute and percentage change, respectively, in NH4NO3 concentrations from a 25 percent increase in stationary source NOx and PM_{10} emissions from all stationary sources in the GCVTR. The spatial pattern of changes is very similar to that in the 50 percent NOx reduction scenario, although the magnitude of changes are about half. Again, it is interesting to see some proportionality in the modeling results – i.e., an emission change that is half as large produces aerosol changes that are about half as large. The percent increase in NH4NO3 concentrations and visibility impairment (in Mm^{-1}) in this scenario is 2 percent and 0.5 percent, respectively, when averaged over all Class I areas in the GCVTR for July-September.

Figures V-7 and V-8 show the absolute and percentage change, respectively, in PM_{10} concentrations from a 50 percent reduction in stationary source PM_{10} emissions from facilities in the GCVTR greater than 100 tpy. Maximum reductions in PM_{10} are about 0.1 to 0.5 ug/m^3, or about 4 to 8 percent. Compared to the NOx reduction scenario, reductions in ambient PM_{10} are more dispersed, with a greater number of local maximums. This may reflect the fact that there are a fewer number of large PM_{10} sources than large NOx sources and that much of the PM_{10} emissions are coarse particles, with shorter transport distances.

Figures V-9 and V-10 show the absolute and percentage change, respectively, in PM_{10} concentrations from a 25 percent increase in stationary source NOx and PM_{10} emissions from all stationary sources in the GCVTR. The spatial pattern of changes reflects where both relatively large NH4NO3 changes (southern CA and central-east Rockies) and PM_{10} changes (additional areas) are predicted. The largest PM_{10} increases are about 0.1 to 0.3 ug/m^3, or 2 to 3 percent. Less than half of this is NH4NO3.

Table V-1 shows the predicted change in light extinction and NH4NO3 at each Class I area in the GCVTR averaged over the July-September period as a result of reducing NOx emissions by 50 percent from stationary sources with emissions greater than 100 tpy in the GCVTR.[14] As shown in the maps, the greatest impacts occur in southern CA, followed by areas in CO. The average improvements in light extinction in these areas is about 0.3 to 1.5 Mm^{-1} (1 to 2.5 percent). The average improvement in NH4NO3 is about 0.05 to 0.25 ug/m^3 (3 to 20 percent).

[14] Tabular, site-specific data for other scenarios is available upon request. Tabulay presentation of results was limitted to this scenario since others tend to produce smaller changes in visibility.

Figure V-1. Base Case Ammonium Nitrate Concentrations (μg/m^3) – for purposes of illustrating spatial patterns, not magnitudes.

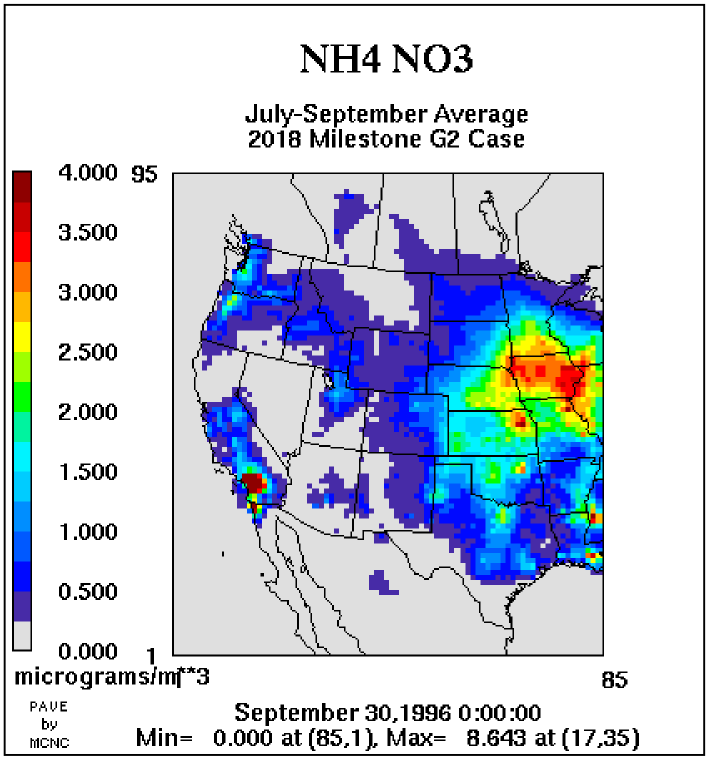

Figure V-2. Base Case PM$_{10}$ Concentrations (μg/m^3) – for purposes of illustrating spatial patterns, not magnitudes.

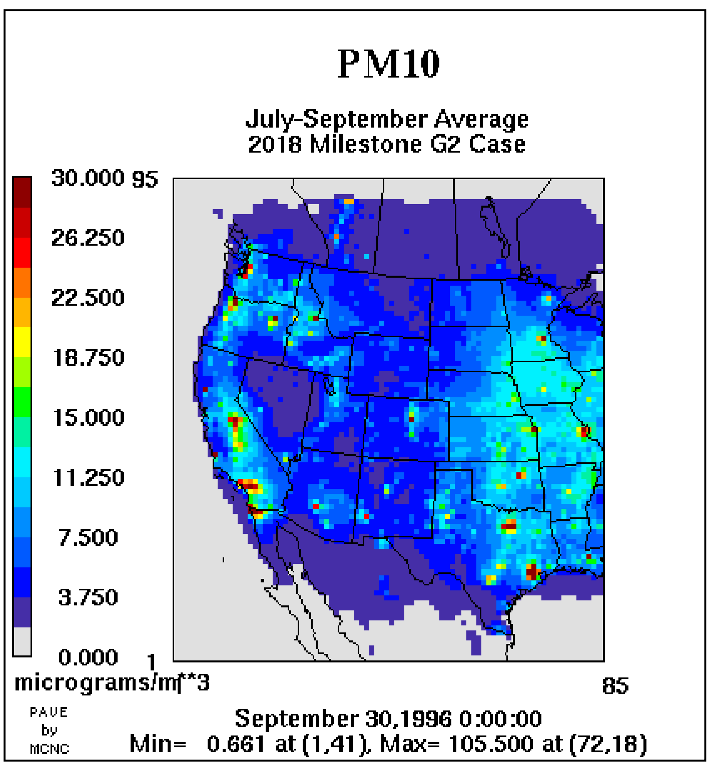

Figure V-3. Change in Ammonium Nitrate Concentrations Resulting from a 50% Reduction in Stationary Source NOx Emissions > 100 tpy.

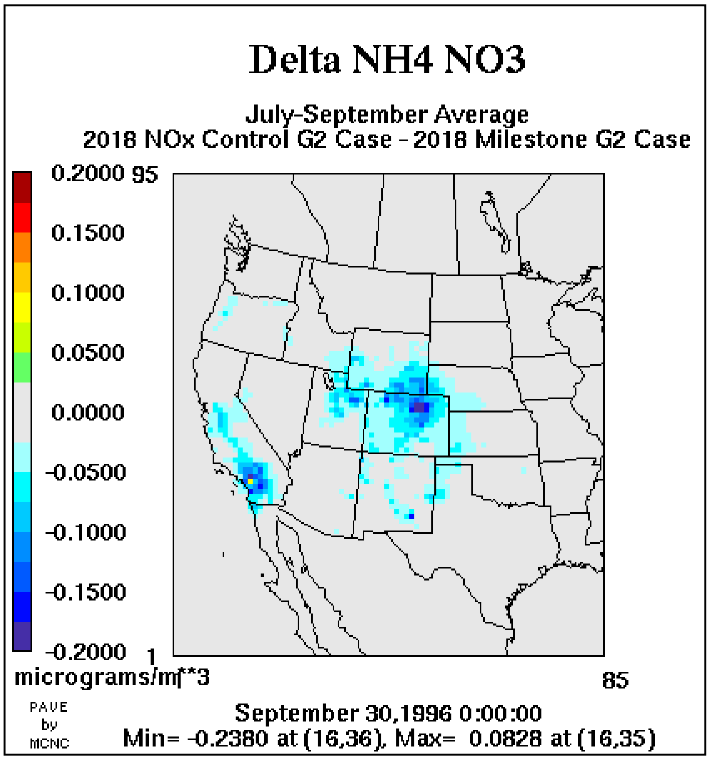

Figure V-4. Relative Change in Ammonium Nitrate Concentrations Resulting from a 50% Reduction in Stationary Source NOx Emissions > 100 tpy.

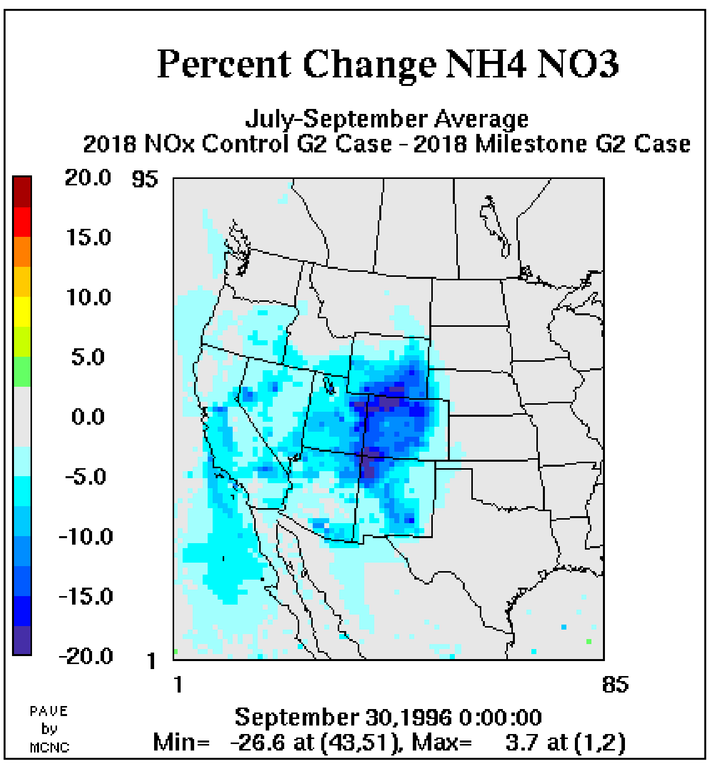

Figure V-5. Change in Ammonium Nitrate Concentrations Resulting from a 25% Increase in Stationary Source NOx and PM_{10} Emissions.

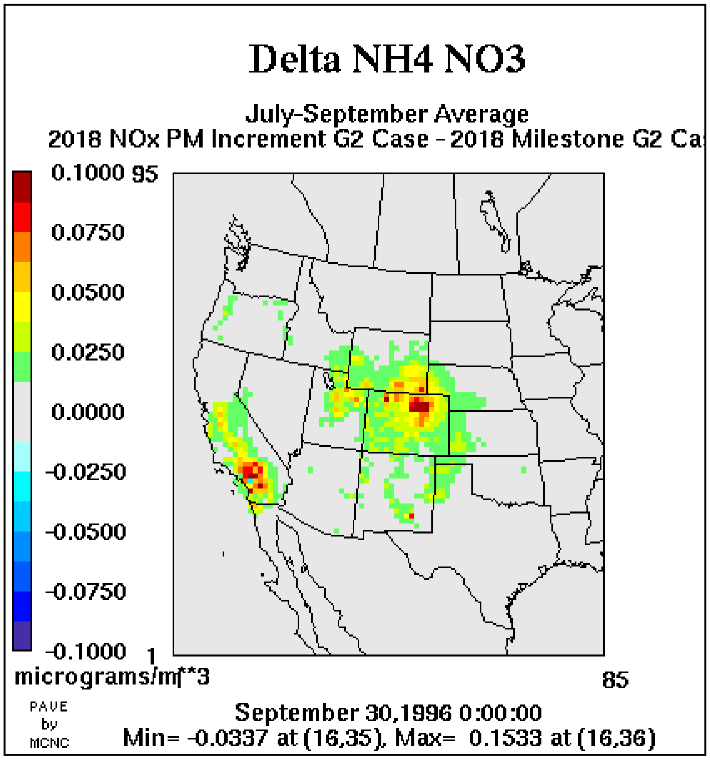

Figure V-6. Relative Change in Ammonium Nitrate Concentrations Resulting from a 25% Increase in Stationary Source NOx and PM_{10} Emissions.

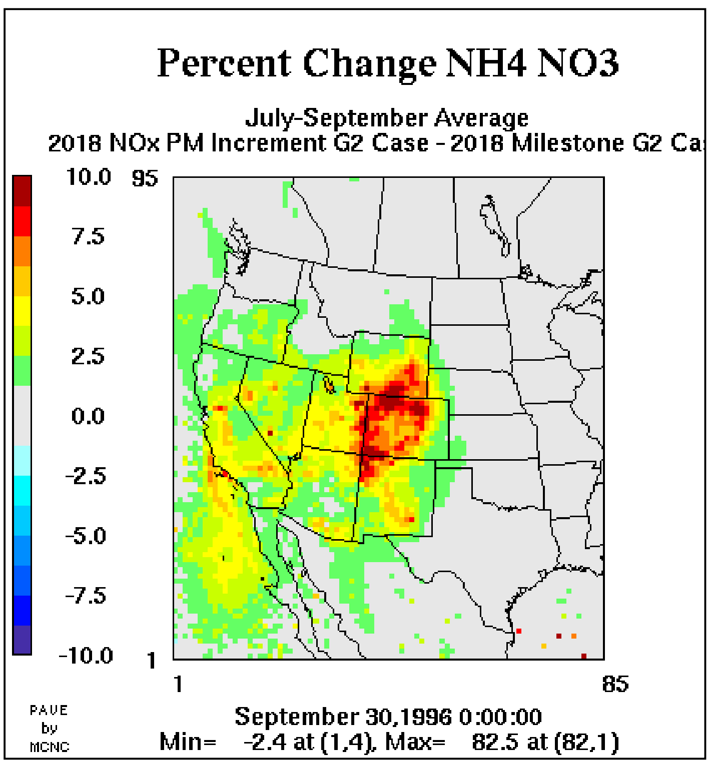

Figure V-7. Change in PM_{10} Concentrations Resulting from a 50% Reduction in Stationary Source PM_{10} Emissions > 100 tpy.

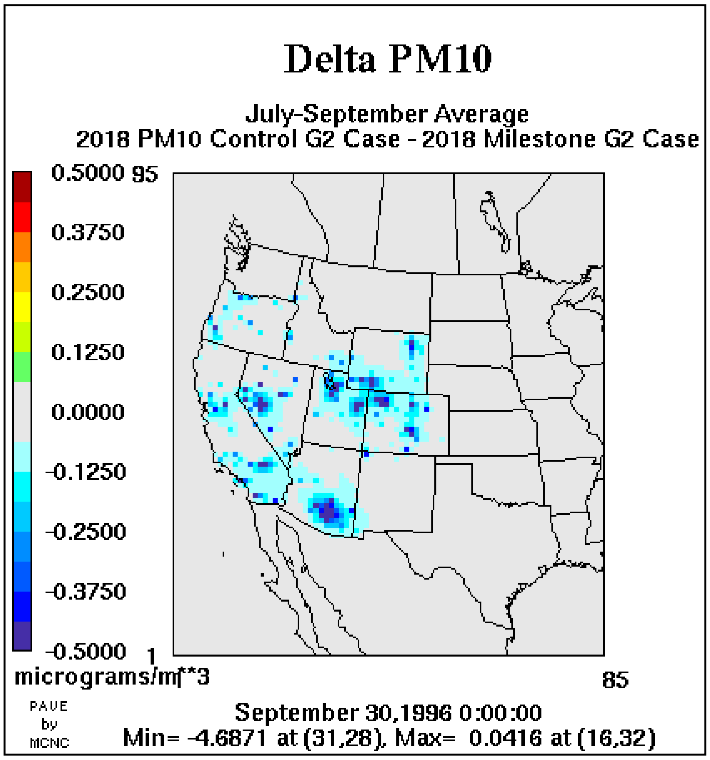

Figure V-8. Relative Change in PM_{10} Concentrations Resulting from a 50% Reduction in Stationary Source PM_{10} Emissions > 100 tpy.

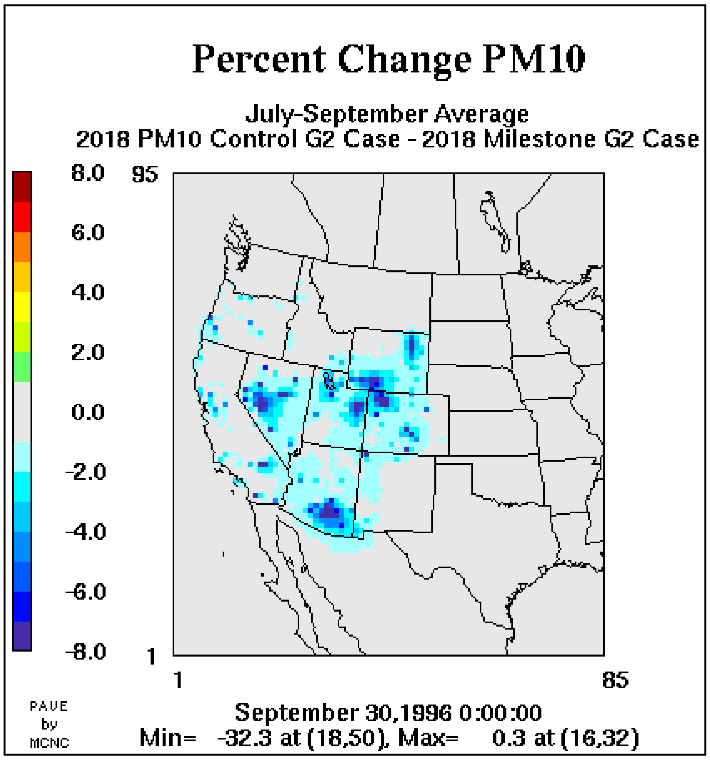

Figure V-9. Change in PM_{10} Concentrations Resulting from a 25% Increase in Stationary Source NOx and PM_{10} Emissions.

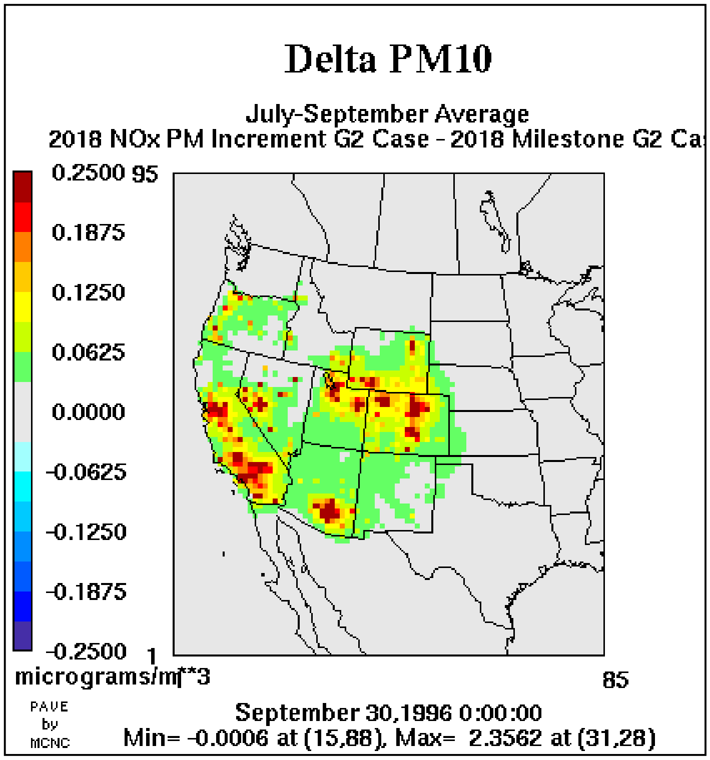

Figure V-10. Relative Change in PM_{10} Concentrations Resulting from a 25% Increase in Stationary Source NOx and PM_{10} Emissions.

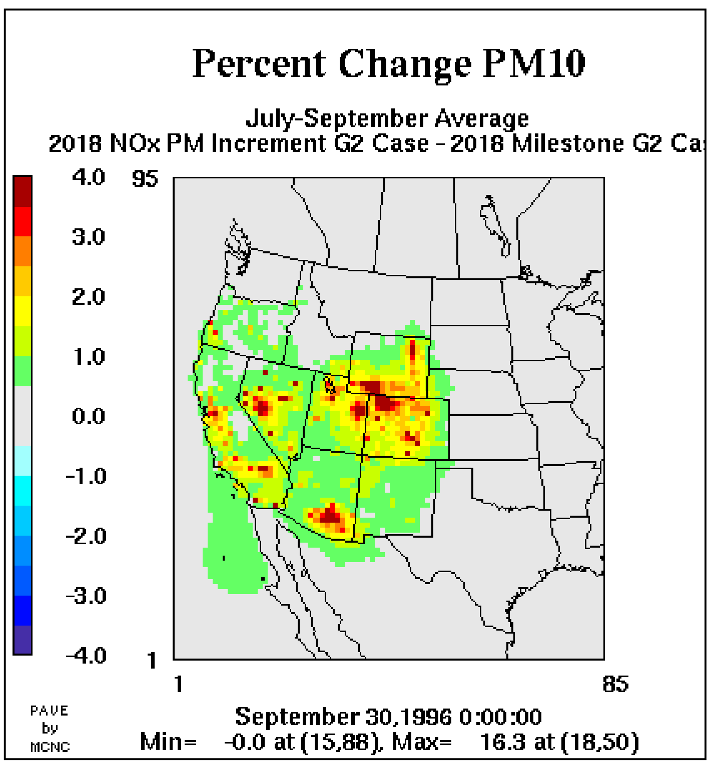

Table V-1. Light Extinction and Ammonium Nitrate Changes Resulting from a 50% Reduction in Stationary Source NOx Emissions > 100 tpy, Sorted by Average Light Extinction.

		Light Extinction		NH4NO3	
State	GCVTR Class I Area	Δ Mm^{-1}	Δ %	Δ $\mu g/m^3$	Δ %
CA	Cucamonga Wilderness	-1.59	-1.37	-0.25	-3.25
CA	San Jacinto Wilderness	-1.13	-1.18	-0.19	-2.97
CA	San Gabriel Wilderness	-0.83	-0.82	-0.13	-3.06
CA	Agua Tibia Wilderness	-0.81	-1.05	-0.12	-2.77
CA	San Gorgonio Wilderness	-0.80	-0.93	-0.16	-2.65
CO	Rawah Wilderness	-0.69	-2.41	-0.11	-16.84
CO	Mount Zirkel Wilderness	-0.61	-2.28	-0.09	-20.86
CO	Rocky Mountain NP	-0.57	-1.68	-0.09	-14.14
CA	Joshua Tree NP	-0.47	-0.77	-0.13	-3.69
CO	Eagles Nest Wilderness	-0.45	-1.41	-0.07	-11.97
CO	Great Sand Dunes NM	-0.43	-1.57	-0.06	-13.87
NM	White Mountain Wild.	-0.36	-1.11	-0.05	-10.51
CO	Flat Tops Wilderness	-0.34	-1.28	-0.05	-13.82
CO	La Garita Wilderness	-0.34	-1.27	-0.05	-12.15
CO	West Elk Wilderness	-0.33	-1.19	-0.05	-12.09
CO	Black Canyon of Gunnison	-0.31	-0.97	-0.04	-14.83
CO	Weminuche Wilderness	-0.29	-1.14	-0.04	-13.02
CO	Maroon Bells-Snowmass	-0.29	-1.00	-0.04	-10.62
CA	Dome Land Wilderness	-0.27	-0.46	-0.04	-4.48
CA	Pinnacles NM	-0.26	-0.86	-0.04	-5.93
NM	Wheeler Peak Wilderness	-0.24	-0.91	-0.03	-8.94
AZ	Mount Baldy Wilderness	-0.22	-0.64	-0.03	-6.25
NM	Salt Creek Wilderness	-0.22	-0.71	-0.02	-7.75
AZ	Petrified Forest NP	-0.21	-0.73	-0.01	-6.88
WY	Bridger Wilderness	-0.20	-0.77	-0.03	-7.51
CA	Hoover Wilderness	-0.20	-0.19	-0.04	-2.60
CA	Emigrant Wilderness	-0.19	-0.25	-0.03	-3.08
NM	Gila Wilderness	-0.18	-0.34	-0.02	-3.81
CA	Minarets	-0.18	-0.23	-0.03	-2.71
OR	Mount Jefferson Wild.	-0.17	-0.28	-0.02	-2.59
NM	San Pedro Parks Wild.	-0.17	-0.64	-0.02	-10.43
NM	Bandelier NM	-0.17	-0.58	-0.02	-7.42
AZ	Superstition Wilderness	-0.16	-0.40	-0.02	-2.04
OR	Mount Washington Wild.	-0.16	-0.30	-0.02	-2.55
OR	Mount Hood Wilderness	-0.14	-0.22	-0.03	-1.83
CA	Kaiser Wilderness	-0.14	-0.19	-0.02	-2.63
CA	Kings Canyon NP	-0.14	-0.22	-0.02	-2.83
CA	John Muir Wilderness	-0.14	-0.23	-0.02	-2.69
CA	San Rafael Wilderness	-0.14	-0.32	-0.01	-5.40
AZ	Sierra Ancha Wilderness	-0.13	-0.35	-0.01	-1.76
CA	Sequoia NP	-0.13	-0.24	-0.02	-4.56
CA	Yosemite NP	-0.13	-0.17	-0.02	-2.63
UT	Arches NP	-0.13	-0.51	-0.01	-14.82

		Light Extinction		NH4NO3	
State	GCVTR Class I Area	Δ Mm^{-1}	Δ %	Δ $\mu g/m^3$	Δ %
NM	Pecos Wilderness	-0.12	-0.44	-0.03	-7.29
WY	Fitzpatrick Wilderness	-0.12	-0.46	-0.02	-4.83
NM	Bosque del Apache Wild.	-0.12	-0.44	-0.01	-8.65
OR	Kalmiopsis Wilderness	-0.11	-0.34	-0.01	-3.05
OR	Eagle Cap Wilderness	-0.11	-0.31	-0.02	-4.29
OR	Three Sisters Wilderness	-0.11	-0.24	-0.02	-2.55
AZ	Grand Canyon NP	-0.11	-0.40	-0.01	-7.36
UT	Capitol Reef NP	-0.11	-0.45	-0.01	-8.21
WY	Grand Teton NP	-0.11	-0.36	-0.02	-3.47
WY	Teton Wilderness	-0.10	-0.36	-0.02	-3.56
OR	Crater Lake NP	-0.10	-0.21	-0.01	-2.09
ID	Hells Canyon Wilderness	-0.10	-0.13	-0.02	-3.87
OR	Strawberry Mountain Wild.	-0.10	-0.15	-0.01	-2.89
AZ	Sycamore Canyon Wild.	-0.10	-0.32	-0.01	-5.25
CA	Marble Mountain Wild.	-0.10	-0.23	-0.01	-2.57
AZ	Chiricahua NM	-0.10	-0.36	0.00	-6.65
AZ	Chiricahua Wilderness	-0.10	-0.36	0.00	-6.65
AZ	Galiuro Wilderness	-0.10	-0.30	-0.01	-4.30
UT	Canyonlands NP	-0.09	-0.42	-0.01	-10.61
OR	Diamond Peak Wild.	-0.09	-0.18	-0.01	-2.20
AZ	Saguaro Wilderness	-0.09	-0.28	-0.01	-6.84
UT	Bryce Canyon NP	-0.08	-0.32	-0.01	-6.14
AZ	Pine Mountain Wild.	-0.08	-0.24	-0.01	-2.82
AZ	Mazatzal Wilderness	-0.08	-0.23	-0.01	-2.82
NM	Carlsbad Caverns NP	-0.08	-0.26	-0.01	-4.03
OR	Mountain Lakes Wild.	-0.07	-0.18	-0.01	-2.43
UT	Zion NP	-0.07	-0.21	-0.01	-7.22
CO	Mesa Verde NP	-0.07	-0.21	-0.03	-17.68
CA	Lava Beds Wilderness	-0.06	-0.15	-0.01	-2.09
WY	Yellowstone NP	-0.06	-0.20	-0.01	-2.50
CA	South Warner Wilderness	-0.06	-0.19	-0.01	-3.77
ID	Selway-Bitterroot Wild.	-0.05	-0.12	-0.01	-2.19
WY	North Absaroka Wild.	-0.05	-0.19	-0.01	-2.43
WY	Washakie Wilderness	-0.05	-0.19	-0.01	-2.43
CA	Point Reyes NS	-0.05	-0.15	0.00	-2.80
ID	Craters of The Moon Wild.	-0.04	-0.14	-0.01	-3.89
OR	Gearhart Mountain Wild.	-0.04	-0.13	0.00	-2.24
CA	Caribou Wilderness	-0.04	-0.11	0.00	-3.38
CA	Thousand Lakes Wild.	-0.03	-0.09	0.00	-2.30
CA	Lassen Volcanic NP	-0.03	-0.07	0.00	-2.28
CA	Yolla Bolly Middle Eel Wild.	-0.03	-0.09	0.00	-1.13
NV	Jarbridge Wilderness	-0.03	-0.13	0.00	-4.49
CA	Ventana Wilderness	-0.02	-0.12	0.00	-5.24
CA	Redwood NP	-0.02	-0.06	0.00	-2.92
	Average	-0.21	-0.51	-0.03	-5.79

SECTION VI:
SUMMARY OF EMISSION CONTROLS AVAILABLE FOR LARGE STATIONARY SOURCES OF NOx AND PM

Final Report

Prepared for:

Lee Alter
Western Governors' Association
1515 Cleveland Place, Suite 200
Denver, CO 80202-5114

Prepared by:

Constance Senior, Brooke Shiley, Bradley Adams
Reaction Engineering International
77 West 200 South, Suite 210
Salt Lake City, UT 84101

Rui Afonso
Energy & Environmental Strategies
50 Old Faith Road
Shrewsbury, MA 01545

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LIST OF ACRONYMS, ABBREVIATIONS AND SYMBOLS

ACFM	Actual cubic feet per minute
AFBC	Atmospheric fluidized bed combustor
BART	Best available retrofit technology
DLN	Dry Low NO_x
EIA	Energy Information Administration
EPA	United States Environmental Protection Agency
GCVTC	Grand Canyon Visibility Transport Commission
GCVTR	Grand Canyon Visibility Transport Region
FGR	Flue Gas Recirculation
Hg	Mercury
ICE	Internal Combustion Engine
LEC	Low Emission Combustion
LNB	Low-NO_x burner
MBtu	Millions of British Thermal Units
MTF	Market Trading Forum
NG	Natural Gas
NO_x	Nitrogen oxides
NSCR	Non-selective catalytic reduction
NSPS	New Source Performance Standard
O&M	Operating and Maintenance
OFA	Overfire air
PM	Particulate matter
PM10	Particulate matter less than 10 microns
PM2.5	Particulate matter less than 2.5 microns
SCC	Source Classification Code
SCR	Selective catalytic reduction
SIP	State Implementation Plan
SNCR	Selective non-catalytic reduction
SO_2	Sulfur dioxide
TPY	Tons per year
WGA	Western Governors' Association
WRAP	Western Regional Air Partnership

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We are grateful to Dr. Praveen Amar for providing help in locating the most recent sources of information on control technologies, as well as for external review of the report from the perspective of making it relevant to readership in the state governments/regional entities.

1 INTRODUCTION

1.1 Background

The Western Regional Air Partnership (WRAP) has undertaken a program to assess emissions control technologies and strategies for large stationary sources of NO_x and PM emissions in the western states region. The WRAP is a collaborative effort of tribal governments, state governments, and various federal agencies to implement the recommendations of the Grand Canyon Visibility Transport Commission (GCVTC) and to develop the technical and policy tools needed by western states and tribes to comply with the U.S. Environmental Protection Agency's (EPA) Regional Haze Rule.

The WRAP established the Market Trading Forum (MTF), in large part, to develop and recommend emission control strategies for stationary sources of air pollution. A major focus of the MTF has been the establishment of regional emission milestones for sulfur dioxide (SO_2) and a regional backstop cap-and-trade program for SO_2 to be triggered if the milestones are not met voluntarily.

The MTF is also responsible for generating a report required in 40 CFR 51.309(d)(4)(v) of the Regional Haze Rule. The report must assess emission control technologies and strategies for stationary source NO_x and PM emissions and the degree of visibility impairment that would result from such strategies. It must also evaluate the need for NO_x and PM milestones to avoid any net emissions increase and to support possible multi-pollutant and multi-source control programs. Finally, this year several states must submit state implementation plans (SIPs) to EPA and must commit to a 2008 revision containing any necessary long-term strategies and Best Available Retrofit Technology (BART) requirements for stationary source NO_x and PM.

This project is essentially a starting point for addressing stationary source NO_x and PM emission sources over the next four years, at which point local and/or regional emission control program(s) may be implemented. Future work by the WRAP will investigate these issues further and will attempt more detailed cost estimates and emission reductions achievable in the WRAP region given the nature of its sources and existing controls.

1.2 Objectives

The main objectives of this project are to identify and briefly describe for large stationary sources in the western United States:

- The universe of modern commercially-available or near-available stationary source NO_x and PM controls (either technologies or best management practices);
- Trends in such controls;
- Their approximate capital and operating costs, control efficiencies, and cost effectiveness;
- Secondary environmental impacts, such as control of other air pollutants and generation of solid or hazardous waste;
- Real-world experience at facilities implementing or testing such controls;

- Future opportunities for improvements and demonstrations; and
- Recommendations for future work.

1.3 Definitions and Methodology

The work plan for the project consisted of the following tasks:

Task 1. Inventory of Stationary Sources in the WRAP Region. This task involved a review of the 1996 WRAP stationary source emissions inventory (version 3, in MS Access format), as well as other recent and relevant databases to determine the number/type of stationary sources with emissions greater than 100 tons per year (TPY) and the type and performance of air pollution control devices installed on those sources. Two subsets were created for NO_x and PM emissions, respectively, based on the following criteria:

- Sources (defined as emission units, or records, in the database) having annual emissions of the pollutant of interest greater than 100 TPY; and
- Sources located in the thirteen-state region: AZ, CA, CO, ID, MT, ND, NM, NV, OR, SD, UT, WA, WY (See Figure 1).

Table 1 lists the fields extracted from the WRAP database.

Figure 1. Thirteen-state region considered in the technology assessment.

Table 1. WRAP database fields used in the technology assessment.

Field	Description
FIPST	FIP State Code
POINTID	NAPAP Point ID Code
STACKID	Stack Number
BLRID	Boiler ID Code Code (utility only)
SEGMENT	Segment Number
ORISID	ORIS Plant ID (utility only)
PLANT	Plant Name
SCC	Source Classification Code
SCC1_DESC	General category (e.g., External Combustion Boiler)
SCC3_DESC	Major industrial group within general category
SCC6_DESC	Specific industry or emission source
SCC8_DESC	Particular emitting process or fuel type
NOX_ANN	Annual NO_x Emissions, tons per year
PM10_ANN	Annual PM Emissions, tons per year
CO_ANN	Annual CO Emissions, tons per year
SO2_ANN	Annual SO_2 Emissions, tons per year
NOX_CPRI	Primary Control Equipment Code - NO_x
PM_CPRI	Primary Control Equipment Code - PM
CONTROL_DEVICE_DESC	Control Device Description (either NO_x or PM)

Note: Codes taken from the 1996 National Emission Trends (NET) PC Inventory File Format

The source classification codes (SCCs) used to categorize sources served as general guidelines for choosing the categories in Task 1. The similarities (or differences) in the control technologies applicable to specific SCCs were also factors in grouping sources. For example, a category called "Coal-fired boilers" was created containing emissions data from utility and industrial boilers (of different boiler types) burning coal because the same NO_x and PM control technologies can be applied to most of these sources. With this in mind, Table 2 gives the categories created for characterization of the WRAP emissions and a description of the WRAP categories (i.e., SCC codes) used to define the categories in this report.

For electric utility point sources, additional databases were used to determine boiler capacity (MBtu/yr), enhance and update information on control technologies in place, and verify other source information. These databases were: EPA CEMs database for 1996 and 2001 [1], EPA E-GRID database for 1996 and 2000 [2] and the EIA-767 database for 1996 [3].

The results of Task 1 are discussed in Section 2 of this report.

Table 2. List of Categories Used to Characterize Point Sources

Category	**WRAP Sources (based on SCC Codes contained with the category)**
Coal-Fired Boilers	All coal-fired external combustion boilers
Reciprocating Engines *NG* *Diesel* *Process Gas*	All reciprocating ICE's *Natural gas-fired ICE's, including 2- and 4-cycle* *Diesel-fired ICE's, including large-bore engines* *Unspecified process gas-fired ICE's*
Cement Kilns	All cement kilns (wet and dry process)
Oil/NG Boilers	External combustion boilers firing oil or natural gas
Turbines *NG* *Diesel*	All fired turbines *Natural gas-fired turbines* *Diesel-fired turbines*
Mineral Processing	Cement crushing, grinding and drying, asphalt, other drying applications
Petrochemical	Flares, cat.crackers, nitric acid plants, unspecified process gas operations, *does not include process heaters*
NG Compressor	Technology (reciprocating engine or turbine) not specified
Pulp and Paper	Recovery boilers, lime kilns, drying and smelting
Wood Boilers	Wood waste and/or bark boilers, technology unspecified
Refinery Process Heaters	Process heaters
Glass Manufacture	Glass melting furnaces
Primary Metal Production	Electric arc furnaces, reheat furnaces, material handling and unspecified
Waste Combustion	Liquid waste (Dakota gasifier) and solid waste (WTE)
Refinery	Unspecified refinery emissions
In-process Fuel Use	Unspecified combustion systems at glass and cement plants
Jet Engine Testing	Jet engine testing
Oil and Gas Production	Flares and unspecified processes
Smelting Operations	Copper and aluminum smelting
Sugar Beet Processing	Sugar beet processing
Secondary Metal Production	Steel foundries
Turbines, Steam	Geothermal power production

Task 2. Survey and Documentation of Emission Control Technologies. In this task, we focused on the identification and compilation of control technologies for NO_x and PM (main focus) and for SO_2 and Hg (secondary focus). Sources identified in Task 1 that represented minor contributions to the emissions profile of the region, either due to their small number, uniqueness, or size, were considered in a more cursory fashion if their control technology options fell outside of the range of the more common/available technologies. This effort consisted mainly of literature reviews, on-line searches and personal (telephone) contacts and interviews.

The following information was collected on each technology or process:

- Type and fundamentals of technology or process;
- Projected performance;
- Costs (capital and O&M or cost effectiveness in $/ton of pollutant removed) or cost projections;
- Status of development and opportunities for or barriers to further development; and
- Applicability to category (or categories) of WRAP sources identified in Task 1.

The results of this task are presented in Sections 3 and 4.

Task 3. Control Technology Analysis and Discussion.   This task was the main focus of the project, in which a thorough evaluation and discussion of the many identified technologies was conducted. A summary containing the following information was created for each technology:

- Process name
- For each source category to which the technology was applicable, the following information was tabulated:
    - Total annual NO_x or PM emissions from sources greater than 100 TPY
    - Percentage NO_x and PM reduction
    - Cost ($/ton or $/ACFM)
    - Development status
- Detailed descriptions were prepared for the following:
    - Process description
    - Achievable NO_x or PM reduction
    - Cost information
    - Development status
    - Practical considerations
    - Compatibility with other air pollution control technologies
    - Secondary environmental impacts
- References

The results of this task are presented in Appendices C and D.

Task 4. Final Report. The draft version of the final report was submitted to WRAP on 25 April 2003. The final report was submitted on 30 June 2003.

2 NO_x AND PM SOURCES IN THE WESTERN UNITED STATES

2.1 Characterization of NO_x Sources

Table 3 gives the annual NO_x emissions in the GCVTR as well as in thirteen-state region for sources (defined as emission units, or records, in the WRAP database) exceeding 100 TPY. The cut-off of 100 TPY captures 84% of the stationary source NO_x emissions in the WRAP database for the thirteen-state region. Figure 2 shows the distribution of annual NO_x emissions (greater than 100 TPY) as a function of state.

The largest source category by far in the thirteen-state region is coal-fired boilers (69%); the top five categories (coal-fired boilers, internal combustion engines, cement kilns, turbines and oil and natural gas boilers) account for almost 90% of the NO_x emissions. Therefore, this report concentrates on control technologies applicable to these major process categories.

The states with the largest NO_x emissions are AZ, CA, ND, NM, UT, and WY. Since all these states except ND are in the GCVTR, it is not surprising that emissions from the nine states in the GCVTR (AZ, CA, CO, ID, NM, NV, OR, UT, WY) account for 75% of the thirteen-state emissions greater than 100 TPY. Appendix A contains NO_x emissions by process category and by state.

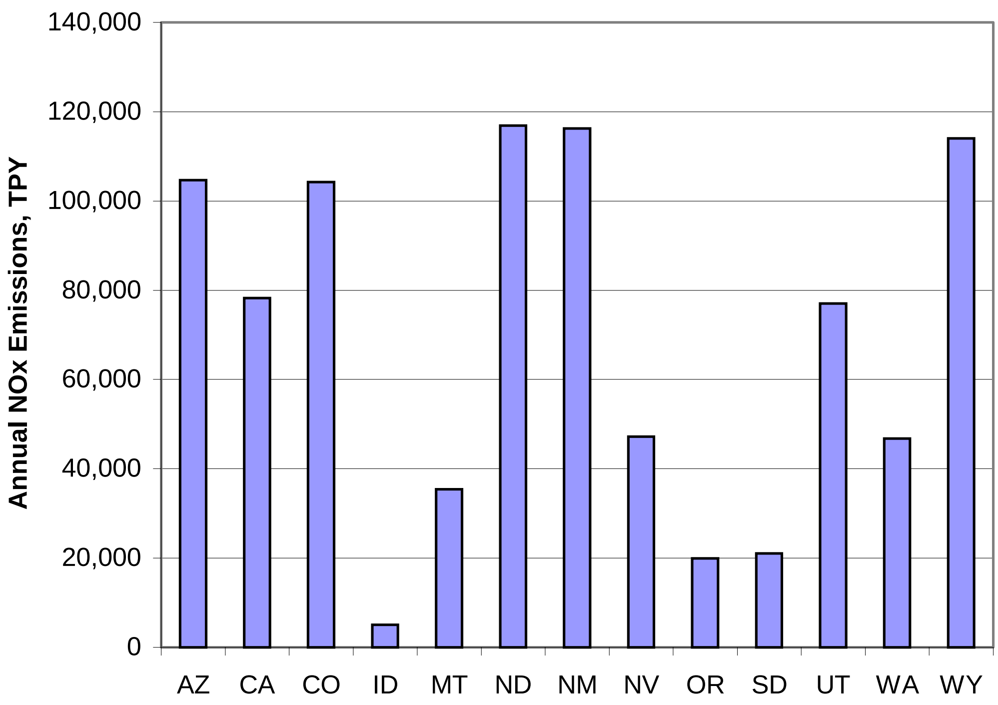

Figure 2. Annual NO_x emissions from sources with emissions greater than 100 TPY for the thirteen-state region.

Table 3. A comparison of annual emissions of NO_x from sources with emissions greater than 100 TPY between the thirteen-state region and the GCVTR.

	13-States		GCVTR		
Category	**# Units**	**Total NO_x TPY (>100 TPY)**	**# Units**	**Total NO_x TPY (>100 TPY)**	**% NO_x in GCVTR**
Coal-Fired Boilers	151	607,748	117	436,882	72%
Reciprocating Engines	423	86,210	394	78,092	91%
Cement Kilns	39	41,009	31	32,503	79%
Oil/NG Boilers	112	32,910	80	26,116	79%
Turbines	86	25,278	78	23,955	95%
Mineral Processing, Other	34	16,250	25	13,342	82%
Petrochemical	48	13,719	31	8,326	61%
NG Compressor	16	10,959	16	10,959	100%
Pulp and Paper	39	10,010	20	4,619	46%
Wood Boilers	48	9,776	36	6,864	70%
Refinery Process Heaters	38	9,311	29	7,302	78%
Glass Manufacture	14	5,033	12	4,379	87%
Primary Metal Production	17	3,476	16	3,360	97%
Waste Combustion	6	3,309	2	339	10%
Fugitive	8	3,256	8	3,256	100%
In-process Fuel Use	9	2,605	8	2,016	77%
Fixed Wing Aircraft	4	2,297	4	2,297	100%
Oil and Gas Production	7	1,140	5	792	70%
Smelting Operations	3	961	2	852	89%
Food and Agriculture	3	730	1	111	15%
Secondary Metal Production	4	507	0	0	0%
Turbines, Steam	1	165	1	165	100%
Total (> 100 TPY)	**1,110**	**886,659**	**916**	**666,527**	**75%**

With few exceptions, the distribution of NO_x sources is similar in the thirteen-state region as compared to the GCVTR. ICE's (reciprocating engines and turbine) are predominantly in the GCVTR, while pulp and paper emissions are mostly outside the GCVTR. As a result of this similarity, the scope of this project was expanded to include additional WRAP states at minimal cost.

The achievable NO_x emission rate depends on the fuel type. For coal-fired boilers, lower NO_x emission rates are obtained when firing subbituminous coal as compared to bituminous coal. Thus, it is useful to look at the distribution of coals in use in the thirteen-state region. Figure 3 shows the distribution of coals burned in utility boilers as a function of boiler type and coal rank. Most coal burned in the West is burned close to the mine; this distribution of coal rank reflects the native coals in the West.

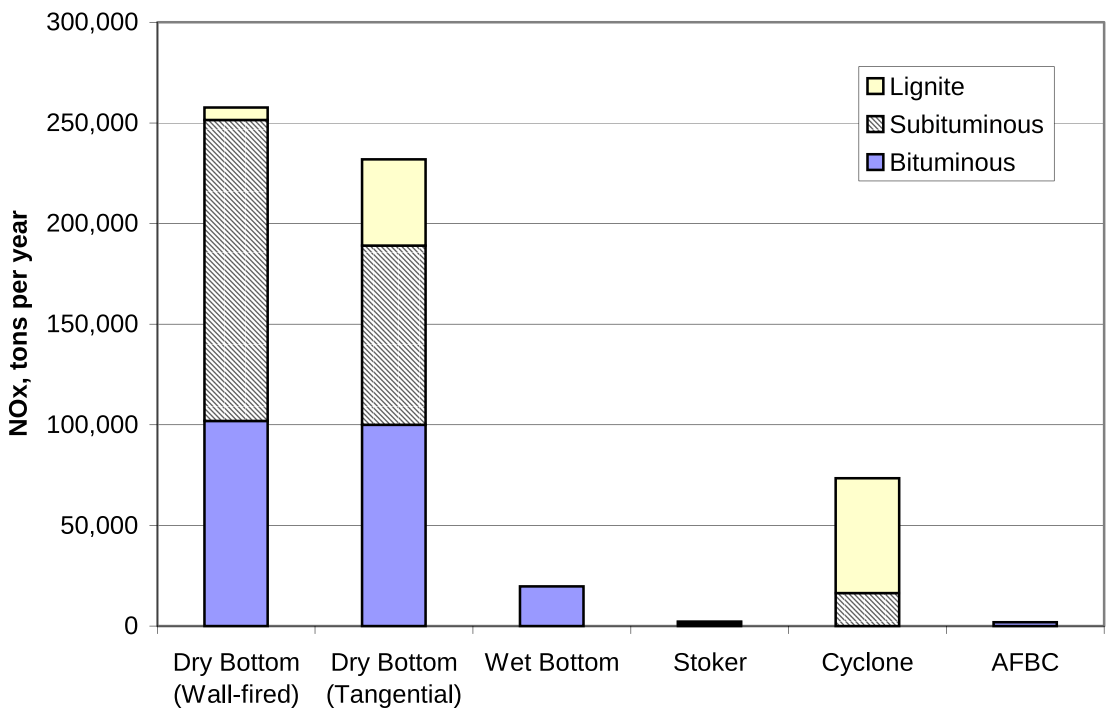

Figure 3. NO_x emissions from coal-fired utility boilers as a function of boiler type and coal rank for thirteen-state region from WRAP 1996 database.

For ICE's, the application of NO_x control technology can depend on the type of fuel. More so than with utility boilers, the design and operation of the engine is often determined by the primary fuel. Most of the stationary ICE's with annual emissions greater than 100 TPY burn natural gas, as shown in Figure 4.

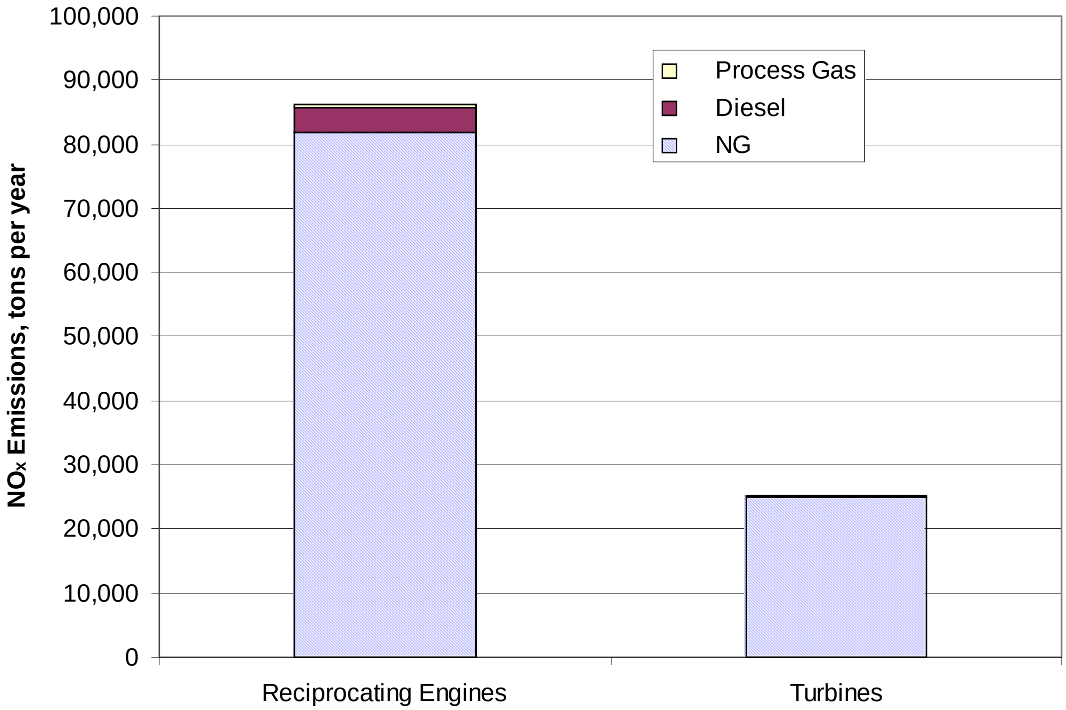

Figure 4. NO_x emissions from Internal Combustion Engines as a function of engine type and fuel for thirteen-state region from WRAP 1996 database.

As long as a source category consists of primarily large sources, the cut-off of 100 TPY will include most of the NO_x emission sources. The 100-TPY cut-off captures 84% of the NO_x emissions in the WRAP database as a whole. However, certain source categories contain a very large number of small sources. For ICE's (reciprocating engines and turbines) the 100-TPY cut-off only captures about 56% of the emissions as shown in Figures 5 and 6, although this is by far the second largest source category of stationary source NO_x emissions. Thus, NO_x control programs for sources in this category will require careful consideration of population attributes (e.g., controlling a large number of small sources).

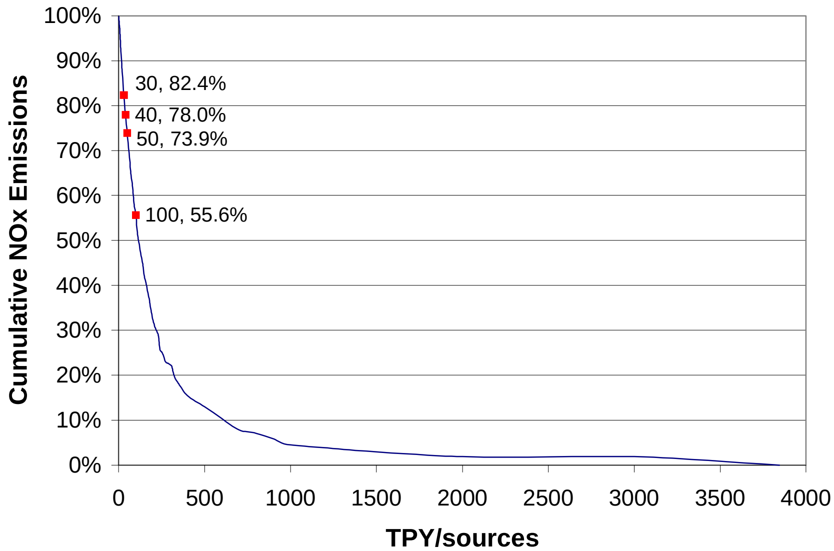

Figure 5. Cumulative NO_x emissions from ICE's in the thirteen-state region as a function of annual emission per source.

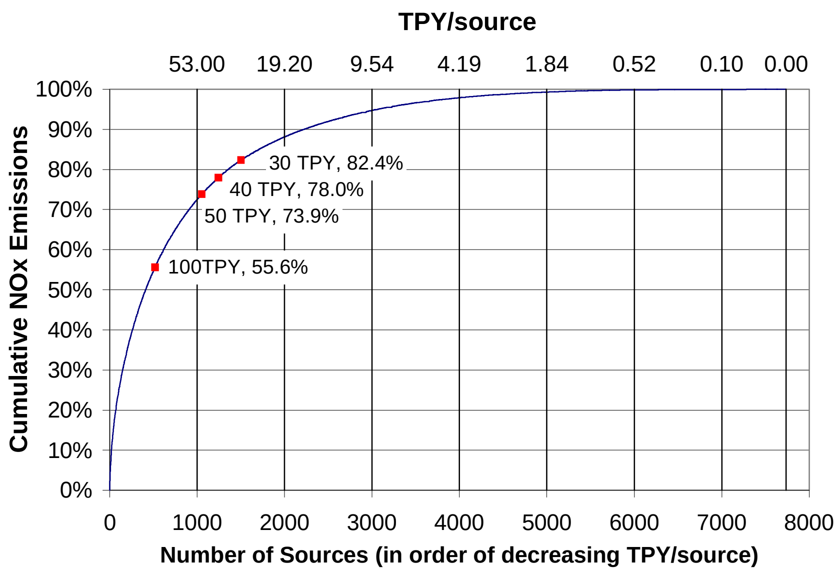

Figure 6. Cumulative NO_x emissions from ICE's in the thirteen-state region as a function of number of sources (in order of decreasing annual emission per source.)

The 1996 WRAP database contains information on control technologies for the pollutants of interest. According to the 1996 data for sources greater than 100 TPY, few sources had NO_x controls, as shown in Table 4. Overall, just above 4% of the NO_x sources greater than 100 TPY in the WRAP 1996 database had installed controls. Coal-fired boilers were the most frequently controlled (15% of the units), followed by petrochemical processes (about 13% of the units). Note that control technologies listed in the right-hand column are as reported in the WRAP database. In a few cases, the description of the control technology does not seem correct (e.g., fabric filter or electrostatic precipitator) for NO_x control; this is a limitation of the data available and it is outside the scope of this program to determine the accuracy of the data in the WRAP database.

Table 4. NO_x Control Technologies in use in 1996 on Sources Greater than 100 TPY from 1996 WRAP database.

Category	**# Units**	**Units Controlled**	**Total NO_x TPY**	**Avg NO_x TPY/Unit**	**NO_x Control Technology** (number of applications in parentheses)
Coal-Fired Boilers	151	23	607,748	4,025	Ammonia Injection(2), Fluid Bed Dry Scrubber(1), Low Excess Air Firing(3) , Modified Furnace Or Burner Design(13), Misc.(4)
Reciprocating Engines	423	3	86,210	204	Catalytic Reduction(1), Process Change(2)
Cement Kilns	39	2	41,009	1,052	Electrostatic Precipitator – High Efficiency(2)
Oil/NG Boilers	112	4	32,910	294	Low Excess Air Firing(3), SNCR(1)
Turbines	86	5	25,278	294	Steam Or Water Injection(5)
Mineral Processing	34	1	16,250	478	Fabric Filter - High Temperature, i.e. T>250F(1)
Petrochemical	48	6	13,719	286	Catalytic Afterburner(1), Catalytic Afterburner With Heat Exchanger(1), Catalytic Reduction(1), Staged Combustion(2), Tray-Type Gas Absorption Column(1)
NG Compressor	16	0	10,959	685	None
Pulp and Paper	39	0	10,010	257	None
Wood Boilers	48	1	9,776	204	Ammonia Injection(1)
Refinery Process Heaters	38	0	9,311	245	None
Glass Manufacture	14	0	5,033	360	None
Primary Metal Production	17	1	3,476	204	Process Enclosed(1)
Waste Combustion	6	0	3,309	552	None
Refinery	8	0	3,256	407	None
In-process Fuel Use	9	0	2,605	289	None
Jet Engine Testing	4	0	2,297	574	None
Oil and Gas Production	7	0	1,140	163	None
Smelting Operations	3	0	961	320	None
Sugar Beet Processing	3	0	730	243	None
Secondary Metal	4	0	507	127	None
Turbines, Steam	1	0	165	165	None
Total	**1,110**	**46**	**886,660**	**799**	

2.2 Comparison with Other Databases for NO_x Control Technologies

The level of control for coal-fired boilers in the WRAP database seemed low, even for 1996. Therefore, the 1996 WRAP database was compared with the data available for utility boilers in the 1996 CEMS and E-GRID databases. The EIA-767 database was also searched for NO_x control technologies. The E-GRID database should contain the information in the other two databases since it contains data from 24 different federal data sources, including EIA data and other EPA data. Only coal-fired utility boilers were included in this comparison, not all coal-fired boilers. However, only 3% of the WRAP NO_x emissions from coal-fired boilers in the thirteen-state region were from non-utility boilers.

It is worthwhile to take a closer look at utility boilers for two reasons. First, they are by far the largest source of NO_x emissions, accounting for 68% of the emissions from sources greater than 100 TPY. Second, the effectiveness of NO_x control technologies on boilers depends on the type of the boiler as well as on the fuel burned.

For this exercise, the EPA databases (CEMs and E-GRID) were queried to obtain information on capacity (MBtu per year) and control technologies. Data from 1996 was used in order to compare with the WRAP 1996 database. EPA and WRAP records were matched using ORIS Plant ID numbers and plant names. For matching records, control technologies not listed in the WRAP database were added, capacity (MBtu) entries were added, and NO_x emissions were replaced from the EPA databases.

A comparison of Tables 5 and 6, which contain, respectively, the WRAP data and the WRAP data augmented by the other databases, shows that the combination of the WRAP data and the EPA and EIA data suggests that 44% of the utility boilers had NO_x control (in 1996), as compared to only 12% when considering only the WRAP data by itself. The EPA databases probably undergo a more thorough QA/QC procedure than was used to create the WRAP database. Thus, the E-GRID and other federal databases might be expected to have more complete information.

Table 5. NO_x Emissions and Control Technologies for Utility Boilers in the Thirteen-State Region from WRAP 1996 Database.

	Number of Units	Controlled Units	NOx Emissions (TPY)	Average Emissions (Tons/Source)	NO_x Control Technology
Dry Bottom	99	14	489,580	4,945	Modified Furnace/Burner Design (13), Low Excess Air Firing(1)
Cyclone	5	1	73,468	14,694	Low Excess Air Firing(1)
Wet Bottom	2	0	19,688	9,844	None
NG Boiler	48	3	18,813	392	Low Excess Air Firing(3)
Stoker	6	0	1,779	296	None
Coal-fired AFBC	2	1	1,954	977	None
Wood Boiler	2	0	598	299	None
Oil Boilers					None
Total	**164**	**19**	**605,881**	**3,694**	

Table 6. NO_x Emissions and NO_x Control Technologies for Utility Boilers in the Thirteen-State Region from WRAP 1996 Database Combined with EPA and EIA Databases.

	Number of Units	Controlled Units	NOx Emissions (TPY)	Average Emissions (Tons/Source)	NO_x Control Technology
Dry Bottom	100	45	538,003	5,380	Modified Furnace/Burner Design(13) , Low Excess Air Firing(1), Low NOx Burner(21), OFA(3), Misc.(7)
Cyclone	5	1	73,528	14,706	Low Excess Air Firing(1)
Wet Bottom	3	3	23,409	7,803	Low NOx Burner(3)
NG Boiler	47	22	19,917	424	Low Excess Air Firing(3), SCR(2), SNCR(3), Misc.(14)
Stoker	6	0	3,987	665	None
Coal-fired AFBC	2	2	1,954	977	Low Excess Air Firing(1), Misc.(1)
Wood Boiler	3	0	957	319	None
Oil Boilers	1	0	110	110	None
Total	**167**	**73**	**661,866**	**3,963**	

The achievable NO_x emission rate depends on the boiler-fuel combination. The largest general class of utility boilers (in terms of number and capacity) is the dry bottom boiler. Dry bottom boilers can further be subdivided into wall-fired and tangential. Natural gas boilers emit less NO_x than coal-fired boilers per unit of fuel consumed. Of coal-fired boilers, tangential-fired units have the lowest emission rate and cyclones have the highest. The controls in the WRAP database are almost entirely low-NO_x burners or other combustion modifications. Figure 7 compares the range of NO_x emission rates for all boilers and fuels.

Application of low-NO_x burners and other combustion modifications can reduce NO_x emissions significantly; this can be seen in the large range of NO_x emission that is due, in part, to the use of NO_x controls on some of the boilers in each subset. Substantial NO_x reductions can also be achieved on coal-fired boilers just with combustion modifications.

Since 1996, low-NO_x burners have continued to improve; currently there are vendors who will guarantee NO_x emissions as low as 0.15 lb/MBtu from low-NO_x burners or low-NO_x firing systems. Furthermore, options have been developed for other combustion modifications, and SCR has begun to be applied to coal-fired boilers. Thus, the potential for NO_x control on coal-fired boilers is significantly better today than in 1996.

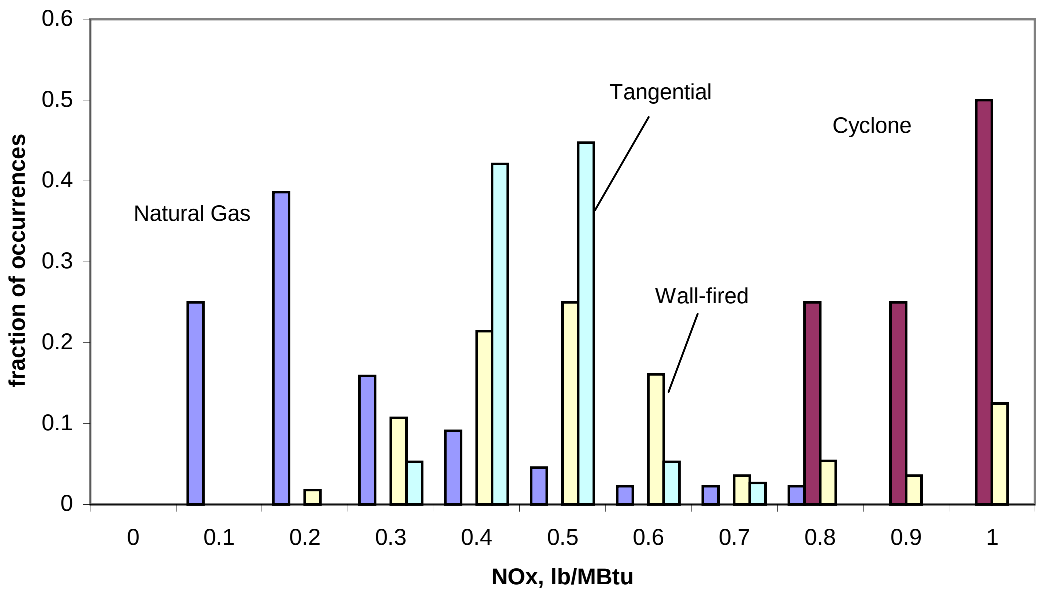

Figure 7. Distribution of NO_x emission rates for utility boilers in the thirteen-state region, combination of WRAP and EPA/EIA databases for 1996.

2.3 Trends in NO_x Emissions and Controls for Coal-Fired Utility Boilers, 1995-2000.

The most recent data available from the EPA databases for electric utility boilers are from 2000. In this section, we compare the 1996 data on NO_x emissions and controls discussed in the previous section with data from 2000.

Table 7 presents the data for 2000 derived from the EPA E-GRID and CEMS databases; this should be compared with Table 6 for 1996. The capacity of electric utility boilers increased by 37%, from 3,019,873,933 MBtu/yr in 1996 to 4,130,818,353 MBtu/yr in 2000, but the total NO_x emissions decreased by 7%. Figure 9 shows that the average annual emissions from dry bottom coal boilers (the largest category) decreased. Overall there was a decrease in emissions and an increase in the number of units that were controlled.

The number of sources increased, particularly the number of natural gas boilers, which increased from 47 to 82. The percent of natural gas boilers having NO_x controls decreased from 47% to 30%. During the time from 1996 to 2000, low-NO_x burners were added to natural gas units; there was also a small increase in SCR and SNCR on these types of boilers.

NO_x control on dry-bottom boilers increased from 47% to 71% from 1996 to 2000, resulting in a 9% decrease in total NO_x emissions from these boilers. The number of units with low-NO_x burners doubled. Overfire air (OFA) installations, though small in number, tripled. There were no SCR or SNCR installations on coal-fired boilers in 2000.

Thus, there was a modest reduction in NO_x emissions from electric utility boilers from 1996 to 2000, accompanied by a substantial increase in generating capacity. NO_x control increased, particularly on coal-fired boilers. The added NO_x control technologies were primarily low-NO_x burners and OFA.

Table 7. NO_x Emissions and NO_x Control Technologies for Utility Boilers in the Thirteen-State Region combined with EPA and EIA Databases for 2000.

	Number of Units	Controlled Units	NOx Emissions (TPY)	Average Emissions (Tons/Source)	NO_x Control Technology
Dry Bottom	96	68	489,680	5,101	Modified Furnace/Burner Design(13), Low Excess Air Firing(1), Low NOx Burner(41), OFA(9), Misc.(4)
Cyclone	5	2	66,013	13,203	Low Excess Air Firing(1), OFA(1)
NG Boiler	82	25	39,381	480	Low Excess Air Firing(4), Low NOx Burner(8), OFA(4), SCR(5), SNCR(4)
Wet Bottom	2	2	14,159	15,519	Low NOx Burner(2)
Coal-fired AFBC	2	2	2,118	1,059	Low Excess Air Firing(1), Misc.(1)
Wood Boiler	2	0	598	299	None
Stoker	1	0	335	335	None
Oil Boilers	1	0	216	216	None
Total	**191**	**99**	**612,500**	**3,207**	

2.4 Characterization of Sources of Particulate Matter (PM)

Table 8 gives the annual PM emissions for all PM sources in the thirteen-state region with emissions greater than 100 TPY. The cut-off of 100 TPY captures 60% of the PM emissions in the 1996 WRAP database for the thirteen-state region. With few exceptions, the distribution of PM sources is similar in the thirteen-state region as compared to the GCVTR. (Primary metal production emissions are mostly outside the GCVTR.) As a result of this similarity, the scope of this project was expanded to include additional WRAP states at minimal cost.

The largest source category (for those sources with emissions greater than 100 TPY) in the thirteen-state region is coal-fired boilers (40%); the top eight categories account for 92% of the PM emissions. Therefore, this report will focus on control technologies applicable to these process categories.

The state with the largest PM emissions is WY, followed by AZ, ID, and NM (Figure 9). Since all these states are in the GCVTR, it is not surprising that emissions from the nine states of the GCVTR (AZ, CA, CO, ID, NM, NV, OR, UT, WY) account for 83% of the total stationary source emissions greater than 100 TPY, as shown in Figure 10. Appendix B contains PM emissions by process category and by state.

Table 8. Annual Emissions of PM from Sources with Greater than 100 TPY.

Category	**13-States**		**GCVTR**		
	# Units	**Total PM TPY (>100 TPY)**	**# Units**	**Total PM TPY (>100 TPY)**	**% PM in GCVTR**
Coal-Fired Boilers	88	46,010	67	35,137	76%
Mineral Processing	85	24,499	75	21,824	89%
Petrochemical	42	10,836	37	9,716	90%
Wood Boilers	24	5,718	20	5,210	91%
Refinery Emissions	11	5,631	7	5,011	89%
Primary Metal Production	20	4,697	11	2,244	48%
Pulp and Paper	15	4,476	13	4,119	92%
Smelting Operations	8	3,555	7	3,397	96%
Miscellaneous	1	2,456	1	2,456	100%
Oil/NG Boilers	5	1,379	5	1,379	100%
Sugar Beet Processing	5	1,150	3	750	65%
Cooling Tower	4	932	4	932	100%
Cement Kilns	4	641	3	524	82%
Turbines	2	838	2	838	100%
Secondary Metal Production	1	537	1	537	100%
Jet Engine Testing	2	535	2	535	100%
Reciprocating Engines	3	525	3	525	100%
Refinery Process Heaters	1	176	1	176	100%
Total	**321**	**114,589**	**262**	**95,308**	**83%**

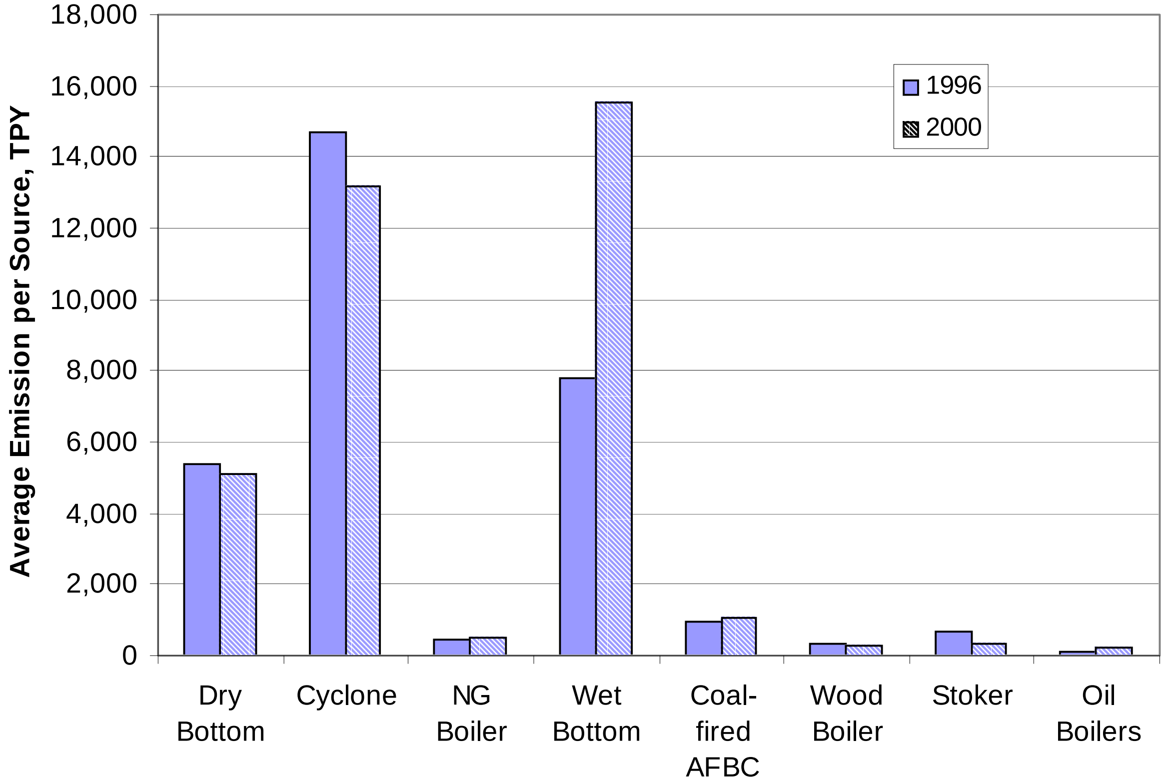

Figure 8. Average Annual NO_x Emissions (greater than 100 TPY) from Electricity Generating Boilers: Comparison of 1996 and 2000 data from EPA Databases.

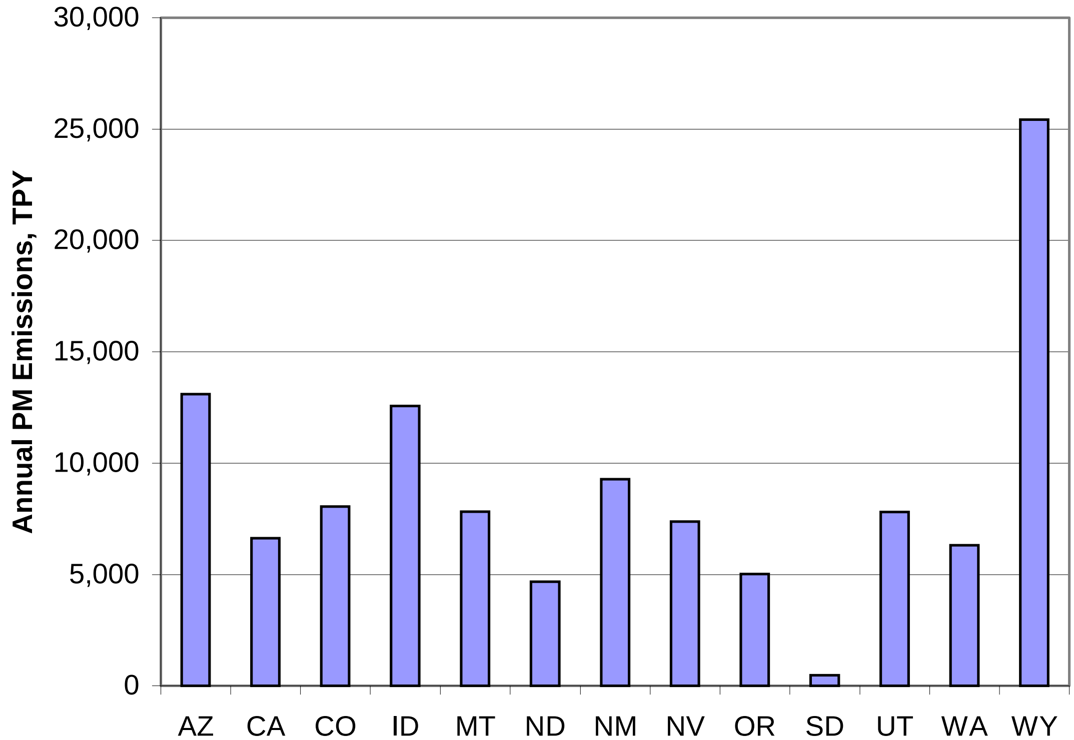

Figure 9. Annual PM Emissions from Sources with Emissions Greater than 100 TPY for the Thirteen-State Region.

Table 9 lists the control technologies in use in the 1996 WRAP database for particulate matter. 72% of coal-fired boilers, the largest category of emissions, had some form of PM control. Overall, though, only 38% of sources with emissions greater than 100 TPY had controls.

Table 9. PM control technologies in use on sources greater than 100 TPY from 1996 WRAP database.

	Number of Units	Controlled Units	Total PM (TPY)	Avg PM (TPY/Source)	PM Control Technology
Coal-Fired Boilers	88	64	46,010	523	Centrifugal Collector (Cyclone)(2), Electrostatic Precipitator(35), Fabric Filter(12), Multiple Cyclone(4), Multiple Cyclone/Electrostatic Precipitator(2), Multiple Cyclone/Wet Scrubber(1), Wet Scrubber(8)
Mineral Processing	85	29	24,499	288	Centrifugal Collector (Cyclone)(2), Dust Suppression by Chemical Stabilizers or Wetting(5), Dust Suppression by Water Sprays(16), Fabric Filter(1), Water Curtain(1), Wet Scrubber(4)
Petrochemical	42	7	10,836	258	Centrifugal Collector (Cyclone)(3), Sulfuric Acid Plant - Contact Process(2), Wet Scrubber(2)
Wood Boilers	24	3	5,718	238	Centrifugal Collector (Cyclone)(1), Wet Scrubber(1)
Refinery Emissions	11	3	5,631	512	Dust Suppression by Water Sprays(2), Fabric Filter(1)
Primary Metal Production	20	7	4,697	235	Alkalized Alumina(2), Dust Suppression by Water Sprays(1), Wet Scrubber(3), Misc.(1)
Pulp and Paper	15	3	4,476	298	Centrifugal Collector (Cyclone)(1), Wet Scrubber(1)
Smelting Operations	8	0	3,555	444	None
Miscellaneous	1	0	2,456	2,456	None
Oil/NG Boilers	5	4	1,379	276	Electrostatic Precipitator(4)
Sugar Beet Processing	5	1	1,150	230	Centrifugal Collector (Cyclone)(1)
Cooling Tower	4	0	932	233	None
Turbines	2	0	838	419	None
Cement Kilns	4	1	641	160	Electrostatic Precipitator(1)
Secondary Metal Production	1	0	537	537	None
Jet Engine Testing	2	0	535	267	None
Reciprocating Engines	3	0	525	175	None
Refinery Process Heaters	1	0	176	176	None
Total	**321**	**122**	**114,590**	**357**	

2.5 Comparison with Other Databases for PM Control Technologies

The 1996 WRAP database was compared with the data available for utility boilers in the 1996 CEMS and E-GRID databases. The EIA-767 database was also searched for PM control technologies. The E-GRID database should contain the information in the other two databases since it contains data from 24 different federal data sources, including EIA data and other EPA data.

EPA and WRAP records for 1996 were matched using ORIS Plant ID numbers and plant names. For matching records, control technologies not listed in the WRAP database were added, capacity (MBtu) entries were added, and PM emissions were replaced from the EPA databases. The EIA-767 database reported PM emissions as lb PM/MBtu, from which we calculated PM emissions in tons per year.

PM emissions data in the EPA databases do not agree with data in the WRAP database, suggesting that the data were obtained from different measurement and/or estimation methods. The differences, illustrated by a few sample records in Table 10, follow no general trend from plant to plant.

Table 10. Sample PM Records from WRAP 1996 and EPA 1996 databases.

Boiler	Capacity (MBtu/yr)	PM Emissions Rate, EPA (PM/MBtu)	PM Emissions Rate, WRAP (PM/MBtu)	PM Emissions, EPA (TPY)	PM Emissions, WRAP (TPY)
Four Corners 1 (NM)	16,530,550	0.03	0.13	248	1,048
Four Corners 2 (NM)	9,369,730	0.03	0.13	141	618
Four Corners 3 (NM)	18,823,220	0.03	0.13	282	1,243
Four Corners 4 (NM)	58,100,720	0.01	0.03	291	883
Four Corners 5 (NM)	52,759,010	0.01	0.03	264	789
Reid Gardner 1 (NV)	9,599,371	0.05	0.05	240	222
Reid Gardner 2 (NV)	23,152,788	0.05	0.01	579	128
Reid Gardner 3 (NV)	30,579,084	0.05	0.02	764	278
Reid Gardner 4 (NV)	42,514,192	0.05	0.01	1,063	245

A comparison of Tables 11 and 12, which contain, respectively, the WRAP data and the WRAP data augmented by the other databases, shows that the combination of the WRAP data and the EPA and EIA data suggests that about 94% of the utility boilers had PM control (in 1996), as compared to only 53% when considering only the WRAP data by itself. The EPA databases probably undergo a more thorough QA/QC procedure than was used to create the WRAP database. Thus, the E-GRID and other federal databases might be expected to have more complete information.

Table 11. PM Emissions and Control Technologies for Utility Boilers in the Thirteen-State Region from WRAP 1996 Database.

	Number of Units	Controlled Units	PM Emissions (TPY)	Average Emissions (TPY/Source)	PM Control Technology
Dry Bottom	60	30	36,889	615	Multiple Cyclone(3), Fabric Filter(8), Wet Scrubber(7), Electrostatic Precipitator(12)
NG Boiler	4	4	1,235	309	Electrostatic Precipitator(4)
Cyclone	3	3	702	234	Electrostatic Precipitator(3)
Stoker	3	0	571	190	None
Coal-fired AFBC	1	1	381	381	Multiple Cyclone(1)
Wet Bottom	1	0	102	102	None
Total	**72**	**38**	**39,880**	**554**	

Table 12. PM Emissions and Control Technologies for Utility Boilers in the Thirteen-State Region from WRAP 1996 Database Combined with EPA and EIA Databases.

	Number of Units	Controlled Units	PM Emissions (TPY)	Average Emissions (TPY/Source)	PM Control Technology
Dry Bottom	77	75	84,140	1,093	Multiple Cyclone(3), Fabric Filter(15), Wet Scrubber(8), Electrostatic Precipitator(44), Multiple Cyclone/Electrostatic Precipitator(3), Multiple Cyclone/Wet Scrubber(2),
Cyclone	5	5	1,633	327	Electrostatic Precipitator(4), Fabric Filter(1)
NG Boiler	4	4	1,235	309	Electrostatic Precipitator(4)
Wet Bottom	3	2	697	232	Fabric Filter(2)
Stoker	3	0	571	190	None
Coal-fired AFBC	2	2	274	137	Multiple Cyclone/Electrostatic Precipitator(1), Fabric Filter(1)
Total	**94**	**88**	**88,549**	**942**	

3 NO_x CONTROL TECHNOLOGIES

3.1 Overview

As discussed in Section 2, the NO_x emissions greater than 100 TPY in the thirteen-state region come predominantly from coal-fired boilers. We have concentrated on obtaining detailed information on NO_x control technologies for the top five categories, which account for 90% of the emission, although in some cases, where information was readily available, we have collected information for other source categories (refinery process heaters, glass melters, and wood-fired boilers). Table 13 shows that these source categories together account for 92% of the NO_x emissions greater than 100 TPY.

Table 13. Annual NO_x emissions greater than 100 TPY from major source categories.

Category	# Units	Total NO_x TPY	% of NO_x Emissions
Coal-Fired Boilers	151	607,748	68%
Reciprocating Engines	423	86,210	10%
Cement Kilns	39	41,009	5%
Oil/NG Boilers	112	32,910	4%
Turbines	86	25,278	3%
Wood Boilers	48	9,776	1%
Refinery Process Heaters	38	9,311	1%
Glass Manufacture	14	5,033	1%
Others	199	69,385	8%
Total	**1,110**	**886,660**	

In this section, the information is organized in two formats. First, Table 14 lists all the technologies considered. For the most part, these are commercial technologies, in that vendors are offering these technologies. Not all technologies listed in Table 14 have demonstrated long-term operation, however. Table 14 gives the following information about each technology:

- Name of the technology
- Source categories to which the technology can be applied
- Was a summary prepared? (Yes/No). If yes, technology summaries are contained in Appendix C.

Second, Tables 15 through 22 summarize the NO_x control options for major source categories for ease of comparison. More detailed information, particularly on the range of cost and NO_x control, is given in Appendix C. These tables contain the following information:

- Name of Technology
- Process Description
- Applicability to units in the source category
- Range of performance (NO_x removal efficiency)
- Range of costs ($/ton of NO_x removed, levelized annual cost)
- Commercial status

Table 14. NO_x Control Technologies.

	Technology	Applicability	Summary in Appendix C (Y/N)
1	Air or fuel staging	Coal-fired boilers, Cement kilns	Y
2	Batch/Cullet Preheating	Glass Melters	Y
3	Biosolids injection	Cement kilns	N (not common)
4	Burner Modifications	Coal-fired boilers	N (see LNB)
5	Catalytic combustion	Gas Turbines	Y
6	DLN (fuel-lean combustion)	Gas Turbines	Y
7	Electric Boost	Glass Melters	N (too expensive)
8	Flue Gas Recirculation (FGR)	Oil/Nat'l Gas Boilers	Y
9	Fuel Reburn	Coal-fired boilers, Wood/biomass boilers, Glass Melters	Y
10	High Energy Ignition	Reciprocating Engines	Y
11	High-Pressure Fuel Injection	Reciprocating Engines	Y
12	Hybrid Reburn + SNCR	Coal-fired boilers	N (see Reburn, SNCR)
13	Hybrid SNCR + SCR	Coal-fired boilers	N (see SNCR, SCR)
14	Hydrocarbon-enhanced SNCR	Coal-fired boilers	N (see SNCR)
15	Intelligent controls	Coal-fired boilers, Oil/NG boilers, Wood/biomass boilers	Y
16	Iron addition (CemStar)	Cement kilns	Y

	Technology	**Applicability**	**Summary in Appendix C (Y/N)**
17	Kiln dust insufflation	Cement kilns	N (see O_2-enhanced combustion)
18	Kiln temperature control	Cement kilns	Y
19	LNB + FGR	Coal-fired boilers, Oil/NG boilers, Process heaters, Pyrolysis furnaces	N (see LNB, FGR)
20	Low-Emission Combustion (LEC)	Reciprocating Engines	Y
21	Low NO_x Burners	Coal-fired boilers, Oil/NG boilers, Glass Melters, Pyrolysis furnaces, Process heaters, Cement kilns	Y
22	Low-NO_x Calciner	Cement kilns	Y
23	Mid-kiln or tower tire injection	Cement kilns	Y
24	Non-Selective Catalytic Reduction (NSCR)	Reciprocating Engines	Y
25	NOxTech	Reciprocating Engines	Y
26	Overfire Air	Coal-fired boilers, Wood/Biomass boilers. Oil/Nat'l Gas Boilers	Y
27	Oxy-Fuel Firing	Glass Melters	Y
28	Oxygen-enhanced Combustion Modifications	Coal-fired boilers, Cement kilns, Glass Melters	Y
29	Pre-stratified Charge	Reciprocating Engines	Y
30	Rich Reagent Injection (RRI)	Coal-fired boilers	N (see SNCR)
31	SCONOX	Oil/Nat'l Gas Boilers, Reciprocating Engines, Gas Turbines	Y
32	SCR	Coal-fired boilers, Oil/NG boilers, Glass Melters, Pyrolysis furnaces, Process heaters, Reciprocating Engines, Gas Turbines	Y

	Technology	Applicability	Summary in Appendix C (Y/N)
33	SNCR	Coal-fired boilers, Wood/Biomass boilers Oil/NG boilers, Glass Melters, Pyrolysis furnaces, Cement kilns, Reciprocating Engines, Gas Turbines	Y
34	Tempering (Steam, water or air injection)	Gas turbines, Process heaters, Pyrolysis furnaces	Y

Table 15. Coal-Fired Boilers.

Technology	Description	Applicability	Performance	Cost, $/T	Commercial
Burner Modifications	Burner air and/or fuel modifications to improve air/fuel interaction	Most units.	10 to 30% NO_x reduction	100-200	Y
Fuel Reburn	Inject portion of the fuel into the furnace downstream of burner zone. Usually requires OFA to complete combustion	Most units. Furnace height (residence time) may restrict some applications	20 to 30% NO_x reduction for Fuel-Lean Gas Reburning (no OFA), and 30 to 60% reduction for conventional reburning.	500-2000 (Highly dependent on cost of reburn fuel)	Y
Hybrid Reburn + SNCR	Co-inject reburning fuel and SNCR reagent.	Same as individual technologies.	50-70%	300-600	Y
Hybrid SNCR + SCR	Overfeed reagent into the furnace, and allow ammonia carryover to further reduce NO_x over a catalyst downstream.	Same as individual technologies.	50 to 90% NO_x reduction, de-pending on how much catalyst is installed.	800-2000	Y
Hydrocarbon-enhanced SNCR	Inject small amount of natural gas to create radicals that enhance SNCR effectiveness at 1700 to 2000 °F. Emerging technology.	Most units. Can use more NH_3 with less slip.	40 to 60% NO_x reduction	500-1000	Y
"Intelligent" Controls	Sensors and software optimize air-fuel ratio to burners.	Available for all units	0 to 30% NO_x reduction.	<100-300	Y
Low-NO_x burners (LNB)	Burners designed to produce lower NO_x emissions – "staged" combustion	Most boilers already have LNB.	30-50% NO_x reduction.	200-1000	Y
Overfire air (OFA)	Form of "staged" combustion. Divert portion of the air from the windbox to OFA ports installed above the burners.	Most units. Furnace height may restrict some applications	20 to 40% NO_x reduction.	250-600	Y

Table 15. Coal-Fired Boilers (Continued).

Technology	Description	Applicability	Performance	Cost, $/T	Commercial
Oxygen-enhanced combustion modification	Improve effectiveness of OFA operation by injecting O_2 into fuel-rich flames. Operate more fuel-rich without the problems. Emerging technology.	Best applied with new OFA system designed to achieve stoichiometric air-fuel ratio < 0.8.	30-50% beyond OFA	1000-2000	Y
Rich Reagent Injection (RRI)	SNCR applied to fuel-rich region of OFA system.	Most units. Modeling required to determine injection locations.	20 to 30% additional NO_x reduction beyond OFA.	800-1500	Y
Selective Catalytic Reduction (SCR)	Ammonia added upstream of catalytic reactor installed upstream of air preheater (conventional), downstream of a hot ESP (low dust), or downstream of the cold ESP (tail end).	Most units. Space availability may constrain some options. High sulfur fuels more challenging	70 to 90+% NO_x reduction	1500-2000	Y
Selective Non-catalytic Reduction (SNCR)	Inject ammonia-based reagent into upper furnace (1700-2000 degrees F) to destroy NO_x.	Most. Residence time and temperature characteristics are important.	25 to 50% NO_x reduction, depending on the furnace temperature and time for reaction.	800-1500	Y

Table 16. Reciprocating Engines.

Technology	Description	Applicability	Performance	Cost, $/T	Commercial
High Energy Ignition	Provide continuous electrical discharge at the spark plug gap for 10 to 90 ^{o} of crankshaft rotation. This extended energy delivery ensures combustion in the leanest of conditions.	For lean-burn engines (to support ignition under very lean conditions)	80% NO_x reduction. Use of plasma ignition is new, so there is limited operating experience.	115-200+	Y
High-Pressure Fuel Injection	Enhance mixing of fuel and air under lean conditions	Same as LEC	~80%	Not available, but less than LEC.	Y
Low-Emission Combustion (LEC)	Retrofit kits available to implement lean burn for new engines as well as retrofit.	Not available for all engines, some fuel efficiency decrease. Requires turbo-charging or inter-cooling upgrades.	80-90% NO_x reduction	190-700, depending on engine BHP. $6500 for 80 BHP.	Y
Non-Selective Catalytic Reduction (NSCR)	Install oxidation-reduction catalyst that uses hydrocarbons in exhaust to destroy NO_x.	Requires rich-burn engine to produce hydrocarbons used for NO_x reduction.	40-98% NO_x reduction, depending on engine speed. Average of 95% reduction is achievable.	<500	Y
NOxTech	Inject chemical reagent into exhaust at temperatures of 1400 to 1500 °F.	Applicable to all engines, but exhaust must be heated for most engines.	90-95% NO_x reduction, 60-80% particulate removal, 50-70% CO removal, 90% hydrocarbon removal.	~ 1000	Y
Pre-stratified Charge	Inject air into intake manifold so that the piston initially draws in air, followed by a fuel-rich air-fuel mixture.	For carbureted, rich-burn engines.	80-95% NO_x reduction.	< 500	Y

Table 16. Reciprocating Engines (Continued).

Technology	**Description**	**Applicability**	**Performance**	**Cost, $/T**	**Commercial**
SCONOX	Add chemical reactor for NO_x sorption, followed by regeneration.	Theoretically works for all engines. Catalyst regeneration is difficult. Little operating data available.	95% reduction of NOx, CO, and hydrocarbons.	Not available	Y
SCR	Inject ammonia upstream of a catalyst that operates at 300-900 °F.	All engine types (especially diesel), but difficult to control if load range is wide.	75-90% NOx reduction	< 1000	Y

Table 17. Cement Kilns.

Technology	Description	Applicability	Performance	Cost, $/T	Commercial
Air or fuel staging	Inject portion of the fuel downstream of the main flame to create locally reducing conditions where NO_x can be destroyed. Sometimes includes installing a "NO_x fan" to increase burnout.	More easily implemented in tower kilns.	0 to 50% NO_x reduction, depending on existing equipment.	1000-2000	Y
Biosolids injection	Add sewerage sludge to mid-kiln or tower for combined SNCR and fuel-staging affect.	Tried in long kilns and preheater/precalciner kilns, but effectiveness is limited by poor combustion and increased hydrocarbon or SO_2 emissions.	20 to 30% NO_x reduction, but can reduce kiln capacity due to high moisture content.	100-500	Y
Iron addition (CemStar)	Change cement formulation by adding waste iron to lower clinkering temperature and suppress NO_x.	Applicable to all kiln types, but may affect cement quality.	20 to 30% NO_x reduction, depending on cement specifications	0-100	Y
Kiln dust insufflation	Re-inject cement kiln dust (CKD) into flame zone to lower peak temperatures and increase clinker production.	Applicable to long kilns.	0 to 20% NO_x reduction in conjunction with a 0-5% kiln capacity increase.	100-300	Y
Kiln temperature control	Add temperature-monitoring device to kiln controls to minimize high-temperature excursions where more NO_x is emitted.	Applicable to all kiln types, but risks unacceptable cement quality.	0 to 20% NO_x reduction, and requires less operator attention.	200-500	Y
Low-NO_x Burner (LNB)	Replace open pipe burner with multi-annular design. Usually accompanied by installation of an indirect coal feed system to reduce coal transport airflow.	Applicable to all kiln types. Can reduce cement quality on some kilns.	0 to 20% NO_x reduction; production may increase.	500-1000	Y

Table 17. Cement Kilns (Continued).

Technology	Description	Applicability	Performance	Cost, $/T	Commercial
Low-NO_x calciners	Replace calciner with new low-NO_x design.	Applicable only to preheater/precalciner kilns.	30-50% NO_x. Little experience	1000-5000	Y
Mid-kiln or tower tire injection	Inject whole tires or shredded tires downstream of the flame to reduce NO_x formed in the burner.	Injected mid-kiln in long kilns, and into lower tower for preheater/precalciner kilns.	15 to 30% NO_x reduction; generate revenues.	0-1000	Y
Oxygen enrichment	O_2 lance to decrease fuel requirement for clinker formation.	Cement quality could be more difficult to control.	0 to 20% NO_x reduction and potential for additional capacity.	200-1000	Y
SNCR	Inject ammonia-based reagent into upper furnace (1700-2000°F) to destroy NO_x.	Applicable to preheater/precalciner kilns.	30 to 70% NO_x reductions, depending on access to temperatures in 1600-1800 °F range.	200-1000	Y

Table 18. Oil/Natural Gas-Fired Boilers.

Technology	Description	Applicability	Performance	Cost, $/T	Commercial
Flue Gas Recirculation (FGR)	Recycle 15-25% of the flue gas to the windbox to reduce flame temperature. Can use eductors for induced FGR	Most units, but could affect heat balance. Induced FGR requires pressure part changes.	40-80% NO_x reduction	500-3000	Y
Low-NO_x Burners	Burners designed to produce lower NO_x emissions – "staged" combustion	Most boilers.	30-60% NO_x reduction	200-1000	Y
Overfire Air (OFA)	Form of "staged" combustion. Divert portion of the air from the windbox to OFA ports installed above	Most units. Furnace height may restrict some applications	40-80% NO_x reduction	1000-2000	Y
SCONOX	Add chemical reactor for NO_x sorption, followed by regeneration.	Steam-hydrogen regeneration gas not practical for some boilers. Limited testing to date.	70-99% NO_x reduction claimed.	Not available	Y
SCR	Ammonia added upstream of catalytic reactor.	Most units. Space availability may constrain some options. High sulfur fuels more challenging	70-90+% NO_x reduction	2000-10000	Y
SNCR	Inject ammonia-based reagent into upper furnace (1700-2000^{o}F) to destroy NO_x.	Most. Residence time and temperature characteristics are important.	30-60% NO_x reduction	1300-3000	Y

Table 19. Turbines.

Technology	**Description**	**Applicability**	**Performance**	**Cost,$/T**	**Commercial**
Catalytic combustion	Catalytic combustor reduces combustion temperature below thermal NO_x limit.	Limited experience.	0.05 lb/MBtu (80% reduction) has been measured.	> 500	Y
DLN (fuel-lean combustion)	Low NO_x combustor is GT “equivalent” of LNB.	Most turbines. Flame instability a problem for some gas fuels.	0.1 lb/MBtu (70% reduction) can be guaranteed on new units.	1000-2000	Y
SCONOX	Add chemical reactor for NO_x sorption, followed by regeneration.	Reliability of system not yet proven.	0.02 lb/MBtu (> 90% reduction) claimed.	> 7000	Y
SCR	Add catalyst section to HRSG to destroy NO_x at temperatures of 600 to 900 °F.	Applied to most turbines	90 % reduction down to 0.03 lb/MBtu.	500-10000+	Y
Tempering (Water/ Steam Injection)	Spray water or steam into combustor to suppress flame temperature.	Can be applied to most turbines, but some will experience slight efficiency loss.	0.15 lb./MBtu (50% reduction) can be achieved.	2000-7000	Y

Table 20. Wood or Biomass-Fired Boilers.

Technology	Description	Applicability	Performance	Cost, $/T	Commercial
Fuel Reburn	Inject portion of the fuel into the furnace downstream of burner zone. Usually requires OFA to complete combustion	Stoker, water tube	40-60% NO_x reduction	300-3000	Y
"Intelligent" Controls	Sensors and software optimize air-fuel ratio to burners.	Watertube boilers	0-20 % NO_x reduction	200-500	Y
Overfire air (OFA)	Form of "staged" combustion. Divert portion of the air from the windbox to OFA ports installed above the burners.	Stoker, watertube	20-60% NO_x reduction	200-2000	Y
Selective Non-Catalytic Reduction (SNCR)	Inject ammonia-based reagent into upper furnace (1700-2000^o F) to destroy NO_x.	Stoker, FBC, watertube	40-80 % NO_x reduction reported	900-2200	Y

Table 21. Process Heaters.

Technology	Description	Applicability	Performance	Cost, $/Ton	Commercial
LNB + FGR	Staged firing with flue gas mixed with pre-combustion air	Oil/gas fired, MD only	50-60%	Gas: 1,720-2,480 Oil: 2,390-2,910	Y
Low-NO_x Burners, Ultra Low-NO_x Burners	Staged firing; Combines staged firing with induced flue gas recirculation	Oil/gas fired	30-50% Ultra-LNB: 50-80%	Gas: 1,210-1,820 Oil: 1,200-2,340 Gas: 810-1,280 Oil: 400-1,440	Y
SCR	Ammonia added upstream of catalytic reactor.	Oil/gas fired	75-90%	Gas: 5,130-10,600 Oil: 3,710-6,490	Y
SNCR	Inject ammonia-based reagent into upper furnace (1700-2000^o F) to destroy NO_x.	Oil/gas fired	50-70%	Gas: 1,470-2,640 Oil: 1,230-2,350	Y

Table 22. Glass Melting Furnaces.

Technology	Description	Applicability	Performance	Cost, $/Ton	Commercial
Batch/Cullet Preheating	Residual heat of waste gas used to preheat batch materials/cullet (recycled glass)	Any glass melting furnace w/ >50% cullet in batch	5-25%	890-1,040	Y
Electric Boost			10-30%	2,600-9,900	Y
Low-NO_x Burners	Burners designed to produce lower NO_x emissions – “staged”		40%	790-1,680	Y
Natural Gas Reburn	Inject portion of the fuel into the furnace downstream of burner zone.		50-65%	moderate	Y
Oxy-Fuel Firing	Oxygen used instead of air; requires different furnace design	Oil/gas fired furnaces	80-85%	2,150-4,400	Y

The formation of NO_x is a byproduct of the combustion of fossil fuels. Nitrogen contained in fuels such as coal and oil, as well as the harmless nitrogen in the air, will react with oxygen during combustion to form nitrogen oxides (NO_x). The degree to which this formation evolves is dependent on many factors, including both the combustion process itself and the properties of the particular fuel being burned. This explains why similar boilers firing different fuels or similar fuels burned in different boilers will yield different NO_x emissions.

As a result of these complex interactions in the formation of NO_x, an equally large number of approaches to minimize or reduce its emissions into the atmosphere have been and continue to be developed. A relatively simple way of understanding the many technologies available for NO_x emission control is to divide them into two major categories: (1) those that minimize the formation of NO_x during the combustion process (e.g., smaller quantities of NO_x are formed); and (2) those that reduce NO_x after the combustion process. It is common to refer to the first approach as "combustion modifications" whereas technologies in the second category are termed "post-combustion controls."

Within each of these categories, several technologies and variations of the same technology exist. Finally, combinations of some of these technologies are not only possible but often desirable as they may produce more effective NO_x control than the application of a stand-alone technology.

The following summaries describe the major technologies in each category.

3.2 Coal-Fired Boilers

Combustion modifications can vary from simple "tuning" or optimization efforts (similar to a "tune-up" of a car) to the deployment of dedicated technologies such as low-NO_x burners (LNB), Overfire air (OFA), or Reburn. All combustion modification approaches face a common challenge: that of striking a balance between NO_x reduction and fuel efficiency. The concern is exemplified by the typically higher carbon levels in the fly ash, which reflect lower efficiency (more fuel needed for the same electrical output) and which may contaminate the fly ash itself, possibly making it unsuitable for reutilization (e.g., cement and concrete production).

Combustion Optimization

Combustion optimization efforts can lead to reductions in NO_x emissions of 5%-15% or even higher in cases where a unit may be poorly "tuned." It is important to remember that optimization results are truly a function of the "pre-optimization" condition of the power plant or unit, and as such have limited opportunity for drastic emission reductions. Recent development of "intelligent controls" - software-based systems that "learn" to operate a unit and then maintain its performance during normal operation may go a long way towards keeping plants well-tuned as they age.

LNB's and OFA

LNB's and OFA represent practical approaches to minimizing the formation of NO_x during combustion. Simply, this is accomplished by controlling the quantities and the way in which fuel and air are introduced and mixed in the boiler (usually referred to as "fuel or air staging"). These technologies are the most prevalent in the power industry at present. For example, plants that have had to comply with Phase I of Title IV of the CAAA of 1990 have largely used these technologies for compliance. (Phase II of the Title IV has required the use of post-combustion technologies to meet more stringent requirements for both Group 1 and Group 2 boilers.) Competing manufacturers have proprietary designs, geared towards application in different boiler types, as well as reflecting their own design philosophies. LNB's and OFA, which can be used separately or as a system, are capable of NO_x reductions of 40% - 60% from uncontrolled levels. Again, the type of boiler (e.g., dry vs. wet-bottom, wall- vs. tangential-fired, NSPS vs. pre-NSPS) and the type of fuel (e.g., bituminous vs. sub-bituminous) will influence the actual performance achieved. NO_x emission rates on the order of 0.15 lb/MBtu can be achieved with low NO_x burners under circumstances, particularly in dry-bottom boilers burning low-rank coals.

LNB's/OFA have little or no impact on operating costs, other than those noted above. As such, the economics of these technologies are driven by capital/retrofit costs which typically range from $10-$40/kW, with the lower range reflecting easier "plug-in" application, whereas the higher costs are typically associated with more difficult and involved retrofits (e.g., where new controls or other systems may be replaced as part of the LNB retrofit).

From the standpoint of scheduling retrofits for existing units, LNB/OFA retrofit projects have "lead" times of 10-14 weeks and can require outages of 6-10 weeks, depending on factors such as scope of work, integration with other plant outage requirements, etc.

Reburn

Reburn, while generically included in the "Combustion Modification" category, is different from the other technologies in this group (LNBs/OFA) in that it "destroys" NO_x through chemically reducing conditions shortly after it is formed rather than minimizing its formation as discussed previously. From a practical standpoint, this is accomplished by introducing the reburn fuel (theoretically any fossil fuel can be used, but natural gas is the most common) into the boiler above the main burner region. Subsequently, this "fuel-rich" environment reacts with and "destroys" the NO_x formed in the main burners. This technology has been implemented in the U.S. and overseas, and while not as common as LNB/OFA, it is commercial at this time. Owing to stricter compatibility criteria, reburn is not as universal as LNB/OFA in its applicability to the overall boiler population. Specific criteria such as boiler size, availability of natural gas, type and quality of the main fuel are all important in determining the suitability of a unit for this technology. One important feature of reburn is its compatibility with cyclone boilers, for which the previously mentioned technologies are not particularly well suited. Cyclones boilers represent over 25,000 MW of capacity in the U.S.

Reburn performance has been shown to range from 35%-60% depending on such factors as reburn fuel type and quantity, initial NO_x level, boiler design, etc. Reburn can be thought of as a "dial-in" NO_x technology in that NO_x reductions are a function of the amount of reburn fuel. This feature may provide strategic value in compliance scenarios.

With respect to cost, systems using natural gas as the reburn fuel range from $15/kW to $30/kW whereas those using coal for reburn range from $30/kW to $60/kW. Operating costs are primarily driven by the fuel cost differential in the case of gas reburn, while for coal or oil reburn fuel preparation costs (pulverization and atomization, respectively) represent the dominating O&M costs. Countering these costs, particularly in the gas reburn case, are SO_2, particulates, and CO_2 co-benefits proportional to the fraction of gas used.

Project retrofit schedules for this technology are on the order of 15 to 20 weeks with 6 to 10 weeks of outage time likely.

Recently, reburn technology has evolved into several variations of the original approach. One of these is “Fuel Lean Gas Reburn" (FLGR) developed for specific applications where NO_x reductions of around 30%-40% may be required. FLGR uses less gas than conventional reburn (3%-7% vs 15%-20%), and its capital cost is less than $10/kW, making it a potentially effective option in specific applications.

SCR and SNCR

Readily available post-combustion NO_x controls are limited to selective non-catalytic reduction (SNCR) and selective catalytic reduction (SCR). They are fundamentally similar in that both use an ammonia-containing reagent to react with the NO_x produced in the boiler and convert it to nitrogen and water. SNCR accomplishes this at higher temperatures (1700ºF-2000ºF) in the upper furnace region of the boiler, while SCR operates at lower temperatures (about 600ºF) and hence needs a catalyst to produce the desired reaction between ammonia and NO_x.

While this difference between the two technologies may seem minor, it results in significant difference in performance and costs. This is because in the case of SNCR, the reaction occurs in a somewhat uncontrolled fashion (e.g., the existing upper furnace becomes the "makeshift" reactor, which is not what it was originally designed to be), while in the SCR case, a dedicated reactor and the reaction-promoting catalyst ensure a highly controlled, efficient reaction. In practice, this means that SNCR has lower capital costs (no need for a reactor/catalyst); higher operating costs (lower efficiency means that more reagent is needed to accomplish a given reduction in NO_x); and finally, has limited NO_x reduction capability (typically 30%-40%, with some cases achieving reductions in the 50% range). SCR, on the other hand, has higher capital costs but offers lower operating costs and the opportunity for very high NO_x reductions (up to 90%).

Capital costs range from $10 to $15/kW and $60 to $100/kW for SNCR and SCR, respectively. Operating costs are driven primarily by the consumption of the chemical reagent – usually urea for SNCR and ammonia for SCR, which in turn is dependent upon the efficiency of the process (usually referred to in terms of reagent utilization) as well as the initial NO_x level and the desired percent reduction. Two additional parameters important in the overall operating costs are (1) the potential contamination of fly ash by ammonia, making it unusable and (2) the life cycle of the catalyst due to fly ash.

Combined Approaches

In theory, most of these technologies can be used together. However, NO_x reductions are not necessarily additive, and more importantly, the “economics” of the combined technologies may or may not be cost-effective. Such analyses are highly site- and strategy-specific.

However, several such combinations of technology are considered attractive and have or are gaining acceptance. For example, the combination of LNB/OFA with either SCR or SNCR is more prevalent than the application of the post-combustion technologies alone. The economics of this approach are justified by the reduced chemical (SNCR) and capital costs (SCR – smaller reactor/catalyst) due to lower NO_x levels entering the SCR/SNCR system. Another example is the combination of Reburn with SNCR, driven by the synergisms between the two (similar location, temperatures in the boiler). This application may yield NO_x reductions of 60%-70% with capital costs in the $20-$30/kW range, but has a relatively high operating cost due to reagent and reburning fuel consumption.

3.3 Reciprocating Engines

Several control technologies are available for ICE’s, having a wide range of complexity, cost and performance.

Some in-cylinder methods offer low to moderate NO_x reductions at costs well below $1,000/ton. These include injection timing retard, and air/fuel ratio adjustment (with or without high-energy ignition). These methods are widely available, and NO_x performance will vary from one engine design to another. However, fuel efficiency can suffer as a result of these methods and emissions of products of incomplete combustion can increase.

Spark-ignited engines that can be retrofitted with Low-Emission Combustion (LEC) technology can potentially achieve significant NO_x reductions (80 to 90%). LEC technology can be expensive to retrofit on some engines, and it may not be available from all engine manufacturers. For large, low-speed engines, LEC technology is estimated to provide annual NO_x reductions of about 80% at under $1,000/ton under most conditions. LEC technology is estimated to be more cost effective on smaller, medium-speed engines (under $500/ton for annual control under most conditions). It is estimated to be somewhat more expensive for dual-fuel engines (annual control at a capacity factor of 65% is estimated to cost under $1,000/ton).

SCR is the only commercially available choice for post-combustion control of diesel and lean-burn spark-ignition engines. Experience in the U.S. with SCR on these engines is growing, especially for diesel engines. SCR has been applied to approximately 30 diesel engines and to an equivalent number of constant-load lean burn ICE’s. Experience with SCR on variable-load engines is limited. In analysis using data from case studies, it was estimated that SCR provides annual NO_x reductions of as high as 90% at a cost below $1,000/ton in all cases, except for very low capacity factors (~10%), and it provides seasonal reductions at a cost of under $1,000/ton for engines operating at high capacity factors (typically, 65% or greater).

Recent developments from the application of urea-SCR on mobile sources (diesel trucks) offer the possibility of reducing the size and capital cost of SCR systems for stationary ICE’s. This new technology, developed from efforts to apply SCR to mobile diesel engines, appears to make it possible to achieve much more cost-effective NO_x reduction on stationary ICE's that operate for only a few hundreds of hours a year. NO_x reduction of about 75% is estimated to be possible for under $2,000/ton even for seasonal controls of some stationary ICE's that operate only a few hundred hours each ozone season. Seasonal control at a cost of under $1,000/ton is estimated to be achievable for most applications with capacity factor greater than 45%.

3.4 Cement Kilns

As with other combustion systems, modifying the combustion process is one strategy for reducing NO_x in cement kilns. However, the quality of the clinker produced by the kiln can be affected by combustion modifications so these must be undertaken carefully.

Monitoring temperature and excess air in the combustion zone increases the efficiency of the cement-making process and can result in reduced NO_x emissions. Combustion modifications include staged combustion of air or fuel. Specifically designed low-NO_x burners are sometimes used. Even without low-NO_x burners, staging can be achieved by adding some of the fuel mid-kiln, as in mid-kiln injection of tires. Mid-kiln injection of fuel (most often tires) was in practice in twenty kilns in the U.S. in 2000.

Iron addition (CemStar process) has been used at about a dozen facilities in the U.S. This reduces the temperature needed in the kiln for formation of clinker and allows the combustion zone to operate cooler (and thus reducing NO_x).

Post-combustion (post-kiln) NO_x controls include SCR and SNCR. SCR has not been used on cement kilns in the U.S.; pilot studies have been conducted in Europe. SNCR technology requires a specific temperature window and residence time; these are not attainable in all cement kilns. SNCR can be applied to preheater/precalciner kilns. SNCR is widely practiced in Europe on cement kilns, but to date there have been only a handful of demonstrations in the U.S.

3.5 Natural Gas and Oil Fired Boilers

The menu of NO_x control options for gas and oil-fired boilers is essentially the same as for coal-fired boilers. One noted exception is the use of Flue Gas Recirculation (FGR), which is not effective in coal applications and hence, is not mentioned there.

While the control technologies are common to the coal-fired options, application issues require different considerations and analyses. Examples range from differences in the inherent NO_x formation amongst the fuels (thermal NO_x vs. "fuel"-NO_x), which dictate that combustion-based technologies are designed accordingly for each fuel, to the fact that gas produces no PM or SO_2/SO_3 and hence can afford some design changes from coal and oil applications. Equally important are the economics of the different fuels, which may favor different technology approaches.

In summary it can be said that the available menu of technologies is the same as for coal applications, but that (at least for gas), deployment of these technologies tends to be less constraining than for coal.

3.6 Turbines

There have been some important developments in gas turbine NO_x control technology, but well-established technologies continue to play an important role in reduction of NO_x. Dry Low NO_x (DLN), catalytic combustion, and some new post-combustion methods are making their way into the control technology market, while water or steam injection and SCR continue to be important technologies for reducing NO_x from gas turbines.

Many turbine manufacturers can convert or replace conventional combustors on existing turbines with DLN combustors. DLN combustion retrofits have been made possible by recent developments in gas turbine combustor technology. DLN technology offers the potential for substantial reduction of NO_x from turbines firing natural gas or other low-nitrogen fuels, as well as improved engine performance when compared to wet controls (water or steam injection). For turbines under about 15 MW in size, NO_x emissions of 25 ppm can be guaranteed for new turbines and emissions below 42 ppm can be guaranteed for retrofitted turbines. For large turbines (75 MW and higher in size), controlled NO_x emission levels of as low as 9 ppm have been guaranteed, even for retrofits.

DLN capital costs vary with the size of the turbine and the specifics of the particular turbine being retrofitted. The baseline NO_x level significantly affects the estimate of cost per ton of NO_x reduced. Using expected baseline NO_x emissions levels provided by the turbine manufacturers and retrofit costs expected to be typical of most applications, retrofit of DLN on industrial turbines (about 3 to 10 MW) originally equipped with conventional combustion control is estimated to provide NO_x reductions under $2,000/ton for annual controls with high capacity factors and at a higher cost for seasonal controls. For larger turbines (~75 MW), cost was estimated to be well below $1,000/ton for nearly all conditions.

Water injection and steam injection are two well-established technologies that can offer controlled NO_x emission levels below 42 ppm in many cases. Because water or steam injection technologies frequently have lower capital cost than DLN but higher variable costs, these technologies can be more attractive for peaking turbines or other turbines that operate infrequently. It was estimated that water injection installed on peaking units that operate 200 hours to 400 hours in the summer would reduce NO_x at a cost of about $2,500/ton to about $7,000/ton, depending upon the number of operating hours and the fuel used (gas or distillate oil).

SCR continues to be the most widely used post-combustion technology for gas turbines. Catalyst technology developments have made SCR viable over a wider temperature range. This makes SCR a viable control option in situations that were difficult in the past, such as simple-cycle turbines that may now benefit from high-temperature SCR and combined-cycle turbines with duct burners that may now benefit from low-temperature SCR.

The cost of NO_x reduction with SCR varies considerably according to application, turbine size, and the type of SCR technology that is appropriate for the application. As in the case of the DLN cost estimates, expected baseline NO_x emissions levels provided by the turbine manufacturers were used as a basis for cost calculations. Conventional SCR on a large (~75MW) combined-cycle turbine with high capacity factors was estimated to cost about

$440/ton for annual controls and $870/ton for seasonal controls, for turbines equipped with conventional combustion technology (baseline NO_x emissions of 154 ppm). For turbines with lower baseline NO_x emissions (such as those equipped with DLN combustors having baseline NO_x emissions of 15 ppm), the cost per ton of additional NO_x removed was estimated to be greater, ranging from about $3,700/ton (annual control, high capacity factor) to over $13,000/ton (seasonal controls, low capacity factor). On smaller turbines (~5 MW), the cost of conventional SCR is estimated to be as low as $1,300/ton (with annual control and conventional combustion technology having baseline NO_x emissions of 142 ppm). Seasonal controls for smaller turbines are estimated at over $15,000/ton of NO_x removed at a low capacity factor (45%) with baseline NO_x emissions of 42 ppm.

For installations that may be better suited for high- or low-temperature SCR variants, such as simple-cycle turbines (high-temperature SCR) or combined-cycle turbines with limited space (low-temperature SCR), the cost of SCR is somewhat higher than for conventional SCR on a combined-cycle plant. A 75 MW turbine at a high capacity factor equipped with conventional combustion technology (baseline NO_x emissions of 154 ppm) can be controlled annually with high- or low-temperature SCR for about $550/ton and for about $1,200/ton seasonally. As with conventional SCR, turbines with lower baseline NO_x emissions (such as those equipped with DLN combustors) showed a higher cost per ton of NO_x reduction. The estimated cost of NO_x reduction for a 75 MW turbine with baseline NO_x emissions of 15 ppm ranges from $5,170/ton (annual controls, high capacity factor of 85%) to as high as $20,000/ton (seasonal controls, low capacity factor of 45%). On smaller turbines (~5MW), the cost for high- or low-temperature SCR is estimated to be as low as $2,000/ton with annual control and conventional combustion technology (baseline NO_x emissions of 142 ppm). Cost is estimated to range from $6,750/ton (annual controls, high capacity factor of 85%) to about $27,000/ton (seasonal controls, low capacity factor of 45%) with baseline NO_x emissions of 42 ppm.

Emerging combustion technologies (such as catalytic combustion) and post-combustion technologies (such as SCONOx) offer the potential for very low NO_x emission levels. Because there is much less experience with these technologies, available cost information is limited.

4 PM CONTROL TECHNOLOGIES

4.1 Overview

As discussed in Section 2, 8 source categories make up about 92% of the PM emissions and are summarized in Table 23. Detailed information on PM control technologies has been obtained for industrial processes that generate particulate matter. We have not provided cost information on fugitive emissions, however, since costs of fugitive dust control are highly variable and it is difficult to find an adequate metric for costs and then quantify them.

Table 23. PM emissions from top eight source categories.

	# Units	Total PM TPY	% PM Emissions
Coal-Fired Boilers	88	46,010	40%
Mineral Processing	85	24,499	21%
Petrochemical	42	10,836	9%
Wood Boilers	24	5,718	5%
Refinery Emissions	11	5,631	5%
Primary Metal Production	20	4,697	4%
Pulp and Paper	15	4,476	4%
Smelting Operations	8	3,555	3%
Others	28	9,168	8%
Total (>100 TPY)	**321**	**114,589**	

Table 24 lists all the technologies considered. These are commercial technologies, in that vendors are offering these technologies with demonstrated operating experience in a wide range of applications. Table 24 gives the following information about each technology:

- Name
- Source categories to which the technology can be applied
- Summary prepared? (Y/N)

Technology summaries are contained in Appendix D.

Table 24. PM Control Technologies

	Technology	Applicability	Summary (Y/N)
1	Cyclones	Coal-fired boilers, Oil/NG boilers, Wood/Biomass boilers, Cement kilns, Smelting	Y
2	Electrostatic precipitator (ESP)	Coal-fired boilers, Oil/NG boilers, Wood/Biomass boilers, Cement kilns	Y
3	Fabric Filter	Coal-fired boilers, Oil/NG boilers, Wood/Biomass boilers, Cement kilns	Y
4	PM Scrubber	Coal-fired boilers, Oil/NG boilers, Wood/Biomass boilers, Cement kilns, smelting	Y
5	Surface modification • Water • Surfactants • Shape	Fugitive Emissions, Mineral Products	N
6	Traffic operations	Fugitive Emissions, Mineral Products	N

4.2 PM Control for Coal-Fired Boilers and Other Combustion Sources

Particulate matter is generated by a variety of physical and chemical processes. It is emitted to the atmosphere through combustion, industrial processes, fugitive emissions and natural sources. In combustion processes, the mineral matter (inorganic impurities) is converted to ash. The particles suspended in the flue gas are known as fly ash. Fly ash constitutes the primary particulate matter, which enters the particulate control device. Particulate matter is in general referred to as "PM", "PM10", "PM2.5" (particulate matter (PM) with an aerodynamic equivalent diameter of 10 microns or less and 2.5 microns or less, respectively).

Quantity and characteristics of the fly ash and particle size distribution depend on the mineral matter content of the fuel, combustion system, and operating conditions. Combustion technique mainly determines the particle size distribution in the fly ash and hence the final particulate emissions. Common combustion systems in pulverized coal firing include dry bottom, wall (front, opposed) and corner (tangential) burners and wet bottom furnaces. In dry bottom boilers, 10-20% of the ash is discharged as dry, bottom ash. In wet bottom boilers, 50-60% of the ash is discharged at the bottom of the boiler as slag. Stokers or grate-fired boilers are used to burn coal, wood and waste. The majority of the ash falls through the grate and is discharged as bottom ash. Mineral composition of the coal and the amount of carbon in the fly ash determine the quantity, resistivity and cohesivity of the fly ash.

PM emissions from other point source processes involve similar phenomena where particulate matter is carried with the flue gas, in suspension to the stack. Hence, the general technologies applicable to one source are typically suitable for the others as well. Factors such as type and quantity of PM, characteristics of the process gas (temperature, moisture, other contaminants) will have a major influence on the selection and design of the PM control technology.

Without getting into the details of the various technologies, the following four major types of particulate controls technologies are common for a variety of applications:

- Wet scrubbers – scrubbers work on the principle of rapid mixing and impingement of the particulate with the liquid droplets and subsequent removal with the liquid waste. For particulate controls the "venturi scrubber" is an effective technology whose performance is directly related to the pressure loss across the venturi section of the scrubber. Venturi scrubbers are effective devices for particulate control. However, for higher collecting efficiencies and a wider range of particulate sizes, higher pressures are required. High-energy scrubbers refer to designs operating at pressure losses of 50-70 inches of water. Of course, higher pressure translates to higher energy consumption. Performance of scrubbers varies significantly across particle size range with as little as 50% capture for small (<2 microns) sizes to 99% for larger (>5 microns) sizes.

- Electrostatic Precipitators (ESP) –ESP's operate on the principle of electrophoresis, by imparting a charge to the particulates and collecting them on opposed charged plates. Dry vs. wet refers to whether the gas is water cooled and saturated prior to entering the charged plate area, or is collected dry on the plates. In gases with high moisture content, dry ESP's are not suitable because the wet gas would severely limit the ability to collect the "sticky" particulates from the plates. The wet ESP technology is capable of very high removal efficiencies and is well-suited for the wet gas environments. Both types of ESP's are capable of 99+% removals for particle sizes above 1 micron.

- Fabric Filters – These are essentially "giant" vacuum cleaners. As in the case of the dry ESP, Fabric Filters are not well suited for wet gas applications. However FFs are extremely efficient in collecting PM including fine (submicron) size fractions.

- Cyclones – Cyclones are devices that separate particulates from the gas stream through aerodynamic/centrifugal forces. However, the technology is only effective in removing larger size particulates (greater than about five microns).

4.3 Other Developments

While the technologies above represent the major available options for particulate control from point sources, it is relevant to note that advancements and innovative application of these technologies have and will continue to occur. Examples of these can vary from simple retrofits (e.g. new filter bag materials for Fabric Filters or newer spark control electronics on ESPs) to innovations including electrostatically- enhanced fabric filtration and hybrid concepts that combine attributes of various technologies.

The Electric Power Research Institute's (EPRI) COHPAC process and the University of North Dakota Energy and Environmental Research Center's Advanced Hybrid Particulate Collector

(AHPC) are examples of hybrid particulate collectors. In COHPAC, an ESP is followed by a pulse-jet Fabric Filter either immediately following it or actually integrated into the original casing of the ESP (in the case of larger older ESP's), where the FF acts as a "polishing" device significantly increasing the overall and fine particulate collection efficiency of the ESP alone. The AHPC technology can be described as an ESP with alternating rows of electrode plates and highly efficient membrane filter bags. In this case, the technology benefits from good synergism between the ESP and FF during bag cleaning resulting in very high performance levels, small sizes and operational flexibility.

4.4 Costs

As with most control technologies, the costs of PM controls involve both capital and operating costs. A cost-effectiveness indicator such as $/ton as is typically used for other technologies (e.g. NO_x and SO_2) is very difficult to address for generic PM control costs, as the range of PM reductions for different fuels and processes is wide that cost ranges become useless. An attempt to summarize costs in terms of capital and O&M components is presented below.

Capital

While it is customary to indicate capital costs on a $/kW basis for power generation applications, this is not relevant for non-power applications since no electricity is generated. However, one of the main parameters dictating the "sizing" and hence, the costs of a PM control device, is the quantity of flue gas it must handle. As a result, it is more appropriate to generalize capital costs on a "$/ACFM" basis. The following values represent typical costs for several of these technologies (these numbers reflect unit sizes ranging from utility-size units up to about 2,000,000 ACFM to smaller process down to about 10,000 ACFM))

- Dry ESPs - $15 - $40/ACFM
- Wet ESPs - $15 - $40/ACFM
- Reverse Air Fabric Filter - $17 - $40/ACFM
- Pulse Jet Fabric Filter - $12 - $40/ACFM
- Venturi Scrubber - $5 - $20/ACFM
- Cyclone - $1 - $5/ACFM

O&M

O&M costs are difficult to generalize for such a variety of technologies and applications, as they are affected by many parameters that include type of fuel, type of process, local ash disposal options, local cost of power, etc. O&M costs include fixed costs (FOM) and variable costs (VOM). The costs provided below are presented in $/year-ACFM and reflect costs for coal based fuels but should reasonably apply to other sources as well.

Fixed O&M

- Dry ESPs - $0.25 - $0.65/yr-ACFM
- Wet ESPs - $0.15- $0.50/yr-ACFM
- Reverse Air Fabric Filter - $0.35 - $0.75/yr-ACFM

- Pulse Jet Fabric Filter - $0.50 - $0.90/yr-ACFM
- Venturi Scrubber - $0.25 - $0.65/yr-ACFM
- Cyclone – Not applicable

Variable O&M

- Dry ESPs - $0.45 - $0.60/yr-ACFM
- Wet ESPs - $0.25 - $0.50/yr-ACFM
- Reverse Air Fabric Filter - $0.70 - $0.80/yr-ACFM
- Pulse Jet Fabric Filter - $.90 - $1.1/yr-ACFM
- Venturi Scrubber - $1.2 - $1.8/yr-ACFM
- Cyclone – Not applicable

5 MULTI-POLLUTANT CONTROL TECHNOLOGIES

Emerging environmental issues and proposed federal legislation (President's Clear Skies Initiative, Carper Bill, Jeffords' Bill) as well as state legislation (examples include MA, NY, NC, NH, CT) have driven interest in multi-pollutant (as opposed to single pollutant) control technologies capable of addressing air pollutant emissions more comprehensively with greater flexibility and ultimately lower cost. Multi-pollutant control technologies integrate in-situ and/or post-combustion controls of at least two of the following pollutants: SO_2, NO_x, and Hg (and other hazardous air pollutants including cadmium, arsenic, and nickel), and CO_2. Multi-pollutant controls are intended primarily for large utility coal-fired boilers since the complexity of some of these processes as well as regulatory drivers often limit them to larger, utility boilers. Since coal-fired boilers represent the single largest source category for both NO_x (as well as SO_2 and Hg) and PM in the thirteen-state region, it is worth considering some of these technologies.

5.1 Proposed Multi-pollutant Emission Regulations from Utility Boilers

In 2002 and 2003 three "multi-pollutant" bills were introduced in the US Congress that call for coordinated reductions in NO_x, SO_2, and Hg from coal-fired power plants [26]. Some of the bills also include emission limits for CO_2. The three bills are briefly summarized here.

- The Clean Power Act (CPA, Jeffords) would amend the CAA to require electric power generation sources greater than 15 MW. It is the most stringent of the three proposals. It will cap SO_2 emissions at 2.26 mm TPY in 2008 (0.28 mm TPY in the western region that includes WRAP states and MT, WY and CA; and 1.98 mm TPY in the eastern region). For NO_x, the cap of 1.51 mm TPY is to be met by 2008. The cap on Hg is at 5 TPY, also to be met by 2008. In addition, this bill sets a cap of 2.08 billion TPY for CO_2 to be met by 2008 (roughly 1990 levels). Except for Hg, national trading will be allowed to meet the caps.

- The Clear Skies Act (CSA) has been proposed by the Bush administration. It is the least stringent of the three proposals. It would cap SO_2 emissions at 4.5 mm TPY in 2010 and at 3 mm TPY in 2018. The corresponding limits for NO_x are 3 mm TPY (in 2008) and 1.7 mm TPY in 2018. For Hg, the proposed national caps are at 26 TPY in 2010 and 15 TPY in 2018. There are no limits for CO_2. A national trading program similar to the existing trading program for SO_2 emissions under Title IV of the Clean Air Act will be the implementation mechanism to achieve these caps. All electric generation sources greater than 25 MW would fall under this program.

- The Clean Air Planning Act (CAPA, Carper,Breaux, Baucus, and Chafe)) was intended as middle ground between the CPA and CSA. For SO_2, the caps are 4.5 mm TPY by 2008, 3.5 mm TPY by 2012, and 2.25 mm TPY by 2015. The caps for NO_x are 1.87 mm TPY by 2008 and 1.7 mm TPY by 2012. The Hg cap limits are 24 TPY by 2008, and a potential cap of 5-16 TPY by 2012 (this cap to be set by EPA and implies a control in the range of 79 to 93% from current Hg emission level). Cap and trade program will be the implementation mechanism for all four pollutants, except trading for Hg will be limited. In a "hybrid" approach, limited trading for Hg would be allowed (each plant will be required to reduce its Hg emissions at site by at least 50% in 2008 and by 75% in 2012). For CO_2, CAPA proposes to stabilize CO_2 emissions at 2005 levels (approximately 2.6 billion TPY) by 2008, and then stabilize to 2001 levels (approximately 2.4 billion TPY) by 2012.

All three bills recognize and incorporate the WRAP SO_2 trading program by setting separate caps on SO_2 emissions in the West. The CPA and CAPA allow nationwide trading of NO_x, while the CSA divides the country into two zones for NO_x trading. The western zone includes the ND, SD, NE, OK, KS, western TX, the eleven states west of the Rockies, AK, HI and the U.S. territories. The largest differences among the three bills are in the Hg emissions reduction requirements. The first-phase Hg emissions caps under CSA and CAPA are about the same, but compliance would come two years earlier under CAPA. CPA has the most stringent Hg reduction requirement: a cap of 5 TPY or about 90% control. The CSA would allow nationwide Hg trading, while the CAPA would allow partial trading. There is no trading under CPA.
Both CSA and the first phase of CAPA have modest Hg emission reduction targets; these would make it possible in some cases to achieve reduction of Hg as a "co-benefit" of other control technologies, for example, from the combination of an SCR and wet scrubber. If one of these bills were enacted, there might be some additional incentive to install an SCR and/or FGD on plants for which there might not be justification on the basis of a single pollutant.
In terms of Hg co-benefits, the West is at a disadvantage as compared to the East. In the latter region, more utilities burn bituminous coals that are high in chlorine (which tends to increase the amount of oxidized Hg in flue gas) and in sulfur. Wet scrubbers are effective for the removal of oxidized Hg, but ineffective for removal of the elemental Hg that is the predominant form of Hg in many western power plants. If all coal-fired power plants must reduce Hg emissions by upwards of 70%, the West will have a more difficult job than the East, owing to differences in coal composition. The bills that allow Hg trading (CSA and CAPA) would allow western power plants to deploy Hg control technology at plants were the highest emissions reductions are likely to be achieved.

If the CPA is enacted or if none of the three bills are enacted this year, it is likely that EPA will continue with the MACT process for Hg control, which does not allow trading and which will probably impose a Hg emission reduction target in the range of 70% to 90% (or an emission limit in the range of 0.2 to 0.6 pound of Hg per trillion Btu input). In this case, coal-fired power plants will have to look at application of activated carbon injection, the most mature technology for Hg control currently, or one of the multi-pollutant processes under development. Activated carbon injection may require adding additional particulate control equipment (such as a polishing baghouse with high cloth to air ratio), which will lower PM as well as the emissions of other hazardous pollutants including arsenic, chromium, lead, manganese, and nickel) as a consequence.

5.2 Multi-pollutant Control Technologies

A multi-pollutant control technology may be one integrated process or a combination of synergistic processes. In addition to in-situ and post-combustion control processes, options such as advanced power generation technologies, power plant rehabilitation-upgrading-repowering, fuel switching or blending and power plant optimization are sometimes included in the multi-pollutant control category. Emerging and commercial processes for multi-pollutant control for coal-fired boilers are summarized in Table 25, which is largely taken from Reference 4, with more recent information from the DOE-EPRI-U.S. EPA -A&WMA Combined Power Plant Air Pollutant Control Symposium in Washington, D.C., May 19-22, 2003.

Approximately half of the options listed in Table 25 are in commercial and early commercial stages. However, nearly all the options in commercial stage are proven SO_2 control technologies, which also remove Hg, advanced power generation options and power plant upgrading-fuel switching options. Nearly all in-situ and post-combustion controls (SO_2-NO_x or SO_2-NO_x-Hg) are either in demonstration or pilot-scale. Some technologies (e.g., SNO_X, SNRB, Advacate and CZD) have been tested either in pilot or demonstration scale in the early phase of the U.S. Department of Energy's Clean Coal Technology (CCT) program, but have not been adopted by the industry. Some of these technologies may become more cost-effective if additional controls are required. Most of the environmental control processes increase the auxiliary power requirements of the plant (some up to 5%, but mostly in the range of 1 to 2%), increasing proportionally the CO_2 emissions.

Emerging post-combustion, multi-pollutant control technologies are being developed by a number of companies. The Electro-Catalytic Oxidation (ECO) system is a four-stage pollution control process that integrates established technologies to remove SO_2, NO_x, Hg and PM2.5. The system also produces a valuable fertilizer byproduct. The AIRborne process removes SO_2 and NO_x from plant emissions while turning the leftover material into a high-quality granular fertilizer. EnviroScrub is a dry scrubbing system that results in control of SO_2, NO_x, and possibly mercury and results in a byproduct that can be sold into the fertilizer, chemical, and/or explosives industry. None of these technologies controls emissions of CO_2.

Capital costs of options controlling two pollutants (either SO_2-NO_x or SO_2-Hg) are projected to be in the 50-315 $/kW range, but there is significant uncertainty associated with these estimates because of their early stage of development. Also, lack of information, especially associated with O&M costs, makes it difficult to compare their cost-effectiveness. Further monitoring and updating of cost-related information is needed. For reference, the costs of the combined commercial technologies, FGD and SCR are above 200-250 $/kW.

Advanced power generation technologies such as circulating fluidized bed (CFB), pressurized fluidized bed (PFBC) and integrated gasification combined cycle (IGCC) are potentially attractive options because they are revenue-generating options, while reducing significantly SO_2 and NO_x, and to a lesser extent CO_2. These options are available mainly for new power plants. Also, supercritical pulverized coal boiler provides an attractive alternative to subcritical pulverized coal boiler for nearly the same investment and results in an additional 4-12% reduction of all emissions. While this may not seem to be a significant percentage, their cost-effectiveness is attractive; also, the amount of CO_2 reduction (in tons or tons per year) is significant.

Of particular interest are options such as power plant optimization, fuel blending or switching and power plant upgrading. These options may play an important role in a flexible compliance regulatory framework and may result in significant savings for the utility industry compared to the implementation of control technology options. Optimization involves only operating changes, and while it results in only minor emission reductions, its costs are very low and therefore it is an attractive option and should be pursued in all power plants. Fuel blending or switching, and power plant upgrading provide significant opportunities for emission control, but their site-specific nature makes it difficult to generalize regarding their emission reduction potential and cost-effectiveness. A more site-specific assessment is recommended to assess the potential for these options in a typical utility system.

Table 25. Commercial and Emerging Multi-Pollutant Control Technologies for External Combustion Boilers.

Technology	**Status**	**Emissions Reductions**	**Applicability**	**Issues**
SO_2/Mercury Control				
Dry Scrubbers (conventional)	C	SO_2: >95%; NO_x: NA; Hg: 5-85%	Low to medium sulfur coals	Hg removal can vary significantly with coal type, operating conditions
SO_2 sorbents, low temperature	P/C	SO_2: 40-85%; NO_x: NA; Hg: 0-90%	Units with ESP or FF for particulate control	Potential impacts on ESP or FF
SO_2 sorbents, furnace injection	C/D	SO_2: 65-70%; NO_x: NA; Hg: 65-90%	Existing plants, especially older units less than 300 MW	Demonstration on long-term basis needed
Activated carbon with SO_2 sorbent processes	P/C	SO_2: 40-85%; NO_x: NA; Hg: 50-90%	Units with ESP or FF for particulate control	Not used commercially, potential impacts on ESP or FF
Wet FGD with mercury oxidation processes	P	SO_2: 95%; NO_x: NA; Hg: 80+%	Wet Scrubber Plants	Full scale demonstration underway, insufficient information at present
Wet FGD with wet ESP	C/P	SO_2: 99%; NO_x: NA; Hg: 80+%	Integration with wet scrubbers, retrofit dry ESPs, new units	Few application in power industry, potentially expensive alloys required
Advanced Dry FGD	P/C	SO_2: 90-98%; NO_x: NA; Hg: <90%	NOX-Hg control for low to medium sulfur coals(same as Spray Dryers)	Hg removal may vary significantly with coal type, operating conditions (similar to Spray Dryers)
SO_2/NO_x Control				
E-BEAM	C/D	SO_2: 95+%; NO_x: 50-90%; Hg: NA	New and retrofit	High costs and auxiliary power requirements
SNOX	C	SO_2: 90+%; NO_x: 50-90%; Hg: 0%	New and retrofit	Cost-effectiveness
SNRB	P	SO_2: 80-90%; NO_x: 50-90%; Hg: 0%	New and retrofit	Requires demonstration
AIRborne	D	SO_2: 90->99%; NO_x: 50-60%; Hg: 30-75%	New and retrofit	Demonstration in progress; capital cost comparable to FGD-SCR
Thermal NOX	D	SO_2: 90-95%; NO_x: 80-90%; Hg: NA	New and retrofit	In demonstration

Status: P = pilot stage; C = commercial; D = demonstration

Table 25. Commercial and Emerging Multi-Pollutant Control Technologies for External Combustion Boilers. [Continued]

Technology	Status	Emissions Reductions	Applicability	Issues
SO_2/NO_x/Mercury Control				
Activated Coke	C	SO_2: 90-98%; NO_x: 60-80%; Hg: 90-99%	New and retrofit	High costs, especially operating costs due to high activated coke costs
Activated carbon with particulate controls	P/C	Hg: 50-90%	Retrofit and new units with ESP an/or FF	Not widely demonstrated at full scale, ash salability, ESP/FF performance, impact of mercury speciation
Electro Catalytic Oxidation	D	SO_2: 95-98%; NO_x: 90%; Hg: 70+%	New and Retrofit	Demonstration required
EnviroScrub	D	SO_2: 99+%; NO_x: 99%; Hg: 60-70%	New and retrofit.	Demonstration required; costs estimated to be 30-50% lower than FGD-SCR
Wet FGD and SCR	C	SO_2: 95%; NO_x: 90-95%; Hg: 0-80%	Plants with SCR and Wet scrubber technologies	Depends on Hg speciation in flue gas.

Status: P = pilot stage; C = commercial; D = demonstration

6 SUMMARY AND RECOMMENDATIONS

6.1 NO_x and PM Sources

The main objectives of this project were to identify and briefly describe the available (or emerging) technologies for control of NO_x and PM emissions that could be applied to sources in the western United States. The starting point for this work was an analysis of large (greater than 100 TPY) sources from the WRAP 1996 Emission Inventory (Version 3). Sources were limited to those from the thirteen-state region: AZ, CA, CO, ID, MT, ND, NM, NV, OR, SD, UT, WA, and WY.

The source profile from the thirteen-state region was compared with that from the nine-state GCVTR: AZ, CA, CO, ID, NM, NV, OR, UT, and WY. The GCVTR accounted for 75% of the NO_x emissions and 83% of the PM emissions within the thirteen-state region. Generally, the distribution of sources was the same in the GCVTR as compared to the thirteen-state region. Thus, conclusions based on the thirteen-state region should therefore be valid for the GCVTR while achieving broader applicability to WRAP members.

The cut-off of 100 TPY captures 84% of the NO_x emissions in the 1996 WRAP database for the thirteen-state region. For ICE's (reciprocating engines and turbines) the 100 TPY cut-off only captures about 56% of the emissions, though this category is the second largest category and responsible for 10% of stationary source emissions. Thus, NO_x control programs for sources in this category will require careful consideration of population attributes (e.g., a large number of small sources).

The largest source category for NO_x by far in the thirteen-state region is coal-fired boilers (68%); the top five categories (coal-fired boilers, internal combustion engines, cement kilns, turbines and oil and natural gas boilers) account for 90% of the NO_x emissions. The states with the largest stationary source NO_x emissions according to the 1996 WRAP database were AZ, CA, ND, NM, UT, and WY.

According to the WRAP 1996 (Version 3) stationary source emissions database, about 4% of the NO_x sources greater than 100 TPY had at least one type of control. Coal-fired boilers had the highest level of control (15%), followed by petrochemical processes (13%). The level of control for coal-fired boilers seemed low, even for 1996. Therefore, the 1996 WRAP database was compared with the data available for utility boilers in the 1996 CEMS and E-GRID databases. The EIA-767 database was also searched for NO_x control technologies. This comparison only looked at coal-fired utility boilers and not all coal-fired boilers. However, only 3% of the WRAP NO_x emissions from coal-fired boilers in the thirteen-state region were from non-utility boilers. WRAP data augmented by these other databases suggested that 44% of the utility boilers had at least one type of NO_x control in 1996, mostly low-NO_x burners.

The NO_x emission rate from external combustion boilers that is achievable with combustion modification depends on the fuel type. For coal-fired boilers, lower NO_x emission rates are obtained when firing subbituminous coal as compared to bituminous coal. Considering the amount of subbituminous coal in the West, there is a fairly even split between bituminous and subbituminous coals as fuels for utility boilers. This may have shifted since 1996, however.

The cut-off of 100 TPY captures 60% of the PM emissions in the 1996 WRAP database for the thirteen-state region. The largest source category in the thirteen-state region is coal-fired boilers (40%); the top eight categories account for 92% of the PM emissions (greater than 100 TPY): coal-fired boilers, mineral processing, petrochemical, wood boilers, fugitive, primary metal production, pulp and paper, and smelting operations. The state with the largest PM emissions is WY, followed by AZ, ID, and NM.

In the 1996 WRAP database, 72% of coal-fired boilers, the largest category of emissions, had PM controls. Overall, though, only 38% of units had PM controls.

6.2 Controls for NO_x and PM

Many commercially available technologies exist for control of NO_x and PM emissions from stationary sources. Twenty-five NO_x control technologies and four PM control technologies were summarized. Cost and performance information was obtained for most technologies.

There are a lot more technologies available for NO_x control because of the different ways in which NO_x can be prevented or destroyed. In contrast, PM control on industrial processes is often done only at the back end of the process. This is not to say that process modification cannot be used to reduce PM emissions. Fugitive emissions, for example, can sometimes be controlled by process modification. Further work should be done to look into the details of important industrial processes to determine where process modification will yield significant reductions in PM.

Most of the NO_x emissions from stationary sources are generated by combustion or by high temperature thermal processing. NO_x control technologies fall broadly into two categories: combustion modifications and post-combustion removal or destruction. Combustion systems differ, from internal combustion engines to external combustion boilers. Thus, there are many different strategies for modifying the combustion process. Deciding on an appropriate NO_x control technology is highly dependent on the process conditions and on the type of fuel. The existing NO_x control technology on a particular source will also influence what additional NO_x controls can be added successfully. Post-combustion NO_x controls are not truly "back-end" technologies, like ESPs and baghouses for PM control; some degree of process integration is required. Thus, not all post-combustion control processes can be applied to a given source.

There is no "one size fits all" solution for NO_x control. Deciding which technology to apply to a certain source depends on:

- The fuel type;
- The specific combustion process;
- Post-combustion characteristics: temperature, residence times, etc.;
- The type of NO_x control technology already in use; and
- The target NO_x emission rate.

Emerging environmental issues and regulatory changes have driven interest in multi-pollutant (as opposed to single pollutant) control technologies capable of addressing air pollutant emissions more comprehensively with greater flexibility and ultimately lower cost. Multi-pollutant control technologies integrate in-situ and/or post-combustion controls of at least two of the following: SO_2, NO_x, and mercury pollutants, and CO_2 emissions. Multi-pollutant controls are intended primarily for external combustion boilers, particularly coal-fired boilers. The complexity of some of these processes as well as regulatory drivers often limit them to larger, power-generation boilers.

Emerging post-combustion, multi-pollutant control technologies are being developed for SO_2, NO_x, and mercury that could be applied to stationary combustion sources in the western U.S. in the next five or ten years. These processes generally produce a saleable byproduct and have SO_2 removal rates of greater than 50%, and NO_x removal rates of greater than 70%. Several of these processes are currently in pilot or full-scale demonstration. Costs of options controlling two pollutants (either SO_2-NO_x or SO_2-Hg) are projected to be in the 50-315 $/kW range, but there is significant uncertainty associated with these estimates because of their early stage of development. Also, lack of information, especially associated with O&M costs, makes it difficult to compare their cost-effectiveness. Further monitoring and updating of cost-related information is needed. For reference, the costs of the combined commercial technologies, FGD and SCR are above 200-250 $/kW.

6.3 What's on the horizon? What trends will influence emissions and control technologies?

- The rate of advancement and use of multi-pollutant technologies (NO_x/Hg, SO_2/Hg, PM/Hg, etc.) will depend on the levels of future mercury emissions reduction.

- Significant enhancements have been made in the ability of combustion modifications to reduce NO_x formation, but they may be reaching their maximum potential given the theoretical limits within the combustion process and given the nitrogen content of some fuels (e.g., coal). Determining how much NO_x emissions can be reduced in the West through this type of technology will require closer examination of the types and vintages of combustion modifications already in place.

- There is (and always will be) uncertainty in the future mix of fuels for some combustion processes (e.g. electricity production). This influences the retirement of existing sources and the investment in new sources, which, in turn requires that a range of projections be made for future source distribution scenarios.

- Historically new technologies have had one major evaluation criteria in common: their performance improvement over the existing technology (e.g. SCR capable of 90% reductions over SNCR). As technologies push the potential control levels to 90% or more, we need to view them from a new perspective, one which includes greater emphasis on overall impacts, costs, inter-pollutant compatibility, etc.

6.4 Recommendations for Future Work

Further work must be done in order to generate both accurate costs and reasonable control scenarios to be used in both regional-scale atmospheric models and in evaluating regional control strategies, particularly in light of the multi-pollutant control legislation currently under consideration in Congress. This includes the following:

- Accurate cost information (generally available now);
- Details of the emission-generating processes;
- NO_x and PM control technologies already in place; and
- Accurate estimates of the current emissions.

Better use could be made of existing EPA databases; in addition, the WRAP database should be updated to give a more accurate description of sources and existing control technology.

In this work, we found that the EPA databases (CEMs and E-GRID) were easy to use and provided what appeared to be a fairly complete picture of current emissions and control technologies for NO_x and PM. Since much has changed in the West since the 1996 WRAP stationary source inventory, these databases are useful for getting more current information on utility boilers, which generate a significant amount of the emissions in the western U.S. It would be worthwhile now to look at trends in emissions and NO_x control technologies in the West by analyzing the most recent CEMs and E-GRID databases.

Sufficient detail about the configuration and process of the sources is generally not available in the EPA databases and these databases are only for utility boilers. The next WRAP inventory should be used to collect the information needed to make estimates of costs for control. Better identification of sources is important; there are instances in the 1996 WRAP database in which there is insufficient information on the type of source and/or the fuel in use. Obviously, better identification of existing air pollution control technology is critical. For combustion sources, particularly utility boilers, the capacity, in terms of MBtu/yr should also be included in the WRAP database.

Consideration should also be given to selecting a subset of sources for detailed characterization and calculate ranges of costs and expected emissions reductions. The subset should be a representative distribution of those sources within the most important source categories.

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APPENDIX A : Breakdown of NO_x Emissions by State

Table A-1. WRAP NO_x Emissions for sources > 100 TPY by State

Category	**13-States**		**AZ***		**CA***		**CO***	
	# Units	**Total NO_x TPY (>100 TPY)**	**# Units**	**Total NO_x TPY (>100 TPY)**	**# Units**	**Total NO_x TPY (>100 TPY)**	**# Units**	**Total NO_x TPY (>100 TPY)**
Coal-Fired Boilers	151	607,748	15	75,018	3	1,544	31	82,927
Reciprocating Engines	423	86,210	16	6,441	58	10,274	56	11,328
NG	*404*	*81,786*	*14*	*5,731*	*54*	*9,436*	*56*	*11,328*
Diesel	*16*	*4,021*	*2*	*709*	*3*	*708*		
Process Gas	*3*	*403*			*1*	*130*		
Cement Kilns	39	41,009	2	4,662	16	15,886	4	4,470
Oil/NG Boilers	112	32,910	4	1,092	40	12,290	9	2,643
Turbines	86	25,278	8	1,918	37	8,990	9	1,655
NG	*83*	*24,821*	*7*	*1,795*	*37*	*8,990*	*9*	*1,655*
Diesel	*3*	*457*	*1*	*123*				
Mineral Processing	34	16,250	4	2,861	4	3,263		
Petrochemical	48	13,719	1	101	13	3,978	4	730
NG Compressor	16	10,959	14	10,686				
Pulp and Paper	39	10,010			3	602		
Wood Boilers	48	9,776			14	2,430		
Refinery Process Heaters	38	9,311			28	7,096		
Glass Manufacture	14	5,033			11	4,128	1	251
Primary Metal Production	17	3,476	2	1,009			2	244
Waste Combustion	6	3,309						
Refinery Emissions	8	3,256			8	3,256		
In-process Fuel Use	9	2,605			7	1,906		
Jet Engine Testing	4	2,297			4	2,297		
Oil and Gas Production	7	1,140						
Smelting Operations	3	961	2	852				
Sugar Beet Production	3	730			1	111		
Secondary Metal Production	4	507						
Turbines, Steam	1	165			1	165		
Total (> 100 TPY)	1,110	886,659	68	104,639	248	78,217	116	104,249

*** GCTVR State**

Table A-1. WRAP NO_x Emissions for sources > 100 TPY by State [continued]

Category	ID*		MT		ND		NM*	
	# Units	Total NO_x TPY (>100 TPY)	# Units	Total NO_x TPY (>100 TPY)	# Units	Total NO_x TPY (>100 TPY)	# Units	Total NO_x TPY (>100 TPY)
Coal-Fired Boilers	6	2,218	6	25,452	17	108,007	10	70,193
Reciprocating Engines			14	4,357	8	2,569	201	37,755
NG			*4*	*2,056*	*8*	*2,569*	*201*	*37,755*
Diesel			*10*	*2,301*				
Process Gas								
Cement Kilns			1	1,662			1	1,000
Oil/NG Boilers			1	128	3	909	10	3,389
Turbines	1	139	0	0	3	564	12	2,947
NG	*1*	*139*			*3*	*564*	*12*	*2,947*
Diesel								
Mineral Processing	1	117	3	428			1	145
Petrochemical	3	1,449	5	842	1	915	1	124
NG Compressor								
Pulp and Paper	3	377	4	920				
Wood Boilers	4	708	4	1,057			1	360
Refinery Process Heaters							1	206
Glass Manufacture								
Primary Metal Production								
Waste Combustion					4	2,971		
Refinery Emissions								
In-process Fuel Use			1	589				
Jet Engine Testing								
Oil and Gas Production					2	348	1	140
Smelting Operations								
Sugar Beet Production					2	619		
Secondary Metal Production								
Turbines, Steam								
Total (> 100 TPY)	18	5,008	39	35,436	40	116,901	239	116,258

*** GCTVR State**

Table A-1. WRAP NO_x Emissions for sources > 100 TPY by State [continued]

Category	NV*		OR*		SD		UT*	
	# Units	Total NO_x TPY (>100 TPY)	# Units	Total NO_x TPY (>100 TPY)	# Units	Total NO_x TPY (>100 TPY)	# Units	Total NO_x TPY (>100 TPY)
Coal-Fired Boilers	8	39,040	1	4,195	3	17,268	15	66,600
Reciprocating Engines							15	2,074
NG							*14*	*1,772*
Diesel							*1*	*303*
Process Gas								
Cement Kilns	2	3,789	2	687	3	2,718	2	565
Oil/NG Boilers	6	3,727	6	2,155			1	267
Turbines	1	191	3	5,372	2	435	3	772
NG			*2*	*5,229*	*2*	*435*	*3*	*772*
Diesel	*1*	*191*	*1*	*143*				
Mineral Processing	2	218			2	577	5	4,542
Petrochemical							2	324
NG Compressor							2	273
Pulp and Paper			14	3,641				
Wood Boilers			17	3,366				
Refinery Process Heaters								
Glass Manufacture								
Primary Metal Production	1	125	3	514			7	1,263
Waste Combustion							2	339
Refinery Emissions								
In-process Fuel Use	1	109						
Jet Engine Testing								
Oil and Gas Production								
Smelting Operations								
Sugar Beet Production								
Secondary Metal Production								
Turbines, Steam								
Total (> 100 TPY)	21	47,199	46	19,929	10	20,998	54	77,020

*** GCTVR State**

Table A-1. WRAP NO_x Emissions for sources > 100 TPY by State [continued]

Category	**WA**		**WY***	
	# Units	**Total NOx TPY (>100 TPY)**	**# Units**	**Total NOx TPY (>100 TPY)**
Coal-Fired Boilers	8	20,138	28	95,148
Reciprocating Engines	7	1,191	48	10,219
NG	*5*	*918*	*48*	*10,219*
Diesel				
Process Gas	*2*	*273*		
Cement Kilns	4	4,126	2	1,444
Oil/NG Boilers	28	5,758	4	553
Turbines	3	324	4	1,971
NG	*3*	*324*	*4*	*1,971*
Diesel				
Mineral Processing	4	1,904	8	2,197
Petrochemical	11	3,635	7	1,619
NG Compressor				
Pulp and Paper	15	4,471		
Wood Boilers	8	1,856		
Refinery Process Heaters	9	2,009		
Glass Manufacture	2	654		
Primary Metal Production	1	116	1	205
Waste Combustion				
Refinery Emissions				
In-process Fuel Use				
Jet Engine Testing				
Oil and Gas Production			4	652
Smelting Operations	1	109		
Sugar Beet Production				
Secondary Metal Production	4	507		
Turbines, Steam				
Total (> 100 TPY)	105	46,798	106	114,009

***GCVTR State**

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APPENDIX B : Breakdown of PM Emissions by State

Table B-1. WRAP PM Emissions for sources > 100 TPY by State

Category	13-States		AZ*		CA*		CO*	
	# Units	Total PM TPY	# Units	Total PM TPY	# Units	Total PM TPY	# Units	Total PM TPY
Coal-Fired Boilers	88	46,010	9	2,657	1	699	3	684
Mineral Processing	85	24,499	14	4,932	5	710	18	4,700
Petrochemical	42	10,836			5	834	4	757
Wood Boilers	24	5,718			3	471		
Refinery Emissions	11	5,631	2	3,949	1	104	3	843
Primary Metal Production	20	4,697	3	529	1	139	1	232
Pulp and Paper	15	4,476			2	272		
Smelting Operations	8	3,555	1	137				
Miscellaneous	1	2,456			1	2,456		
Oil/NG Boilers	5	1,379						
Sugar Beet Processing	5	1,150	1	210	1	110	1	430
Cooling Tower	4	932						
Cement Kilns	4	641			1	132		
Turbines	2	838	1	590			1	248
Diesel	1	590	1	590				
NG	1	248					1	248
Secondary Metal Production	1	537						
Jet Engine Testing	2	535			2	535		
Reciprocating Engines	3	525	1	104			1	169
Diesel	2	273	1	104			1	169
NG	1	252						
Refinery Process Heaters	1	176			1	176		
Total	**321**	**114,589**	**32**	**13,107**	**24**	**6,638**	**32**	**8,063**

*** GCTVR State**

Table B-1. WRAP PM Emissions for sources > 100 TPY by State [continued]

Category	ID*		MT		ND		NM*	
	# Units	Total PM TPY	# Units	Total PM TPY	# Units	Total PM TPY	# Units	Total PM TPY
Coal-Fired Boilers	8	5,180	4	3,990	11	3,679	9	7,285
Mineral Processing	5	1,864	9	2,565	1	110	2	270
Petrochemical	4	688	2	274	1	590	1	307
Wood Boilers	6	1,683	2	242				
Refinery Emissions								
Primary Metal Production			1	477				
Pulp and Paper	6	2,949						
Smelting Operations			1	158			4	1,242
Miscellaneous								
Oil/NG Boilers								
Sugar Beet Processing					1	297		
Cooling Tower								
Cement Kilns	1	216	1	117			1	176
Turbines Diesel NG								
Secondary Metal Production								
Jet Engine Testing								
Reciprocating Engines Diesel NG								
Refinery Process Heaters								
Total	**30**	**12,579**	**20**	**7,825**	**14**	**4,676**	**17**	**9,280**

*** GCTVR State**

Table B-1. WRAP PM Emissions for sources > 100 TPY by State [continued]

Category	NV*		OR*		SD		UT*	
	# Units	Total PM TPY	# Units	Total PM TPY	# Units	Total PM TPY	# Units	Total PM TPY
Coal-Fired Boilers	8	5,688	1	108	2	236	8	2,436
Mineral Processing	2	244					11	2,510
Petrochemical								
Wood Boilers			11	3,056				
Refinery Emissions					1	233		
Primary Metal Production	1	211	1	276			4	857
Pulp and Paper			5	898				
Smelting Operations							2	2,017
Miscellaneous								
Oil/NG Boilers	4	1,235	1	144				
Sugar Beet Processing								
Cooling Tower								
Cement Kilns								
Turbines Diesel NG								
Secondary Metal Production			1	537				
Jet Engine Testing								
Reciprocating Engines Diesel NG								
Refinery Process Heaters								
Total	**15**	**7,379**	**20**	**5,019**	**3**	**469**	**25**	**7,820**

*** GCTVR State**

Table B-1. WRAP NO_x Emissions for sources > 100 TPY by State [continued]

Category	WA		WY*	
	# Units	Total PM TPY	# Units	Total PM TPY
Coal-Fired Boilers	4	2,968	20	10,400
Mineral Processing			18	6,594
Petrochemical	2	255	23	7,130
Wood Boilers	2	266		
Refinery Emissions	3	386	1	115
Primary Metal Production	8	1,976		
Pulp and Paper	2	357		
Smelting Operations				
Miscellaneous				
Oil/NG Boilers				
Sugar Beet Processing	1	103		
Cooling Tower			4	932
Cement Kilns				
Turbines				
Diesel				
NG				
Secondary Metal Production				
Jet Engine Testing				
Reciprocating Engines			1	252
Diesel				
NG			1	252
Refinery Process Heaters				
Total	**22**	**6,311**	**67**	**25,423**

***GCVTR State**

APPENDIC C: NO_x Control Technology Summaries

Process: Air or Fuel Staging				
Category	**NO_x, TPY (WRAP 1996)**	**$\%NO_x$ reduction**	**Cost, $/ton**	**Status**
Cement Kilns	41,009	0 to 50%	1000-2000	Commercial

Process Description:

Inject portion of the fuel downstream of the main flame to create locally reducing conditions where NO_x can be destroyed. Sometimes includes installing a “NO_x fan” to increase burnout. Most commonly applied to preheater/precalciner kilns in which part of the coal is already being fired in the calciner. In this case, airflow is rerouted downstream of the calciner fuel injector.

Air and Fuel Staging as commonly applied to large industrial/utility boilers is discussed under the more commonly referred names technologies Overfire Air and Fuel Reburn

NO_x Reduction:

NO_x reduction is achieved by creating two separate combustion zones. The burner zone is fired fuel-lean to create the high temperatures needed for clinker formation. Limestone calcination, which takes place at temperatures in the range of 1600 to 1800 °F, is accomplished in the second combustion zone in the tower. NO_x reductions as high as 50% can be achieved by controlling the size of the fuel-rich region in the second combustion zone. Conversely, if combustion is fuel-lean or well-mixed in the second zone, NO_x would not be reduced. The ideal stoichiometric ratio in the calciner is 0.7 to 0.8. Some systems do not perform well because the second combustion zone is too fuel-rich (SR < 0.6), causing significant NO_x production when the staging air is added.

Cost Information:

Capital cost for the technology includes additional ductwork and controls. This should run between $200,000 and 500,000 depending on the length of new ductwork required. Operating cost should not change unless lower temperatures or locally reducing conditions adversely affect cement quality.

Development Status:

Commercially available.

Practical Considerations:

The technology is easier to implement on preheater/precalciner kilns since special injectors are required to introduce fuel or air into the middle of a rotating kiln. In either case, there must be sufficient residence time at high temperature to complete burnout.

Compatibility with other air pollution control technologies:

Reducing conditions may increase sulfur emissions or require additional SO_2 emission controls.

Process: Air or Fuel Staging
Secondary Environmental Impacts: None expected.
References: Dusome D. (1993). "Staged Combustion for NO_x Control at the Calaveras Tehachapi Plant", presented to the Portland Cement Association. Nielsen, P.B. et al. (1990). "An Overview of the Formation of SO_X and NO_X in Various Pyroprocessing Systems", IEEE Cement Industry Technical Conference. Johnson, S.A. and Haythornthwaite, S., "Summary of Available NO_x Control Techniques for the Cement Industry", submitted to the Portland Cement Association, Skokie, IL, 1998.

Process: Batch/Cullet Preheating				
Category	**NO_x, TPY (WRAP 1996)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Glass Manufacturing	5,033	5-25%	890-1,040	Commercial

Process Description:

Batch and cullet (recycled glass) preheating can be applied by direct preheating, indirect preheating and Edmeston EGB Filter. Direct preheating requires direct contact between the flue gas and the raw material in a cross-counter flow and incorporates a bypass that allows furnace operation to continue when preheater use is either inappropriate of impossible. The indirect preheater is in principle a cross-counter flow, plate heat exchanger. The Edmeston electrified granulate bed (EGB) filter system is a hybrid between an electrostatic precipitator for dust removal and a direct cullet preheater.

NOx Reduction:

Cullet preheating is primarily an energy saving technique (savings between 10-20%), but its practice reduces NO_x emissions due to lower fuel requirements and lower furnace temperatures.

Cost Information:

Capital costs generally range from $42K-110K. Economics are strongly dependent on the capacity of the furnace and the preheater.

Development Status:

Commercially available

Practical Considerations:

Cullet preheating systems can be installed at any existing glass melting furnace with greater than 50% cullet in the batch. For economic reasons, the temperature of the waste gas available should be at least 400-450°C, and a cooling of the flue gases by at least 200-250°C is needed. To prevent material agglomeration, the maximum entry temperature of the flue gases should not exceed 600°C.

The design and implementation of the preheating unit should be evaluated with the over-all system configuration. Many technical issues, such as monitoring of the preheating temperature, should be carefully reviewed prior to the implementation.

Compatibility with other air pollution control technologies:

Cullet preheating is compatible with combustion modification techniques and post-combustion technologies.

Secondary Environmental Impacts:

- The use of a direct preheater causes increased emissions of particulate matter (up to 2000 mg/Nm^3) and secondary particulate abatement is necessary.
- Direct preheating reduces acidic compounds, SO_2, HF, and HCl by up to 60%, 50%, and 90% respectively (difference before and after cullet bed).

References

European IPPC Bureau. "Reference Document on Best Available Techniques in the Glass Manufacturing Industry." Seville, Spain, October, 2000.

Process: Catalytic Combustion				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Combustion or Gas Turbines	25,278	> 80%	> 500	Commercial

Process Description:

Catalytic combustion reduces NO_x formed from the combustion process by reducing the combustion temperature to reduce thermal NO_x. The fuel and air are premixed into a fuel-lean mixture (fuel/air ratio of approximately 0.02) and then pass into a catalyst bed. In the bed, the mixture oxidizes without forming a high-temperature flame font. Peak combustion temperatures can be limited to below 2800 °F, which is below the temperature at which significant amounts of thermal NOx begin to form. Catalytic combustors can also be designed to operate in a rich/lean configuration. In this case, the air and fuel are premixed to form a fuel-rich mixture, which passes through a first stage catalyst where combustion begins. Secondary air is then added to produce a lean mixture, and combustion is completed in a second stage catalyst bed.

NO_x Reduction:

According to one developer of the technology, catalytic combustion has been demonstrated to achieve 3 ppm NO_x on a 1.5 MW gas turbine NO_x level of 3.3 ppm was achieved on a General Electric Frame 9 test stand.

Cost Information:

Costs referenced above are preliminary and based on DOE reference below.

Development Status:

Commercially available.

Practical Considerations:

Catalytic combustion techniques apply to all combustor types and are effective on both diesel- and gas-fired turbines. The technology has a limited operating range, and thus cannot be applied to gas turbines subject to rapid load changes.

Compatibility with other air pollution control technologies:

Compatible with post-combustion technology.

Secondary Environmental Impacts:

None expected.

References:

NESCAUM, " Status Report on NO_x Controls for Gas Turbines, Cement Kilns, Industrial Boilers and Internal Combustion Engines: Technologies and Cost Effectiveness," December 2000

U.S. Environmental Protection Agency. "Alternative Control Techniques Document-NO_x Emissions from Stationary Gas Turbines." EPA-453/R-93-007, Research Park Triangle, NC, January 1993.

DOE, "Cost Analyses of NO_x Control Alternatives for Stationary Gar Turbines", November 1999.

Process: DLN (Fuel-lean combustion)				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Turbines	25,278	70%	1,000-2,000	Commercial

Process Description:

Dry Low NO_x (DLN) is a combustion technology for gas turbines that enables gas-turbine combustors to produce low NO_x emission levels without diluents (such as water or steam) or catalysts. DLN technology utilizes a lean, premixed flame as opposed to a turbulent diffusion flame, a gas turbine equivalent of the LNB.

NO_x Reduction:

Engines from 3-10 MW retrofit with DLN achieved 42 ppm NO_x emissions, corresponding to reductions in the range of 60-83%. New and retrofit turbines in the larger, power plant sizes (over 50 MW) have been retrofitted to below 9 ppm of NO_x.

Cost Information:

The cost of NO_x reduction by DLN is very sensitive to the capacity factor of the turbine. There is also substantial variation in capital cost measured in terms of dollars/horsepower ($/hp) due to different turbine types and variations in turbine design. Reported costs in case studies show capital costs ranging from $750K-1,950K (4,700 hp at $160/hp and 13,000 hp at $150/hp). These are total project costs that owners attributed to the project, which may include project management or other charges associated with the project beyond the equipment and installation.

Development Status:

Commercially available

As of August 2000, about 50 turbines had been retrofitted and over 500 new turbines were operating with DLN technology.

Practical Considerations:

Because DLN combustor technology operates under conditions that are much closer to the flammability limit than the conventional combustor technology, there is a significant risk of flame instability. Manufacturers have developed improved electronic turbine controls to address this problem. Some early experience has also found combustor liners failing after only about 5,000 hours compared to over 20,000 hour lifetime for conventional technology. Similarly, manufacturers have developed improved liners to address this problem.

Other considerations are:

- DLN is achievable with fuels that can be premixed and are low in fuel nitrogen content, such as natural gas. Turbines that must maintain low NOx levels while operating on fuel oil may not be compatible with DLN.
- Achieving low NO_x across the full load range requires a sophisticated combustor design, often with variable operating modes in order to maintain flame stability.

Process: DLN (Fuel-lean combustion)
• The DLN combustor is typically larger than a conventional combustor and can have more limited operating ranges.
Compatibility with other air pollution control technologies: Compatible with post-combustion technology (SCR, SNCR).
Secondary Environmental Impacts: None expected.
References: NESCAUM, " Status Report on NO_x Controls for Gas Turbines, Cement Kilns, Industrial Boilers and Internal Combustion Engines: Technologies and Cost Effectiveness" December 2000.

Process: Flue Gas Recirculation (FGR)				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Oil/Natural gas boilers	32,910	40-80%	500-3,000	Commercial
Refinery Process Heaters	9,311	(combined with LNB)	5,900	Commercial

Process Description:

Flue Gas Recirculation (FGR) simply refers to a NO_x reduction approach that involves reintroducing some flue gas (5% to 15%) into the combustion air (or directly into the burner) to suppress flame temperatures and minimize NOx formation.

This technology usually involves a dedicated FGR fan to recirculate the flue gas back to the burner front and it is most applicable to gas fired applications. This is because its main benefit is in the minimization of thermal NO_x (NO_x formed from nitrogen in the combustion air), as opposed to fuel-NO_x (NO_x formed from fuel-bound nitrogen). Since in oil and coal sources a significant fraction of NO_x comes from "fuel-NO_x", FGR is less effective in such applications

NO_x Reduction:

NO_x reductions from FGR on gas-fired sources can be in the range of 40% to 80%.
FGR is often used in combination with LNBs and discriminating between the relative NOx reduction contributions is difficult in some cases.

Cost Information:

The main costs associated with FGR involve the retrofit of the FGR fan(s) and required ductwork to route the flue gas to the burner front. Costs in the range of $10 - $20/kW are expected for power generation sources

Development Status:

FGR is a well-proven technology in commercial operations for many years. Variations of the general concept include Induced FGR where the gas recirculated to the burner zone through an eductor, as well as recirculated to individual burners as opposed to the combustion air windbox for mixing with the combustion air prior to entering the burners.

Practical Considerations:

As mentioned above, FGR is mostly appropriate for gas-fired applications. Its effectiveness on oil and coal reduce its "appeal" to such sources

Care is necessary to ensure that the amount of FGR does not compromise boiler safety by diluting oxygen concentration in the combustion air to unsafe levels

Process: Flue Gas Recirculation (FGR)
Compatibility with other air pollution control technologies: FGR is used in combination with LNB's and OFA. FGR is also compatible with post combustion NO_x technologies although the overall cost effectiveness needs to be addressed case-by-case.
Secondary Environmental Impacts: None expected.
References: EPRI, "Retrofit NO_x Control Guidelines for Gas- and Oil-Fired Boilers", Final Report, December 1993. Poole, L., "Houston Galveston Area NO_x Abatement Industries Perspective," present at the Council of Industrial Boiler Owners, NO_x Control XV Conference, Houston, TX, August 2002.

Process: Fuel Reburn				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Coal-fired boilers	607,748	30-60%	500-2,000	Commercial
Wood/Biomass boilers	9,776	40-60%	300-3,000	Commercial
Glass Melters	5,033	50-65%	"moderate"	Commercial

Process Description:

Reburning, while generically included in the "Combustion Modification" category of NO_x control technologies, differs from the others (BCM, LNB and OFA) by "destroying" NO rather than by minimizing its formation. Fuel is introduced above the main burner zone in the furnace, creating a fuel-rich (reducing) atmosphere in which NO_x formed in the main burner zone is destroyed by reacting with hydrocarbon and nitrogen compounds. The hardware needed for reburning includes reburn fuel burners or nozzles and overfire or burnout air ports (see discussion on fuel-lean reburn for deviations from this). The level of complexity of a particular system depends mostly on the choice of the reburn fuel itself (gas, coal, oil, orimulsion), as well as on the status and capability of the existing boiler (e.g., the burner/boiler control system).

NO_x Reduction:

Full load NO_x reductions with reburning can be expected to range from 35% to 60% depending on factors such as:

- reburn fuel type and quantity; typically the reburn fuel needs to provide 15-20% of the total heat input if it is gas or 25-30% if coal to obtain 50-60% ΔNO_x
- initial NO_x level
- "tolerance" of negative impacts (e.g., efficiency loss, ash quality)

At low loads, NO_x reduction may fall to the 20-40% range, depending on the burner zone stoichiometry and low load operating characteristics of the boiler (e.g., operating at high excess air to control reheat temperature). Reburning, like SNCR and SCR, may be thought of as a "dial-in" technology in that NO_x reductions will be a function of the amount of reburn fuel (or the amount of nitrogen compound reagent in the case of SNCR and SCR). This feature may make it particularly attractive for compliance scenarios based on seasonal use, averaging and/or trading.

Cost Information:

In general, the capital costs range from $15/kW to $30/kW for gas reburn and $30/kW to $60/kW when using coal as the reburn fuel. Operating costs are mainly driven by fuel cost differential (certainly gas vs coal). For other fuels (e.g. coal/orimulsion reburning), fuel preparation costs become more important (micronization, atomization) as there is little or no fuel cost differential.

Retrofit schedules are directly related to the scope of the retrofit requirements. In most cases, 3-6 weeks are adequate for a reburn retrofit.

Process: Fuel Reburn
Development Status: Commercial While reburning does not account for a significant fraction of installed NO_x reduction technologies compared to LNBs, SNCR and SCR worldwide, it is gaining acceptance, and a number of recent activities suggest it has become a viable strategic option for $_{NOx}$ control. This increase in interest is due to two key factors, among others: (1) increased experience and encouraging results, which increase the level of comfort with the technology; and (2) the "proliferation" of advanced reburn technologies, each with its own features, advantages and disadvantages. These "advanced" reburning options involve enhancements of the conventional approach, with features ranging from combinations with SNCR to the outright avoidance of overfire air, as in fuel-lean gas reburn (FLGR).
Practical Considerations: Boilers with the following design and operating characteristics are expected to be more suitable candidates for reburning: • firing low-sulfur coals (e.g., less propensity for waterwall corrosion) • low baseline unburned carbon (e.g., to minimize ash salability impacts). • favorable cross-section/height profiles (e.g., tall boilers which provide for adequate mixing/residence time to maximize effectiveness). • gas availability, very efficient/effective coal pulverizers (e.g., approaching micronization) or access to orimulsion for the reburn fuel Of major importance is the choice of reburn fuel. The increasing experience with coal and orimulsion dictates that these must be considered in light of cost, availability, deliverability and overall project objectives. However, the use of natural gas provides benefits from lower maintenance costs (e.g., less demand on pulverizers) and lower emissions of other pollutants (particulate, SO_x, CO_2).
Compatibility with other air pollution control technologies: Reburn Technology can be implemented with both Low NO_x combustion approaches (e.g. LNBs) and post combustion technologies (SNCR/SCR). However, the overall NO_x reductions are not strictly additive and careful evaluation is required to ensure cost effective strategies.
Secondary Environmental Impacts: Reburn technology has the potential to effect both positive and negative secondary environmental impacts depending on factors such as the reburn fuel, main combustion and reburn zone stoichiometries, boiler physical characteristics, etc. The following are potential impacts that must be analyzed on an individual unit basis • CO may increase due to stoichiometry in the reburn zone • LOI may increase due to stoichiometries and OFA design

Process: Fuel Reburn
• SO_2/CO_2 benefits when reburn fuel is gas (proportional to gas input)

References:

NESCAUM, "Status Report on NO_x Control Technologies and Cost Effectiveness for Utility Boilers", June 1998.

EPRI, "Retrofit NO_x Controls for Coal-Fired Utility Boilers – 2000 Update", EPRI Final Report, December 2000.

Folsom, B. "Field Experience with Reburn NOx Control", ICAC Forum 2000, Arlington, VA. March 2000.

Process: High Energy Ignition System (HEIS)				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Reciprocating Engines	86,210	50% - 80%	115 - 200+	Commercial

Process Description:

HEIS technology, also known as plasma ignition, provides a continuous electrical discharge at the gap of a conventional spark plug for 10 to 90 degrees of crankshaft rotation as opposed to traditional spark ignition where the life of the spark is only a fraction of a degree of crankshaft rotation. The extended energy ensures that ignition will occur even in the leanest of conditions. A rich mixture is ignited in a small ignition cell located in the cylinder head. The ignition cell flame passes to the cylinder where it provides a uniform ignition source.

NO_x Reduction:

Laboratory tests and case studies have shown NO_x emissions in the range of 2.5 to 3.0 g/bhp-hr while maintaining acceptable engine operation. Emissions of 2.5 b/bhp-hr were achieved on a 2,750-bhp engine, amounting to an 84% reduction from the uncontrolled level.

Cost Information:

Cost information was not widely reported. Cost range indicated above was taken from the NESCAUM reference below.

Development Status:
Commercially available

HEIS has been installed on numerous engines to meet NO_x RACT requirements in the range of 2.5 to 3.0 g/bhp-hr in the Eastern United States. Several users have reported over 80% reduction in NO_x emissions.

Practical Considerations:

HEIS technology can be used only in lean-burn, natural gas-fired spark ignition engines. This technique can be retrofit to turbocharged 2- and 4-cycle engines.

Compatibility with other air pollution control technologies:

Compatible with post-combustion NO_x technologies (SCR, NSCR). However, the overall NO_x reductions are not strictly additive and careful evaluation is required to ensure cost effective strategies.

Secondary Environmental Impacts:

In most cases, NO_x reductions have been accompanied by increased power output and increased fuel economy.

References:

Edgerton, S. W., Lee-Greco, J., and Walsh, S. "Stationary Reciprocating Internal Combustion Engines Updated Information on NO_x Emissions and Control Techniques (Final Report)." EPA contract No. 68-D98-026, EC/R Incorporated, Chapel Hill, NC, August 29, 2000.

NESCAUM, " Status Report on NO_x Controls for Gas Turbines, Cement Kilns, Industrial Boilers and

Process: High Energy Ignition System (HEIS)
Internal Combustion Engines: Technologies and Cost Effectiveness," December 2000. State of New Jersey Department of Environmental Protection. "State of the Art (SOTA) Manual for Reciprocating Internal Combustion Engines." Trenton, NJ, July, 1997. Alternative Control Techniques Document: NO_x Emissions from Stationary Reciprocating Internal Combustion Engines. EPA Document No. EPA-453/R-93-032, July 1993.

Process: High-Pressure Fuel Injection				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Reciprocating Engines	86,210	~80%	N/A (less than LEC)	Commercial

Process Description:

High-Pressure Fuel Injection represents a "second generation" Low Emission Combustion (LEC), according to one vendor of NO_x control equipment and retrofit services. The technology uses high pressure to enhance the mixing of air and fuel in the combustion cylinder under fuel lean conditions. This technique reduces the quantity of excess air in comparison to LEC, diminishing the turbocharging and intercooling retrofit requirements.

NO_x Reduction:

Tests from a large (~5,000 bhp) turbocharged Clark engine showed 80% NOx reduction. May be comparable to LEC reductions.

Cost Information:

Less than LEC because the technology does not require pre-combustion chambers or as much excess air, thus reducing the degree of turbocharging and intercooling required.

Development Status:
Commercially available

Considered emerging in 2000.

Practical Considerations:

An LEC retrofit vendor stated that NO_x emissions cannot be reduced to 2 g/bhp-hr through the use of a high-pressure fuel system alone. Less stringent regulatory requirements cans be met with a combination of ignition timing adjustment, high-pressure fuel injectors, and improve A/F ratio and ignition system controls.

Compatibility with other air pollution control technologies:

Compatible with post-combustion NO_x technologies (SCR, NSCR). However, the overall NO_x reductions are not strictly additive and careful evaluation is required to ensure cost effective strategies.

Secondary Environmental Impacts:

None expected.

References:

Edgerton, S. W., Lee-Greco, J., and Walsh, S. "Stationary Reciprocating Internal Combustion Engines Updated Information on NO_x Emissions and Control Techniques (Final Report)." EPA contract No. 68-D98-026, EC/R Incorporated, Chapel Hill, NC, August 29, 2000.

National Center for Environmental Research, U. S. EPA Office of Research and Development. "1994 Phase II Abstracts: Plasma Ignition Retard for NO(x) Reductions." http://es.epa.gov/ncerqa_abstracts/sbir/94/topics43.html.

Process: "Intelligent" Combustion Controls				
Category	**NO_x, TPY (WRAP 1996)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Coal-Fired Boilers	607,748	0-30%	100-300	Commercial
Oil/Gas Boilers	32,910	0-30%	100-500	Commercial
Wood/Biomass Boilers	9,776	0-20%	200-500	Commercial

Process Description:

Sensors and computer software programs are used to control air-fuel ratio to individual burners. Conventional combustion systems provide measured airflow to the windbox (that feeds all burners) and to each pulverizer (that feeds from two to eight burners). However, coal flow to individual burners may deviate by as much as 50%, while airflow to each burner may deviate by over 20%. Measuring and controlling (using existing or new control valves) these quantities at each burner allows the boiler to operate with lower excess air or slightly staged. Sensors are also available to monitor post-combustion processes. Online measurements of unburned carbon and CO provide feedback for burner adjustments. Other sensors evaluate flame quality, furnace temperature, or boiler heat transfer. Software can be rule-based or neural net. Usually the new software resides on the operator's digital control system (DCS).

NO_x Reduction:

Full -load NO_x reductions with combustion monitoring and tuning can be expected to range from 0% to 30% depending on factors such as:

- Current state of "out of tune" combustion system.
- Initial NO_x level.
- Operational flexibility of the burner/furnace design.

The highest NO_x reductions are usually found on boilers that are able to bias their fuel input to lower burners and bias the airflow to upper burners. At low loads where there may be more operating flexibility, NO_x reduction may improve to the 20-40% range, depending on the burner zone stoichiometry and low load operating characteristics of the boiler (e.g., operating at high excess air to control reheat steam temperature).

Cost Information:

In general, the capital costs for combustion monitoring and tuning are less than $1M per boiler. Operating costs are mainly driven by additional labor to maintain the new equipment. Often the installation of this technology is driven by the potential to reduce boiler operational expenses. For example, if total airflow is minimized, boiler efficiency can be increased. Reducing unburned carbon in the ash residue will not only increase boiler efficiency but also could improve salability of this byproduct to the cement industry.

An outage is generally not required when implementing this technology, but coal-flow sensors and adjustable orifices are best installed when a mill is out of service.

Process: "Intelligent" Combustion Controls
Development Status: Commercially available. Many of the sensors, however, are relatively new and do not have a track record for reliability and dependability. Since each application of the technology is custom-engineered, there may be a steep learning curve for every user. For now, each installation also requires onsite presence (for a few weeks) from the supplier or other combustion expert to achieve best results.
Practical Considerations: Boilers with the following design and operating characteristics are expected to be more suitable candidates for combustion monitoring and tuning: • Combustion equipment must be in good operating condition. The technology will not be able to overcome such factors as poor coal fineness or failure of burner parts. • Favorable cross-section/height profiles (e.g., tall boilers which provide for adequate mixing/residence time to maximize effectiveness). • Excess coal pulverizer capacity so that fuel biasing can be maximized. Of major importance is acceptance from boiler operators. If operators want to stick with old procedures and operating conditions, the effectiveness of the technology may not be realized.
Compatibility with other air pollution control technologies: Combustion monitoring and tuning can be implemented with both Low NO_x combustion approaches (e.g. LNBs) and post combustion technologies (SNCR/SCR). However, the overall NO_x reductions are not strictly additive and careful evaluation is required to ensure cost effective strategies.
Secondary Environmental Impacts: Combustion monitoring and tuning has the potential to affect both positive and negative secondary environmental impacts depending on factors such as the fuel, burner stoichiometries, boiler physical characteristics, etc. The following are potential impacts that must be analyzed on an individual unit basis • CO may increase due to stoichiometry in the burner zone • LOI may increase due to increased staging • ESP performance may degrade with increased LOI
References: Power Plant Optimization Guidelines, EPRI Report, December 1998 Alternative Control Techniques Document: NO_x Emissions from Industrial/Commercial/Institutional (ICI) Boilers. EPA Document No. EPA-453/R-94-022, July 1994. Alternative Control Techniques Document: NO_x Emissions from Utility Boilers. EPA Document No.

Process: "Intelligent" Combustion Controls
EPA-453/R-94-023, July 1994. Fuller, T., "Field Experience with the Flame Doctor^{TM} System", EPRI/DOE/EPA Mega Symposium, Washington, May 2003 Kohn, D. "Combustion Optimization Case Studies & Emerging Applications", EPRI/DOE/EPA Mega Symposium, Washington, May 2003

Process: Iron Slag Addition (CemStar)				
Category	**NO_x, TPY (WRAP 1996)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Cement Kilns	41,009	12-30%	0-100	Commercial

Process Description:

Change cement formulation by adding waste iron to lower clinkering temperature and suppress NO_x. The iron waste is usually supplied from local steel production facilities, which limits the technology to certain geographical areas.

NO_x Reduction:

NO_x reduction is achieved by reducing clinkering temperature as well as the required heat input to produce a ton of clinker. The technology reduces total NO_x emissions by about 20 to 30%, and also may increase clinker production.

Cost Information:

Iron addition provides an overall economic benefit while reducing total NO_x emissions. The technology is currently being used at several cement plants for its original purpose of increasing production capacity. There are no capital costs for installing the technology. Operating and maintenance costs depend on the cost of the iron (shipping can be a large portion of this cost).

Development Status:

Commercially available.

Practical Considerations:

There is a limit to how much iron that can be incorporated into the clinker. Cement product specifications may limit or prevent use of this technology for some products.

Compatibility with other air pollution control technologies:

Should not affect other control systems.

Secondary Environmental Impacts:

None expected.

References:

NESCAUM, "Status Report on NO_x Controls for Gas Turbines, Cement Kilns, Industrial Boilers, Internal Combustion Engines; Technologies and Cost Effectiveness." December 2000.

Process: Kiln temperature control				
Category	**NO_x, TPY (WRAP 1996)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Cement Kilns	41,009	0 to 20%	200-500	Commercial

Process Description:

Add temperature-monitoring device to kiln controls to minimize high-temperature excursions where more NO_x is emitted.

NO_x Reduction:

NO_x reduction is achieved by measuring a characteristic flame-zone temperature and then controlling heat input to maintain that temperature. Without direct temperature measurement, temperatures fluctuate within a wide range since clinker formation is an exothermic reaction. When clinker formation slows down or stops, temperatures fall. Operators respond with a large burst of fuel that sends temperature up by as much as 500 °F. Then they back off the fuel input. Temperature measurement helps operators avoid losing clinker formation and thus maintain relatively steady kiln temperatures.

Cost Information:

Capital cost for the technology includes installation of a continuous temperature monitor along with control system upgrades to tie the temperature signal into the coal feed rate. Operating cost should not change unless lower temperatures adversely affect cement quality.

Development Status:

Commercially available.

Practical Considerations:

The dynamics of a cement kiln are very difficult to control, even with direct temperature measurement and control. Each kiln will react differently. It will require considerable operator experience to minimize the temperature on each kiln.

Compatibility with other air pollution control technologies:

Should not affect other control systems.

Secondary Environmental Impacts:

None expected.

Process: Kiln temperature control
References: U.S. Environmental Protection Agency. "Alternative Control Techniques Document: NO_x Emissions from Cement Manufacturing." EPA Document No. EPA-453/R-94-004, January 1994. Johnson, S.A. and Haythornthwaite, S., "Summary of Available NO_x Control Techniques for the Cement Industry", submitted to the Portland Cement Association, Skokie, IL, 1998.

Process: Low-Emission Combustion (LEC)				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Reciprocating Engines	86,210	80-90%	190-700	Commercial

Process Description:

NO_x formation from a spark-ignited engine is highest when the mixture is slightly fuel-lean. LEC enhances the effectiveness of the air/fuel ratio method by enabling much deeper leaning without the adverse effects associated with lean mixtures. Additional combustion air acts as a heat sink, lowering the temperature in the cylinder and reducing NO_x formation. Deeper leaning can be achieved by relocating the spark plug to a precombustion chamber (may use High-Energy Ignition, see associated description) where the mixture is somewhat richer than in the cylinder. Early sparking avoids problems associated with ignition and misfiring that can result form leaning the mixture. Some smaller engines use an "open chamber" LEC design instead of a precombustion chamber. These designs typically incorporate improved air-fuel mixing systems to achieve stable combustion under very lean conditions.

NO_x Reduction:

Large, stationary spark-ignition engines usually achieve 80% NOx reduction through a LEC Retrofit. A NOx emission level of 125 ppm (at 15% oxygen) is an achievable exhaust NOx value. Up to 90% reduction can be achieved in natural gas engines, and about 60-70% for landfill gas engines (probably due to lower initial NOx from the lower heating-value landfill gas).

Engines with open-chamber LEC technology typically are designed for excess air levels only slightly above 50%, while engines with precombustion chambers typically are designed for excess air levels of 75-100%. Consequently, prechambered engines have generally lower NOx emissions than do open-chamber models.

Cost Information:

The capital cost of retrofitting these engines depends on the engine BHP. For engines firing a single fuel, retrofits have been implemented costing $340/hp for 3400hp engines. A lower capital cost is expected for smaller, medium-speed engines, about $200/hp. Dual-fuel engines have much greater capital costs. For these engines (larger than 1,000 hp), the capital cost can be estimated by

Capital Cost = $405,000 + ($450 x hp).

Retrofitting a 2,500 hp engine is projected to cost $615/hp.

Development Status:

Commercially available

The California Air Resources Board considers LEC Retrofit a Reasonably Available Control Technology (RACT) for large spark-ignition engines. LEC based on precombustion chamber technology has been in use for over 20 years. All major manufacturers of lean-burn spark ignition engines offer LEC-equipped models. Retrofit kits are also available.

Process: Low-Emission Combustion (LEC)
Practical Considerations: Available for spark-ignition engines fired with gaseous fuels including dual-fuel engines operating in dual-fuel mode (as opposed to firing only diesel fuel). LEC can cause some fuel efficiency decrease. A reasonable fuel efficiency penalty is estimated to be on the order of 0.5%. Turbocharging and intercooling are required to avoid derate. In retrofit situations, this typically involves upgrading or replacing the turbocharger and intercooler, or adding this equipment. Other equipment associated with increased air flows may also need to be modified for LEC, such as the air intake and filtration system, the intercooler radiator, and the exhaust system and muffler. To maintain the optimum A/F ratio, an automated A/F ratio controller typically is used. The challenge with very lean combustion is to achieve proper ignition and stable combustion. Vendors of LEC technology (i.e., engine manufacturers and third-party retrofitters) have met these requirements with some combination of improved combustion chamber design, enhanced air-fuel mixing, and improved ignition systems.
Compatibility with other air pollution control technologies: Compatible with post-combustion NOx technologies (SCR, NSCR). However, the overall NO_x reductions are not strictly additive and careful evaluation is required to ensure cost effective strategies.
Secondary Environmental Impacts: Emissions of products of incomplete combustion can increase.
References: Edgerton, S. W., Lee-Greco, J., and Walsh, S. "Stationary Reciprocating Internal Combustion Engines Updated Information on NO_x Emissions and Control Techniques (Final Report)." EPA contract No. 68-D98-026, EC/R Incorporated, Chapel Hill, NC, August 29, 2000. NESCAUM. "Status Report on NOx Controls for Gas Turbines, Cement Kilns, Industrial Boilers, Internal Combustion Engines; Technologies and Cost Effectiveness." December, 2000. State of California Air Resources Board. "CAPCOA/ARB Proposed Determination of Reasonably Available Control Technology and Best Available Retrofit Control Technology for Stationary Internal Combustion Engines (DRAFT)." Sacramento, CA, December, 1997. State of New Jersey Department of Environmental Protection. "State of the Art (SOTA) Manual for Reciprocating Internal Combustion Engines." Trenton, NJ, July, 1997. U.S. Environmental Protection Agency. "Alternative Control Techniques Document – NO_x Emissions from Stationary Reciprocating Internal Combustion Engines." EPA-453/R-93-032, July, 1993. Cooper-Bessemer. Facsimile from J. W. Hibbard to W. Neuffer, U. S. EPA. Information on Low Emission Combustion. Cooper-Bessemer, Cooper Energy Services, Mount Vernon, OH. March 3, 1999. 4pp. Dresser-Rand. Facsimile from C. F. Willke to W. Neuffer, U. S. EPA. Information on Low Emission Combustion. Dresser-Rand Services, Painted Post, NY. May 7, 1999. 2pp.

Process: Low-NO_x Burners				
Category	**NO_x, TPY (WRAP 1996)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Coal-Fired Boilers	607,748	30 to 60%	200-1000	Commercial
Cement Kilns	41,009	0 to 20%	500-1000	Commercial
Oil/NG Boilers	32,910	30 to 60%	200-1000	Commercial
Glass Manufacturing	5,033	~ 40%	790-1,680	Commercial
Refinery Process Heaters	9,311	30 to 60%	5,900 (with FGR)	Commercial

Process Description:

LNB's operate on the principal of carefully controlling the rate of mixing of air and fuel within the flame so that peak flame temperatures are low and fuel-bound nitrogen is released in a region where the concentration of oxygen is very low. This inhibits the formation of both fuel and thermal NOx by reducing the concentration of oxygen in the flame zone. Most LNB's work by limiting the amount of air in the primary flame creating a central fuel-rich flame core. Additional air is introduced to surround the primary flame where the temperature is lower, limiting thermal NO_x formation. A few low-NO_x burners split the coal flow into two or more streams to create multiple fuel-rich regions. One Japanese burner concentrates the coal-primary air mixture, and introduces the dilute coal stream downstream of the burner while air is introduced only to the primary flame. The fuel introduced into the primary flame zone results in a high temperature fuel rich central flame. The balance of coal is added outside the primary flame where it burns at a lower temperature.

NO_x Reduction:

Full load NO_x reductions with Low-NO_x Burners can be expected to range from 30% to 60% depending on factors such as:

- Fuel type.
- Initial NO_x level.
- Excess air
- Operational flexibility of the boiler or furnace.

For coal-fired boilers, NO_x emissions rates as low as 0.15 lb/MBtu are achievable, particularly when burning low rank coals. However, the fuel nitrogen content of coal is such that significantly lower emission rates are probably not possible with coal. Lower emission rates can be achieved with natural gas. Installing Low-NO_x burners is usually the first step taken to reduce NO_x emissions.

Cost Information:

In general, the capital costs for burners range from $10,000 to 50,000 per burner plus installation. The lower end of this range applies when existing burners are modified instead of replaced to achieve lower NO_x. Operating costs are negligible unless increased unburned carbon results in lost revenues from ash sales. An outage is generally required when implementing this technology, but coal-flow sensors and adjustable orifices are best installed when a mill is out of service.

Process: Low-NO_x Burners
Development Status: Commercially available.
Practical Considerations: Since low-NO_x Burners usually produce longer flames, the size and shape of the furnace could cause problems for some installations. Flame impingement on sidewalls or rear wall can result in ash deposits, corrosion, or unacceptable unburned carbon in the flue gas. Most burners have optional configurations to shape the flame at the expense of less NO_x reduction.
Compatibility with other air pollution control technologies: Low-NO_x burners can be implemented with other NO_x-control technologies such as OFA, SNCR, or SCR. In general, the NO_x reduction achieved with LNB make post-combustion NO_x control technologies more cost-effective.
Secondary Environmental Impacts: Low-NO_x burners can cause both positive and negative secondary environmental impacts depending on factors such as the fuel, burner stoichiometries, boiler physical characteristics, etc. The following are potential impacts that must be analyzed on an individual unit basis • CO may increase due to stoichiometry in the burner zone • LOI may increase due to increased staging • ESP performance may degrade with increased LOI or finer particulate.
References: EPRI, “Retrofit NO_x Controls for Coal-Fired Utility Boilers – 2000 Update”, EPRI Final Report, December 2000 EPRI, “Retrofit NO_x Controls for Coal-Fired Utility Boilers – 1996 Update Addendum”, May 1997

Process: Low-NO_x Calciners				
Category	**NO_x, TPY (WRAP 1996)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Cement Kilns	41,009	30 to 50%	1000-5000	Commercial

Process Description:

Replace the riser duct in existing preheater/precalciner kilns with new equipment designed for staged combustion. The new duct has separated air and fuel injection points, and extended residence time downstream of the final air addition point to assure acceptable burnout and minimize CO or hydrocarbon emissions.

NO_x Reduction:

NO_x reduction is achieved by creating two separate combustion zones. The burner zone is fired fuel-lean to create the high temperatures needed for clinker formation. Limestone calcination, which takes place at temperatures in the range of 1600 to 1800 °F, is accomplished in the second combustion zone in the tower. NO_x reductions as high as 50% can be achieved by controlling the size of the fuel-rich region in the second combustion zone. Conversely, if combustion is fuel lean or well mixed in the second zone, NO_x will not be reduced. The ideal stoichiometric ratio in the calciner is 0.7 to 0.8. Some systems do not perform well because the second combustion zone is too fuel-rich (SR < 0.6), causing significant NO_x production when the staging air is added.

Cost Information:

Capital cost for the technology includes additional injectors, ductwork and controls. In some cases, the cyclones used to improve gas-solids contact are also replaced. Capital cost range from $500,000 and 5,000,000 depending on how much of the existing tower is replaced. Operating costs should not change unless cement quality degrades due to lower temperatures or locally reducing conditions. An outage is required to install the new equipment.

Development Status:

Commercially available.

Practical Considerations:

Space to fit the newer larger equipment may not be available in all kilns.

Compatibility with other air pollution control technologies:

Reducing conditions may increase sulfur emissions or require additional SO_2 emission controls.

Secondary Environmental Impacts:

None expected.

Process: Low-NO_x Calciners
References: Rother, R. and Kupper, D., “Staged Fuel Supply – An Effective Way of Reducing NO_x Emissions”, Zement-Kalk-Gips, No. 9. 1989.

Process: Mid-Kiln or Tower Tire Injection				
Category	**NO_x, TPY (WRAP 1996)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Cement Kilns	41,009	15-30%	0-1000	Commercial

Process Description:

Cement kilns are normally fired with a single open-pipe burner fueled by coal or natural gas. However, a portion of the main fuel may be replaced by a waste fuel injected in the mid-kiln region of long, wet or dry kilns, or in the calcining region of tower kilns. Special injectors have been designed to time the introduction of two to four tires into the mid-kiln region as the kiln rotates. Due to rotation, tires can only fall into the kiln once per revolution when the door is on top. Alternately, tires can be dropped into the tower where temperatures are high enough to support combustion.

Mid-kiln tire injection is attractive because it not only reduces NO_x but also generates revenue in the form of tipping fees and reduced fuel requirements. Cadence Environmental Energy, a subsidiary of Ash Grove Cement, offers an automated whole-tire injection system, including a fork that picks up the tires and drops them into the kiln through a gate assembly. A second option is to set up a tire shredding operation on site and inject tire flake into the kiln.

NO_x Reduction:

NO_x is lowered by burning some of the fuel at a lower temperature, and by creating pockets of fuel-rich gas as the tires decompose. Hydrocarbons from tire destruction can reduce NO_x formed in the burner flame. Results to date have varied from 15 to 30% NO_x reduction, depending on:

- Kiln type.
- Number of tires injected.
- Injection temperature.

In some installations, a booster fan has been mounted on the kiln downstream of the tire injection point to provide additional burnout air. This "NO_x fan" gets rid of the high CO or smoke emissions caused by the tires, and may allow operation at higher tire injection rates.

Cost Information:

The capital costs for installing a mid-kiln tire injection system are about $2 to 4M. Operating and maintenance costs should not be affected. Often the installation of this technology is driven by the tipping fee revenue generation. If this is possible, injector costs can be recovered within a few years.

An outage is required when implementing this technology, but downtime can be minimized at sites where space is sufficient for installing the injection system ahead of time (without getting in the way of kiln operation).

Development Status:

Commercially available.

Process: Mid-Kiln or Tower Tire Injection
Practical Considerations: The main purpose of a cement kiln is to produce as much high-quality clinker as possible at the lowest energy cost. Over-feeding tires creates locally reducing conditions that cause smoke, soot, and spoil the naturally occurring sulfur capture in the clinker resulting in higher SO_2 emissions. The practical limit on tire injection is replacement of about 10 to 30% of the fuel, depending on the kiln design. Also, since tires are injected every two minutes, the NO_x emissions rise and fall erratically, making control very difficult.
Compatibility with other air pollution control technologies: High airflows from the NO_x fans can cause increased carryover of cement kiln dust (CKD) into the exhaust. Reducing conditions in the flame zone increase SO_2 emissions.
Secondary Environmental Impacts: Combustion monitoring and tuning has the potential to effect both positive and negative secondary environmental impacts depending on factors such as the fuel, burner air-fuel ratio, kiln design, etc. The following are potential impacts that must be analyzed on an individual unit basis • CO, hydrocarbons and soot emissions may increase due to tire byproducts escaping the secondary combustion zone. • SO_2 may increase due to increased staging. • ESP performance may degrade with increased CKD.
References: U.S. Environmental Protection Agency, "Alternative Control Techniques Document: NO_x Emissions from Cement Manufacturing." EPA Document No. EPA-453/R-94-004, January 1994. "Stick a Fork in It". Product Brochure from Cadence Inc., 1997.

Process: Non-Selective Catalytic Reduction (NSCR)				
Category	**NO_x, TPY (WRAP 1996)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
IC Engines, rich-burn only	111,488	40-98%	< 500	Commercial

Process Description:

In NSCR, the engine exhaust is routed to a catalyst bed across which NO_x is reduced to nitrogen gas. At the same time, VOC and carbon monoxide are oxidized to water and carbon dioxide. Because the catalyst reduces emissions all three of these pollutants, NSCR is often referred to as a "three-way catalyst" system. These systems are similar to the catalytic converters used on automobiles.

For an NSCR system to operate optimally (i.e., to minimize NO_x emissions), the inlet exhaust stream must have very low oxygen content, as well as proper concentrations of NO_x, hydrocarbons, and carbon monoxide. This requires initial engine adjustments, followed by careful monitoring of oxygen content in the exhaust. For this reason, an automatic air-fuel (A/F) ratio controller typically is used to regulate the exhaust oxygen content entering the catalyst bed. The controller adjusts the A/F ratio based on input from an oxygen sensor upstream from the catalyst bed.

Because of the requirement for low oxygen content, NSCR systems are limited to rich-burn SI engines.

NO_x Reduction:

This source indicates that these catalyst systems reduce NO_X emissions by over 98 percent, while reducing VOC by 80 percent and carbon monoxide by over 97 percent. NO_x levels in the range of 0.1 to 1.0 g/bhp-hr have been achieved.

Cost Information:

Capital cost for NSCR includes the catalyst as well as the addition of oxygen sensors and controls. Catalyst replacement generally occurs after about 20,000 hours of operation.

Development Status:

Commercial. Information from vendors of NSCR systems indicates that NSCR three-way catalysts have been installed on over 1,000 IC engines in the United States and have been in use for over 10 years. .

Practical Considerations:

The engine adjustments required to optimize NSCR systems typically reduce the efficiency of the engine, harming fuel economy. The biggest operational problem associated with NSCR has been damage to the catalyst caused by excessive temperature. This is caused when the exhaust stream is too fuel rich. In this situation, the uncombusted natural gas is rapidly oxidized in the catalyst bed, burning it out. At about 1,300 ^oF, the catalyst sustains damage.

Compatibility with other air pollution control technologies:

Enhanced removal of CO and VOC can be achieved.

Process: Non-Selective Catalytic Reduction (NSCR)
Secondary Environmental Impacts: None expected.
References: Manufacturers of Emission Controls Association. "Emission Control Technology for Stationary Internal Combustion Engines." Status Report, July 1997. Edgerton, S. W., Lee-Greco, J., and Walsh, S. "Stationary Reciprocating Internal Combustion Engines Updated Information on NO_x Emissions and Control Techniques (Final Report)." EPA contract No. 68-D98-026, EC/R Incorporated, Chapel Hill, NC, August 29, 2000.

Process: NOxTech

Category	NO_x, TPY (WRAP 1996>100 TPY)	$\%NO_x$ reduction	Cost, $/ton	Status
Reciprocating Engines	86,210	90-95%	~ 1000	Commercial

Process Description:

According to product literature, the NOxTech® emission control system, developed by NOxTech Inc., NOxTech is an automated system in which exhaust gases are chemically treated with a nonhazardous liquid chemical. The technology involves replacing the engine exhaust silencer with a reaction chamber where NO_x and reagent react to form nitrogen, water vapor, and carbon dioxide. The non-catalytic chemical reagent is injected into the exhaust at temperatures between 1,400 and 1,500 °F.

NO_x Reduction:

The vendor states that NOxTech has been proven to remove 90-95% of NOx, as seen in the 4,000-bhp diesel-powered generator on Catalina Island.

Cost Information:

Based on vendor literature, self-sustained, gas-phase autocatalysis reduces emissions of NO_x are reduced at costs as low as $1,000/ ton.

Development Status:

Commercially available

As of August 2000, the system has been installed and is operating on several diesel generators in California. Based on commercial performance in these engines, NOxTech has been demonstrated as BACT for some diesel engines.

Practical Considerations:

The exhaust gas must be heated to achieve the temperatures necessary for the NOxTech system reactions. A heat exchanger should be placed downstream from the reactor to reclaim and reuse this heat energy.

Compatibility with other air pollution control technologies:

Compatible with low-NO_x combustion approaches (LNB, combustion modification). Can be used to augment LEC.

Secondary Environmental Impacts:

Technology also potentially removes 60-80% of particulate matter, 90% of VOC, and 50-70% of carbon monoxide from the exhaust, as seen in the 4,000-bhp diesel-powered generator on Catalina Island.

The process produces trace ammonia emissions of less than 2 to 5 ppmv.

Process: NOxTech
References: Edgerton, S. W., Lee-Greco, J., and Walsh, S. “Stationary Reciprocating Internal Combustion Engines Updated Information on NO_x Emissions and Control Techniques (Final Report).” EPA contract No. 68-D98-026, EC/R Incorporated, Chapel Hill, NC, August 29, 2000. NOxTech Inc. “NOxTech® Technology.” website. www.noxtechinc.com/products.htm. NOxTech Inc. Letter and attachments from E. Cazzola to Mary Jo Krolewsky, U. S. EPA Acid Rain Division. April 12, 1999.

Process: Overfire Air (OFA)				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Coal-fired boilers	607,748	20-40%	250-600	Commercial
Oil/NG boilers	32,910	40-80%	1,000-2,000	Commercial
Wood/Biomass boilers	9,776	20-60%	200-2,000	

Process Description:

OFA, like LNB's, represents practical approaches to minimizing the formation of NO_x during combustion. Simply, this is accomplished by "controlling" the quantities and the way in which fuel and air are introduced and mixed in the boiler (referred to as staging).

In the case of OFA, the approach consists of diverting some of the combustion air (typically up to about 30%) to dedicated injection nozzles (called OFA ports) located some distance above the burner or main combustion zone. Variations include the design and location of the OFA ports, the supply of air to the OFA (either directly from the windbox, or from a dedicated booster fan).

NO_x Reduction:

OFA, which can be used separately or as a system with LNBs, is capable of NO_x reductions of 20% - 40% from uncontrolled levels, when used alone. The type of boiler (e.g., dry vs. wet-bottom, wall- vs. tangential-fired, NSPS vs. pre-NSPS, etc.) and the type of fuel will influence the actual performance achieved.

Cost Information:

OFA technologies have little or no impact on operating costs (other than the potential for an increase in unburned carbon - efficiency loss -, and the resulting impact on ash disposal options). Retrofit costs are site-specific. As such, the economics of these technologies are driven by capital/retrofit costs which typically range from $5-$10/kW, with the lower range reflecting easier application whereas the higher costs are typically associated with more difficult and involved retrofits.

From a schedule standpoint, OFA retrofit projects can require outages of 3 – 6 weeks, depending on factors such as scope of work, integration with other plant outage requirements, etc.

Development Status: Commercial

OFA and LNB's are the most prevalent in the power industry at present. Plants that have had to comply with Title IV of the CAAA of 1992 have largely used these technologies for compliance. Competing manufacturers have proprietary designs, geared towards application in different boiler types, as well as reflecting their own design philosophies.

Practical Considerations:

Boilers with the following design and operating characteristics are expected to be more suitable candidates for OFA applications:

- firing lower-sulfur fuels (e.g., less propensity for waterwall corrosion)
- low baseline unburned carbon (e.g., to minimize ash salability impacts).

Process: Overfire Air (OFA)

- favorable cross-section/height profiles (e.g., tall boilers which provide for adequate mixing/residence time to maximize effectiveness).

- units with existing burners in good operating condition,

- Potential O&M impacts due to combustion NOx controls include:
  - Change in optimum excess air level: 0.5-1.5 percentage points increase in excess O_2 is possible
  - 3-5 percentage points increase in LOI is possible; in general, as higher NO_x reduction is being sought, the higher the probability for increased LOI (NO_x vs. LOI trade-off)
  - Changes in reheat and superheat steam temperatures (typically lower by 20-50 degrees F) are possible in some applications.

Compatibility with other air pollution control technologies:

OFA technologies are often used in conjunction with LNB's. As a main combustion based NO_x control approach, OFA is fully compatible with other NOx controls including LNB's, reburning (OFA is an integral component of reburning), as well as the post combustion technologies such as SNCR and SCR

Secondary Environmental Impacts:

OFA, like all combustion modification approaches face a common challenge: that of "striking a balance" between NO_x reduction and fuel efficiency. The concern is exemplified by the typically higher carbon levels in the fly ash, which reflect lower combustion efficiency but also the contamination of the fly ash itself possibly making it unsuitable for reutilization (e.g., cement industry).

References:

EPRI, "Retrofit NO_x Control Guidelines for Gas- and Oil-Fired Boilers", Final Report, December 1993.

EPRI, "Retrofit NO_x Controls for Coal-Fired Utility Boilers – 1996 Update Addendum", May 1997.

EPRI, "Retrofit NO_x Controls for Coal-Fired Utility Boilers – 2000 Update", EPRI Final Report, December 2000

Process: Oxy-Fuel Firing				
Category	**NO_x, TPY (WRAP 1996)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Glass Manufacturing	5,033	80-85%	2,150-4,400	Commercial

Process Description:

Oxy-fuel melting involves the replacement of the combustion air with oxygen (>90% purity). The technique can be used with either natural gas or oil as the fuel, although the use of gas is more common. The elimination of the majority of the nitrogen form the combustion atmosphere reduces the volume of the waste gases (composed mainly of CO_2 and water vapor) by 70-85 % depending on oxygen purity. In general, oxy-fuel furnaces have the same basic design as recuperative melters, with multiple lateral burners and a single waste gas exhaust port. In the most modern furnaces the geometry is optimized for oxy-fuel firing and minimization. Furnaces designed for oxygen combustion do not currently utilize heat recovery systems to pre-heat the oxygen supply to the burners, due to safety concerns; however, the technique potentially involves substantial energy savings because it is not necessary to heat the atmospheric nitrogen to the temperature of the flames. The formation of thermal NO_x is greatly reduced because the main source of nitrogen in the furnace is much lower.

NO_x Reduction:

Compared to air-fuel fired furnaces, NO_x emissions are generally reduced by 70-90%. This reduction equates to:

- <1 kg/ton glass for fiber and container glass furnaces
- 1-2 kg/ton glass for special glass (without nitrate addition)

The latest versions of oxy-fuel burners combined with optimized furnace design and operation can in some cases reduce emissions to 0.3-0.8 kg NO_x/ton of glass melted. No information is available for emissions from flat glass production, but emissions of 0.5 to 1.5 kg/ton of glass melted are considered likely.

Cost Information:

In general, capital costs for oxy-fuel firing are $1,930K-$9,810K. An important factor in the capital cost is that oxy-fuel furnaces do not have a conventional combustion gas preheat system and so the capital cost is generally lower than for a regenerative or recuperative furnace of comparable pull-rate. In most applications, the determining factor regarding cost effectiveness of oxy-fuel firing will be the difference between the energy savings and the costs of the oxygen compared with the costs of alternative NO abatement techniques.

Development Status:

Commercially available

It is estimated that 5-10% of the world's glass production is made with oxy-fuel melting, but this figure varies between the sectors. There are several examples of oxy-fuel furnaces operating successfully in the following sectors: container glass, glass wool, special glass (particularly TV glass), continuous filament glass fiber, and frits. Trials have been carried out in the domestic glass sector resulting in good NO_x reduction, but problems occurred with severe foaming. The problems encountered in domestic glass production are similar to those initially encountered in other applications e.g. container glass. Similar

Process: Oxy-Fuel Firing
solutions are likely to be possible but the higher quality requirements make them more difficult to apply. There are several examples of the technique operating successfully for domestic glass production worldwide. Considerable development work is being undertaken and the number of plants and the level of operating experience are increasing.
Practical Considerations: The merits of oxy-fuel firing vary greatly from case to case depending on furnace size and availability of pure oxygen. The technique is most effectively installed during furnace rebuild. Hot installation may lead to energy savings and to an increased pull rate; however, it is unlikely to result in lower NO_x emissions, and there is a danger of accelerated refractory wear. Furnace waste-gas temperature can be very high, 1200-1300 °C and will usually require cooling. Due to high water content and concentration of corrosive species, cooling is usually by dilution with air. The higher temperatures associated with the technique can result in higher refractory wear. Oxygen required for combustion can be supplied either by delivery to the site or by on-site production. Except for very small applications, the amounts of oxygen required usually make it more economical to produce the oxygen on-site.
Compatibility with other air pollution control technologies: Addition of a cullet preheating system, which can also reduce NO_x and other emissions by reducing the amount of fuel required, can add to the energy savings of oxy-fuel firing by recovering heat from the waste gases. See cullet preheating description.
Secondary Environmental Impacts: Oxy-fuel firing can also help to reduce overall emissions of volatile materials form the furnace (particulates, fluorides, chlorides etc.), due to reduces gas flow over the melt and in some cases reduced turbulence. • Particulate emissions in soda-lime glass can be reduced to 0.2-0.3 kg/ton. • Particulate emissions most effectively reduced for boron containing glasses (up to 50%). • Reduction in fuel usage leads to lower SO_2 emissions for oil-fired furnaces. Concentrations of all pollutants may actually be higher due to reduced gas volume, although the absolute emission is reduced. Dilution with cooling air usually brings the concentrations closer to more normal levels.
References: European IPPC Bureau. "Reference Document on Best Available Techniques in the Glass Manufacturing Industry." Seville, Spain, October, 2000.

Process: Oxygen-Enhanced Combustion Modifications				
Category	NO_x, TPY (WRAP 1996)	%NO_x reduction	Cost, $/ton	Status
Coal-fired Boilers	607,748	30 to 80%	1,000-2,000	Near Commercial
Cement kilns	41,009	0-20%	100-1000	Commercial

Process Description:

In coal-fired boilers, O_2 injection is used to improve effectiveness of OFA operation. Small amounts of oxygen are introduced into the burner zone through specially designed lances. The added O_2 creates a local hot spot that increases the rate of coal volatile release, encourages more NO_x reduction, and enables more fuel-rich operation where less NO_x is formed. The technology has been demonstrated on a 44-MW coal-fired boiler.

In cement kilns, oxygen lances are used to create a hot spot in the flame zone and achieve higher kiln throughput (increase clinker production). In doing so, NO_x is not reduced but NO_x emission rates (lb. NO_x/ton of clinker) goes down in proportion to the increase in production. O_2 injection achieves even higher production when cement kiln dust (CKD) is co-injected. The CKD also quenches peak flame temperature to achieve some reduction in thermal NO_x formation.

NO_x Reduction:

In the coal-fired boiler demonstration, conventional OFA reduced NO_x to around 0.35 to 0.40 lb./MBtu. O_2 injection lowered the NO_x further to around 0.22 to 0.25 lb./MBtu, while also decreasing LOI and opacity, and allowing better steam temperature control when firing bituminous coal. NO_x reductions down to 0.16-0.19 lb./MBtu were achieved when the unit switched to a blend of 90% sub-bituminous and 10% bituminous coal.

In the cement industry, oxygen injection has achieved 0 to 20% NO_x reduction in conjunction with a 0-5% kiln capacity increase. Increased capacity (when it occurs) is the primary cause of the NO_x reduction.

Cost Information:

The primary cost of all these applications of oxygen-enhanced combustion is the cost of the oxygen. Oxygen required for combustion can be supplied either by delivery to the site or by on-site production. Except for very small applications, the amounts of oxygen required usually make it more economical to produce the oxygen on-site. Capital cost for oxygen storage and delivery systems range from $100,000 when pipeline gas is used, to $1,500,000 when on-site storage is required. In general, capital costs are $1,930K-9,810K when on-site generation is chosen.

An important factor for the capital cost of oxy-fuel firing is that oxy-fuel furnaces do not have a conventional combustion gas preheat system and so the capital cost is generally lower than for a regenerative or recuperative furnace of comparable pull-rate. In most applications, the determining factor regarding cost effectiveness of oxy-fuel firing will be the difference between the energy savings and the costs of the oxygen compared with the costs of alternative NO_x abatement techniques.

Process: Oxygen-Enhanced Combustion Modifications
Development Status: The coal-fired boiler technology needs to be demonstrated over several months to show effectiveness, reliability, and safety. Such a demonstration is expected to begin during the summer of 2003. The technologies are commercially available for application to cement and glass manufacturing.
Practical Considerations: Using oxygen enrichment results in less flue gas flow since it eliminates the nitrogen in the air it replaces. The merits of oxy-fuel firing vary greatly from case to case depending on furnace size and availability of pure oxygen. The technique is most effectively installed during furnace rebuild. Hot installation may lead to energy savings and to an increased pull rate; however, it is unlikely to result in lower NO_x emissions, and there is a danger of accelerated refractory wear. Furnace waste-gas temperature can be very high, 1200-1300 °C and will usually require cooling. Due to high water content and concentration of corrosive species, cooling is usually by dilution with air. The higher temperatures associated with the technique can result in higher refractory wear. Many potential users do not want to own and operate an air-separation plant. Oxygen suppliers offer to build, own, and operate the air separation system in return for a long term contract for oxygen sales.
Compatibility with other air pollution control technologies: Oxygen-enhanced combustion on coal-fired boilers can only be effective when implemented with OFA. If O_2 is added to an unstaged flame, NO_x emissions will increase. The technology can also be combined with SNCR or SCR for greater NO_x reductions. O_2 can also be used with post-combustion NO_x control technologies in cement kilns and glass melters.
Secondary Environmental Impacts: Oxygen-enhanced combustion may lessen the impacts of staged combustion. The following are potential impacts that must be analyzed on an individual unit basis: • CO may increase due to stoichiometry in the burner zone • LOI may increase due to increased staging • ESP performance may degrade with increased LOI or finer particulate. Oxy-fuel firing can also help to reduce overall emissions of volatile materials from the kiln or furnace (particulates, fluorides, chlorides etc.), due to reduced gas flow and in some cases reduced turbulence. • Particulate emissions in soda-lime glass can be reduced to 0.2-0.3 kg/ton. • Particulate emissions most effectively reduced for boron containing glasses (up to 50%). • Reduction in fuel usage leads to lower SO2 emissions for oil-fired furnaces. Concentrations of all pollutants may actually be higher due to reduced gas volume, although the absolute emission is reduced. Dilution with cooling air usually brings the concentrations closer to more normal levels.
References: U.S. Environmental Protection Agency, “Alternative Control Techniques Document: NO_x Emissions from

Process: Oxygen-Enhanced Combustion Modifications
Utility Boilers". EPA Document No. EPA-453/R-94-023, July 1994. Bool, L., "NO_x Reduction from a 44MW Wall-Fired Boiler Utilizing Oxygen-enhanced Combustion", EPRI/DOE/EPA Mega Symposium, Washington, May 2003

Process: Pre-Stratified Charge				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Reciprocating Engines	86,210	80-95%	<500	Commercial

Process Description:

Air is injected into the intake manifold so that during the intake stroke, the piston initially draws in air, followed by a fuel-rich air-fuel mixture. Thus, the mixture near the spark plug is fuel rich, promoting good combustion, while the mixture away form the spark plug is very lean, acting a s a heat sink and suppressing NO_x formation.

NO_x Reduction:

From tests for ten engine models ranging from 100 to 800 bhp, NO_x emissions ranged from about 0.1 g/bhp-hr to 9.5 g/bhp-hr, with a mean of 0.6 g/bhp-hr. Engines ranging from 300 to 800 bhp averaged 95% reduction, while tests on engines less than 50 bhp showed NO_x reductions averaging 77%.

Vendors guarantee the achievable NO_x emission level of 2.0 g/bhp-hr.

Cost Information:

See EPA Report below.

Development Status:

Commercially available. In commercial use since 1980s.

Practical Considerations:

Applicable only to carbureted (i.e. non-fuel-injected) rich-burn engines. May cause some power derating; 20% has been observed. While the PSC system itself requires very little maintenance, the engines require more frequent overall maintenance.

Compatibility with other air pollution control technologies:

Compatible with exhaust gas recirculation (EGR), with air injected by PSC system coming form the engine's exhaust. May also be used in conjunction with post-combustion technologies. However, the overall NO_x reductions are not strictly additive and careful evaluation is required to ensure cost effective strategies.

Secondary Environmental Impacts:

Possible increase in CO and VOC emissions.

References:

Edgerton, S. W., Lee-Greco, J., and Walsh, S. "Stationary Reciprocating Internal Combustion Engines Updated Information on NOx Emissions and Control Techniques (Final Report)." EPA contract No. 68-D98-026, EC/R Incorporated, Chapel Hill, NC, August 29, 2000.

Process: SCONOx Technology				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Reciprocating Engines	86,210	95%	Not available	Commercial
Oil/NG boilers	32,910	70-99%	Not available	Commercial
Turbines	25,278	>90%	>7,000	Commercial

Process Description:

The SCONOx system adds a chemical reactor for NO_x sorption using a catalyst/sorbent to remove NO_x, carbon monoxide, and VOC. NO_x is oxidized in the presence of a platinum-based catalyst and the resulting NO_2 is adsorbed onto a potassium carbonate sorbent, forming potassium nitrites. The sorbent must be regenerated periodically by passing a controlled mixture of regeneration gases across its surface in the absence of oxygen. Regeneration gases react with the nitrites to form water and elemental nitrogen. The system is installed as a bed of sorbent/catalyst. A system of louvers and piping allows portions of the bed to oxidize and adsorb pollutants and other portions of the bed to undergo regeneration.

NO_x Reduction:

The first commercial installation in gas turbines achieved NO_x emissions below 2 ppm, a reduction of over 90%.

Vendor testing shows SCONOx reduced NO_x emissions in natural gas-fired reciprocating engines up to 95%. Preliminary testing in diesel engines found the technology reduced NOx by 98.9% to 0.4 g/bhp-hr.

Cost Information:

Cost for Gas Turbine application is preliminary and from DOE reference below.

Development Status:

Commercially available

First commercial installations in gas turbines commenced in 1999. Commercial applications for natural gas-fired reciprocating engines went online in 2000. Diesel applications were sold in 2000, but further information is unavailable.

Practical Considerations:

The technology was initially applied only to gas turbines, but variations have been developed for natural-gas and diesel-fired reciprocating engines.

Regeneration gas flow is about 1 percent of exhaust gas flow. Typically, natural gas is converted to hydrogen in a reformer at 600-900 °F to produce the regeneration gas. The regeneration step is complicated and the reformer requires additional labor and maintenance.

Exhaust temperatures should be controlled at 600-700 °F for best NO_x reduction. Performance also improves as exhaust gas oxygen levels approach zero. Temperature and O_2 control may be difficult at some sites. The catalyst is de-activated by soot or sulfur species, so catalyst must be cleaned every 20,000 hours.

Process: SCONOx Technology
SCOSOx is required to remove SO_2, which would otherwise poison the SCONOx catalyst. SCOSOx requires regeneration similar to SCONOx.
Compatibility with other air pollution control technologies: Due to the emerging nature of the technology, little is discussed about compatibility with other technologies. Based on tests with LEC engines, issues regarding increases in CO/VOC may be of concern
Secondary Environmental Impacts: Carbon monoxide and VOC are also reduced up to 95%.
References: Edgerton, S. W., Lee-Greco, J., and Walsh, S. "Stationary Reciprocating Internal Combustion Engines Updated Information on NOx Emissions and Control Techniques (Final Report)." EPA contract No. 68-D98-026, EC/R Incorporated, Chapel Hill, NC, August 29, 2000. Amar, K.P., Staudt, J. "Status Report on NOx Controls for Gas Turbines, Cement Kilns, Industrial Boilers, Internal Combustion Engines; Technologies and Cost Effectiveness." Northeast States for Coordinated Air Use Management, Boston, MA, January, 2001. Goal Line Environmental Technology News. "Cummins Engine Co. Tests SCONOx® for Diesel IC Engines." Oct 1999. Vol 1, Issue 3.

Process: Selective Catalytic Reduction (SCR)				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Coal-fired boilers	607,748	70-90%	1,500-2,000	Commercial
Reciprocating Engines	86,210	75-90%	<1,000	Commercial
Oil/NG boilers	32,910	70-90%	2,000-10,000	Commercial
Turbines	25,278	~90%	500-10,000	Commercial
Refinery Process Heaters	9,311	75-90%	3,700-11,000	Commercial
Glass Melters	5,033	75-90%	---	Commercial

Process Description:

Post-combustion NO_x controls include **Selective Non-Catalytic Reduction** (SNCR) and **Selective Catalytic Reduction** (SCR). They are fundamentally similar, in that both use an ammonia-containing reagent to react with the NO_x produced in the boiler, and convert it to harmless nitrogen and water, SNCR accomplishes this at higher temperatures (1700ºF-2000ºF) in the upper furnace region of the boiler, while SCR operates at lower temperatures (about 600ºF to 750°F) and hence needs a catalyst to produce the desired reaction between ammonia and NO_x. High temperature catalysts, sometimes used in gas turbine applications can operate at temperatures up to ~1100°F

Conventional SCR incorporates a reactor located typically between the economizer and the air preheater. The reactor housing is sized to provide optimum flue gas velocity and catalyst volume.

In about one-quarter to one-third of the German SCR installations, the SCR reactor is located downstream of the flue gas desulfurization (FGD) system. This is called a "tail-end" configuration. Because the catalyst operates at temperatures of at least 600+°F, the flue gas temperature needs to be increased between the FGD and tail-end SCR. This reheating the flue gas before it enters the SCR. This extra equipment makes the capital and energy costs higher than in a conventional SCR. On the other hand, the tail-end SCR uses less catalyst, experiences a longer catalyst life, and can be built without impacting plant operations, with tie-in typically occurring during a normal two-week outage.

An ammonia injection system is located upstream of the catalyst typically in a grid configuration to inject and disperse the ammonia uniformly into the flue gas.

NO_x Reduction:

NO_x reductions of 90+% are capable with SCR. NO_x reduction levels are typically limited by the need to control residual ammonia to low levels (2-5ppm), and by cost effectiveness considerations (higher cost-to-NOx reduction ratio for deeper reductions. SCR applications typically represent a balance between the percentage NOx reduction requirement, residual ammonia limit, SO_2 to SO_3 oxidation rate, and ability to continuously maintain a uniform, stable NH_3/NO_x distribution across the entry plane into the catalyst.

Cost Information:

Capital costs for retrofit SCR systems to power generation sources are mostly within the range of $60/kW to about $140/kW. The lower end of this range applies to retrofits with nominal difficulty. The high end of the range would typically be associated with retrofits having significantly impeded construction access, extensive relocations, and difficult ductwork transitions.

Process: Selective Catalytic Reduction (SCR)
Operating costs are mainly driven by cost of reagent, energy penalty (pressure loss, ammonia vaporization), catalyst replacement and dedicated O&M costs
Development Status: Commercially available SCR is widely used oversees (Germany and Japan represent over 50,000 MW of installed capacity. In the US, significant activity has recently occurred with SCR installations on coal fired units. Projections for over 100 new installations in the US in the next 5 years have been made.
Practical Considerations: From a technical perspective, SCR can be used many different applications and sources. However, the cost can vary considerably depending on retrofit difficulty and plant layout, fuel, or unit operating characteristics. The performance of an SCR system is dependent on the size and arrangement of the catalysts, the fuel burned, gas flow conditions at the catalyst entrance, and the type and amounts of reagent used. A number of factors should be considered when installing an SCR system. They include: • Operating temperature window temperature which is a function of the catalyst formulation but typically ranges between 600°-750°F for sulfur bearing fuels, • Ammonia injection system design to ensure good distribution in proportion to the mass flux of NO_x for optimized performance (maximum NO_x reduction and minimum NH_3 slip) • Flue gas pressure drop which is dependent upon flue gas velocity, catalyst configuration, and quantity of catalyst required to achieve specified NO_x reduction • Flue gas flow/temperature distribution, as catalyst guarantees are typically predicated upon predetermined conditions • Fouling potential of catalyst and/or APH surfaces. Reaction of excess ammonia with SO_3 generated in the furnace when firing sulfur bearing fuels will form ammonium bisulfate/sulfate that deposits on the cold end sections of the air heater to cause corrosion and increased pressure drop • Flue gas contaminants - alkaline compounds, halogens, and heavy metals can cause catalyst poisoning. • Decreased heat rate at low load if economizer bypass is needed to maintain the required flue gas temperature in the SCR reactor.
Compatibility with other air pollution control technologies: SCR applications are fully compatible with combustion NOx controls (LNBs, OFA, reburn, etc.) and can be used with other amine-based controls (e.g. SNCR) in hybrid configurations. In theory, most of these technologies can be used together. However, NO_x reductions are not necessarily additive, and more importantly, the "economics" of the combined technologies may or may not be cost-effective. Such analyses are highly site- and strategy-specific. However, several such combinations of technology are considered attractive and have or are gaining acceptance. For example, the combination of LNB/OFA with either SCR or SNCR is more prevalent than the application of the post-combustion technologies alone. The economics of this approach are justified by the reduced chemical and capital costs due to lower NO_x levels entering the SCR system.

Process: Selective Catalytic Reduction (SCR)
When combining SCR with NO_x control technologies whose performance depends on mixing characteristics in the upper furnace (i.e., OFA, reburn, or SNCR), potential stratification of inlet NO_x levels to the SCR becomes a key design issue that can impact SCR performance.
Secondary Environmental Impacts: Potential impacts arising from the application of SCR include: • Increased corrosion downstream of the SCR from SO_3 formed on the catalysts • Air heater fouling due to ammonia bisulfate formation in the cold end • Ammonia contamination of fly ash affecting its salability or disposal • Increased system pressure drop • FGD waste management, if located downstream of SCR These impacts are mostly relevant to applications with sulfur and other contaminants-bearing fuels (e.g. coal/oil). Applications with natural gas are more benign both with respect to catalyst choice and life, as well as other plant impacts.
References: EPRI, **“**Retrofit NO_x Controls for Coal-Fired Utility Boilers – 2000 Update”, EPRI Final Report, December 2000 NESCAUM, “Status Report on NO_x Control Technologies and Cost Effectiveness for Utility Boilers”, June 1998. Cichanowicz, J., “100 GW of SCR: Installation Status and Implications of Operating Performance on Compliance Strategies”, EPRI/DOE/EPA Mega Symposium, Washington, May 2003 McIlvaine, R., “SCR Operating Experience of German Power Plant Owners as Applied to Challenging US High Sulfur Service”, EPRI/DOE/EPA Mega Symposium, Washington, May 2003

Process: Selective Non-Catalytic Reduction (SNCR)				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Coal-fired boilers	607,748	25-50%	800-1,500	Commercial
Cement Kilns	41,009	30-70%	200-1,000	Commercial
Oil/NG boilers	32,910	30-60%	1,300-3,000	Commercial
Wood/Biomass boilers	9,776	40-80%	900-2,200	Commercial
Refinery Process Heaters	9,311	50-70%	1,200-2,700	Commercial
Glass Melters	5,033	~40%	---	Commercial

Process Description:

Post-combustion NO_x controls include **Selective Non-Catalytic Reduction** (SNCR) and **Selective Catalytic Reduction** (SCR). They are fundamentally similar, in that both use an ammonia-containing reagent to react with the NO_x produced in the boiler, and convert it to harmless nitrogen and water, SNCR accomplishes this at higher temperatures (1700ºF-2100ºF) in the upper furnace region of the boiler, while SCR operates at lower temperatures (about 600ºF to 750°F) and hence needs a catalyst to produce the desired reaction between ammonia and NO_x.

While this difference between the two technologies may seem minor, it yields significant difference in performance and costs. This is because in the case of SNCR, the reaction occurs in a somewhat uncontrolled fashion (e.g., the existing upper furnace becomes the “reactor”). In practice, this means that SNCR has lower capital costs (no need for a reactor/catalyst); higher operating costs (lower efficiency means that more reagent is needed to accomplish a given reduction in NO_x); and limited NO_x reduction capability (typically 30%-40%, with some cases achieving reductions in the 50% range).

With SNCR, the reagent is introduced directly into the upper furnace, within the temperature window above. Typical applications may include multiple injection nozzles at various elevations (temperature points). in the furnace to optimize the distribution of reagent as well as to allow for operation at various load points.

NO_x Reduction:

SNCR technology is typically capable of NO_x reductions in the range of 25% to 80% depending on many design and operating characteristics of the specific application.

Cost Information:

Capital cots range from $10 to $20/kW for power generation boilers.
Operating costs are driven primarily by the consumption of the chemical reagent – usually urea for SNCR - which in turn is dependent upon the efficiency of the as well as the initial NO_x level and the desired percent reduction. These are typically in the range of $500-$700/ton of NO_x.
An additional consideration important in the overall operating costs is the potential contamination of fly ash by ammonia making it potentially unsalable.

Development Status: Commercial
SNCR is a fully commercial technology widely employed in various industries and applications. Urea-based applications are the predominant approach, as urea seems to have several advantages over ammonia in large-scale applications.

Process: Selective Non-Catalytic Reduction (SNCR)

Practical Considerations:

SNCR applications must be considered on a site –specific basis as several design and operating characteristics will affect the suitability of the technology. Some key issues include

- Available temperature window
- Size (cross-section/height) of the furnace for appropriate distribution and mixing of the reagent
- Sulfur content of the fuel (SO_3 and NH_3 form ammonium salts which can have negative impacts on the downstream equipment)
- Operational profile of the unit (rapid swings in flows/temperatures often result in poor performance in terms of NO_x reduction and ammonia slip)

Compatibility with other air pollution control technologies:

SNCR applications are compatible with combustion NO_x controls (LNBs, OFA, reburn, etc.) and can be used with other amine-based controls (e.g. SCR) in hybrid configurations. In theory, most of these technologies can be used together. However, NO_x reductions are not necessarily additive, and more importantly, the "economics" of the combined technologies may or may not be cost-effective. Such analyses are highly site- and strategy-specific.

The application of SNCR with reburn has yielded several developments by different companies. Various approaches are available commercially. Essentially they all revolve around the ability to combine the injection the reburn fuel and the amine reagent in the upper furnace region. NO_x reductions are not additive but better than the individual technology. While these combined approaches have not gained extensive commercial deployment reductions of 60%-70% have been reported. Economic effectiveness needs to be properly addressed on an individual basis as both the cost of reagent and reburn fuel contribute to the overall cost analyses

Other variations of SNCR-based technology include the use of hydrocarbon injection to promote NH_3 reduction reactions, as well as reagent injection into a fuel rich zone of the OFA system. These variations while offered commercially are still under demonstration

Secondary Environmental Impacts:

SNCR has some of the same issues associated with SCR. The two most likely to warrant consideration are

- NH_3 slip (emissions and impacts on ash)
- Formation of nitrous oxide (N_2O – a green house gas). This is mostly associated with urea, as opposed to ammonia, and may become a larger concern from the perspective of global climate issues

References:

NESCAUM, "Status Report on NO_x Control Technologies and Cost Effectiveness for Utility Boilers", June 1998.

EPRI, "Retrofit NOx Controls for Coal-Fired Utility Boilers – 2000 Update, Final Report", December 2000.

Himes, R., "A Fresh Look at SNCR", EPRI/DOE/EPA Mega Symposium, Washington, May 2003

EPRI, "Sate of the Art Assessment of SNCR Technology", September 1993.

EPRI, "SNCR Feasibility and Economic Evaluation Guidelines for Fossil-Fired Utility Boilers", May 1994

Process: Tempering (Water, air, steam injection)				
Category	**NO_x, TPY (WRAP 1996>100 TPY)**	**%NO_x reduction**	**Cost, $/ton**	**Status**
Turbines	25,278	~50%	2,000-7,000	Commercial
Refinery Process Heaters	9,311	---	---	Commercial

Process Description:

Tempering is a combustion control using water, air, or steam to lower the combustion temperatures, which reduces thermal NO_x formation. Water or steam, treated to quality levels comparable to boiler feedwater, is injected into the combustor and acts as a heat sink to lower flame temperatures.

NO_x Reduction:

Controlled NO_x emission levels range form 25 to 42 ppmv for natural gas fuel and from 42 to 75 ppmv for distillate oil fuel.

Cost Information:

Capital costs for wet injection include a mixed bed demineralizer and reverse-osmosis water treatment system and an injection system. All costs are based on availability of the injection medium on site. Capital costs range from $388K for a 4,430 hp turbine ($89/hp) to $4,830K for a 216,000 hp turbine ($22/hp). For steam injection, capital costs are slightly higher than for water injection.

Development Status:

Commercially available

Practical Considerations:

This technique is available for all new turbine models and can be retrofitted to most existing installations. The decision of which injection medium to use for NO_x reduction depends on many factors including the availability of steam injection nozzles and controls from the turbine manufacturer, the availability and cost of steam at the site, and turbine performance and maintenance impacts. This decision is usually driven by site-specific environmental and economic factors.

Compatibility with other air pollution control technologies:

None.

Secondary Environmental Impacts:

None expected.

References:

Alternative Control Techniques Document: NO_x Emissions from Stationary Gas Turbines. EPA Document No. EPA-453/R-93-007, January 1993.

U.S. Environmental Protection Agency. “Alternative Control Techniques Document – NO_x Emissions form Stationary Reciprocating Internal Combustion Engines.” EPA-453/R-93-032, July, 1993.

Process: Tempering (Water, air, steam injection)
Poole, L., "Houston Galveston Area NO_x Abatement Industries Perspective," present at the Council of Industrial Boiler Owners, NO_x Control XV Conference, Houston, TX, August 2002.

APPENDIX D: PM Control Technology Summaries

Process: Cyclones				
Category	**PM, TPY (WRAP 1996 >100 TPY)**	**%PM reduction**	**Cost**	**Status**
Mineral Processing	24,499	50 – 90%	See below	Commercial
Petrochemical	10,836	50 – 90%	See below	Commercial
Wood/Biomass boilers	5,718	50 – 90%	See below	Commercial
Primary metal production	4,697	50 – 90%	See below	Commercial
Pulp & Paper	4,476	50 – 90%	See below	Commercial

Process Description:

Cyclones use centrifugal force to separate particulate from gas streams, and belong to the broader family of mechanical collectors, which use a variety of mechanical forces to collect particulate. A multiple cyclone is an array of a large number of small (several inch diameter) cyclones in parallel.

PM Reduction:

Multiple cyclones have overall mass removal efficiencies of 70-90%. However, cyclone collection efficiencies fall off rapidly with particle size, so that control of fine particulate (PM-2.5) is limited. While collection efficiency is a function of the cyclone design and particle properties, cyclone removal efficiencies will be 90% or greater for 10 micron particles, dropping to perhaps 70% for 2.5 micron particles, and 50% for 1 micron particles. Addition of a second multiple cyclone in series with the first will allow for increased removal efficiency.

The efficiency of a cyclone increases with the gas flow rate through the cyclone. Cyclones are therefore most effective at high boilers loads, where flue gas flow rates are highest, with collection efficiency decreasing at lower loads.

Cost Information:

The following values represent typical costs for several of these technologies (these numbers reflect unit sizes ranging from utility-size units up to about 2,000,000 ACFM to smaller process down to about 10,000 ACFM).

- Capital - $1 - $5/ACFM
- O&M - NA

Development Status:

Commercial.

Cyclones have been used extensively in various particulate collection applications over the years. In the past, industrial plants used mainly cyclones. Cyclones are robust technologies that can deal with the cyclic operation and load changes. However, their efficiency is moderate when compared with ESP or fabric filtration

Practical Considerations:

Cyclones are best suited for applications of relatively large particle sizes as their effectiveness on smaller particles is limited

Cyclones are less expensive than other PM controls and have no costs beyond the initial capital cost.

Process: Cyclones
Multiple cyclones have no moving parts, but do require regular cleaning to avoid plugging, and preventive maintenance to avoid leaks, which can disrupt flow patterns and thus lower collection efficiency.
Compatibility with other air pollution control technologies: Cyclones are compatible with other PM controls and may be desirable in selected applications to minimize PM loadings into downstream controls such as an ESP, FF or PM scrubber
Secondary Environmental Impacts: None expected.
References: http://www.icac.org http://www.IEA-coal.org.UK/ http://www.croll.com

Process: Electrostatic Precipitator (ESP)				
Category	**PM, TPY (WRAP 1996 >100 TPY)**	**%PM reduction**	**Cost**	**Status**
Coal-fired boilers	46,010	90%-99+%	See below	Commercial
Wood/Biomass boilers	5,718	90%-99+%	See below	Commercial
Oil/NG boilers	1,379	90%-99+%	See below	Commercial
Cement kilns	641	90%-99+%	See below	Commercial

Process Description:

ESP's operate on the principle of electrophoresis, by imparting a charge to the particulates and collecting them on opposed charges plates. Dry vs. wet refers to whether the gas is water cooled and saturated prior to entering the charged plate area, or is collected dry on the plates.

Electrostatic precipitators (ESPs), have been in use for particulate control since the early 1920's, use electrical fields to remove particulate from boiler flue gas.

In an electrostatic precipitator, an electric field is maintained between high-voltage discharge electrodes, typically wires or rigid frames, and grounded collecting electrodes, typically plates. A corona discharge from the discharge electrodes ionizes the gas passing through the precipitator, and gas ions subsequently ionize particulates. The electric fields impart electrostatic forces to the negatively charged particles, "driving" them to the collecting electrodes. Particulates are collected from the electrode plates either by mechanical rapping (Dry ESP) or by using a water spray to remove this particulate. (Wet ESP).

In a typical electrostatic precipitator, collecting plates are arranged parallel to the gas flow, normally 9-18 inches apart, with discharge electrodes between them. Most precipitators have 3-5 independent electrical sections, i.e., sets of discharge and collecting electrodes with independent power supplies called Transformer/Rectifier (TR) sets, in series. Each independent section removes a fraction of the particulate in the gas stream. This arrangement allows the use of lower power (higher voltages, but lower current) in the first sections of the precipitator, where there is more particulate to be removed. Higher power is needed in the later sections, to collect the smaller particles.

A typical wet ESP configuration uses cylindrical collecting electrodes, with discharge electrodes located in the centers of the cylinders. Wet ESPs are useful in obtaining low opacities through the removal of acid gases and mists in addition to fine particulate. In addition, these devices have no rapping re-entrainment losses, and no back corona.

PM Reduction:

Many factors determine electrostatic precipitator removal efficiency. ESP size is an important one. Size determines residence time (longer particle residence times help collection efficiency)
Precipitator size is related to and usually referred to as the specific collection area (SCA), the ratio of the surface area of the collection electrodes to the gas flow. Higher collection areas lead to better removal efficiencies. Collection areas normally are in the range of 200-800 ft^2/1000 acfm. In order to achieve collection efficiencies of 99.5%, specific collection areas of 350-400 ft^2/1000 acfm are typically used.

Electrostatic precipitator collection efficiencies can exceed 99.9%, and efficiencies in excess of 99.5% are common. Precipitators with high overall collection efficiencies will have high collection efficiencies for particles of all sizes. Good control of PM-10 and PM-2.5 can be achieved with well-designed and operated electrostatic precipitators.

Process: Electrostatic Precipitator (ESP)
Precipitator collection efficiencies decreases for very small particles (less than 1 micron). The reason for lower efficiency for submicron particles is that both particle charge and the resistance of the gas to particle motion increase with particle size. As particles get smaller, the particle charge is lower, while the resistance to particle motion is higher resulting in poor collection. In practice this effect means that an ESP precipitator with a 99.9% overall mass collection efficiency may only collect over 90% of submicron particles, and over 97-98% of the 0 to 5 micron particles. Some older precipitators on utility boilers are small, with SCAs below 200 ft²/1000 acfm and correspondingly short treatment times.
Cost Information: The following values represent typical costs for several of these technologies (these numbers reflect unit sizes ranging from utility-size units up to about 2,000,000 ACFM to smaller process down to about 10,000 ACFM)) • Capital: $15 - $40/ACFM • Fixed O&M: Dry ESP's - $0.25 - $0.65/yr-ACFM Wet ESP's - $0.15- $0.50/yr-ACFM • Variable O&M: Dry ESP's - $0.45 - $0.60/yr-ACFM Wet ESP's - $0.25 - $0.50/yr-ACFM
Development Status: Commercial ESP's have been in use for over 75 years and are a widely recognized technology option for PM control
Practical Considerations: Maximizing electric field strength will maximize precipitator collection efficiency. Other actors limiting precipitator performance include flow non-uniformity and particle re-entrainment. Uniform flow distribution helps ensure that there are no high gas velocity, short treatment time paths through the precipitator. Re-entrainment of collected particles may occur during rapping. Proper rapper design and timing will minimize rapper re-entrainment. Maintenance of appropriate hopper ash levels and of flow uniformity will minimize re-entrainment of ash from the hoppers. A major consideration of ESP collection efficiency is the electrical resistivity of the particles to be collected. Particles with resistivities in the range of 10^7-10^{10} ohm-cm are more easily collected with ESPs: these particles are easy to charge, and loose their charge slowly once deposited on a collecting electrode. Particles with low resistivities (less than 10^7 ohm-cm), on the other hand, loose their charge to a collecting electrode rapidly and tend not to adhere to the electrode, causing high re-entrainment losses. (Carbon black is an example of a low resistivity material). Particles with high resistivity (greater than 10^{10} ohm-cm) can be difficult to remove with a precipitator: such particles are not easily charged, and thus are not easily collected. High-resistivity particles also form ash layers with very high voltage gradients on the collecting electrodes. Electrical breakdowns in these ash layers lead to injection of positively charged ions into the space between the discharge and collecting

Process: Electrostatic Precipitator (ESP)
electrodes ("back corona"), thus reducing the charge on particles in this space and lowering collection efficiency. Fly ash from the combustion of low-sulfur coal typically has a high resistivity, and thus is difficult to collect. Flue gas treatment options exist to address both high and low resistivity problems and include the injection of ammonia, SO_3 and other proprietary additives.
Compatibility with other air pollution control technologies: ESP's are compatible with other PM controls and may be desirable in selected applications to minimize PM loadings into downstream controls such as a FF or PM scrubber
Secondary Environmental Impacts: None expected.
References: EPRI, "Economic Evaluation of Particulate Control Technologies", Final Report, September 1992. Staehle, R., "The Past, Present and Future of Wet ESPs in Power plant Applications", EPRI/DOE/EPA Mega Symposium, Washington, May 2003. IEA Coal Research, "Particulate control Handbook", Final report, July 1997. IEA Coal Research, "Prevention of Particulate Emissions", Final report, December 2000. ICAC, "ESPs vs. Fabric Filters: A Symposium and Debate", March 1994. http://www.icac.org http://www.IEA-coal.org.UK/ http://www.croll.com

Process: Fabric Filter				
Category	**PM, TPY (WRAP 1996 >100 TPY)**	**%PM reduction**	**Cost,**	**Status**
Coal-fired boilers	46,010	99+%	See below	Commercial
Mineral Processing	24,499	99+%	See below	Commercial
Wood/Biomass boilers	5,718	99+%	See below	Commercial
Fugitive	5,631	99+%	See below	Commercial
Oil/NG boilers	1,379	99+%	See below	Commercial
Cement kilns	641	99+%	See below	Commercial

Process Description:

Fabric filter (FF) collectors (also referred to as baghouses) are the industrial equivalent of very large vacuum cleaners: by passing flue gas through a tightly woven fabric, particulate in the flue gas will be collected on the fabric by sieving and other mechanisms. The dust cake which forms on the filter from the collected particulate can contribute significantly to the overall collection efficiency.

FF types are usually defined by the type of bag cleaning utilized. Major types include: (1) the "reverse-air" baghouse, where the flue gas flows upward through the insides of vertical bags, which open downward. The fly ash thus collects on the insides of the bags, and the gas flow keeps the bags inflated. To clean the bags, a compartment of the FF is taken off-line, and the gas flow is reversed. This causes the bags to collapse, and collected dust to fall from the bags into hoppers. (Shaking or other method may be necessary to dislodge the dust from the bags.); and (2) the pulse-jet fabric filter, where the dirty gas flows from the outside of the bags inward, and the bags are mounted on cages to keep them from collapsing. Dust that collects on the outsides of the bags is removed by a reverse pulse of high-pressure air. This cleaning does not require isolation of the bags from the flue gas flow, and thus may be done on-line.

PM Reduction:

FF's are capable of 99.9% removal efficiencies. In addition removal efficiency is relatively level across the particle size range, making FF's good alternatives for very small particle sizes
.
Key performance factors include the fabric of the bag, the cleaning frequency and methods, and the particulate characteristics. Fabrics can be chosen for different applications, and some fabrics are specialty-coated for enhanced removal of submicron particulate.

Cleaning intensity and frequency are also important variables in determining removal efficiency. Because the dust cake can provide a significant fraction of the fine particulate removal capability of a fabric, cleaning which is too frequent or too intense will lower the removal efficiency. On the other hand, if removal is too infrequent or too ineffective, then pressure drop will increase rapidly and impact overall operation.

Process: Fabric Filter
Cost Information: FF's have been used extensively for many years in different industries. The power generation sector while predominantly dominated by ESP's has started to utilize FF's in the last 20 years. • Capital: Reverse Air Fabric Filter - \$17 - \$40/ACFM Pulse Jet Fabric Filter - \$12 - \$40/ACFM • Fixed O&M: Reverse Air Fabric Filter - \$0.35 - \$0.75/yr-ACFM Pulse Jet Fabric Filter - \$0.50 - \$0.90/yr-ACFM • Variable O&M: Reverse Air Fabric Filter - \$0.70 - \$0.80/yr-ACFM Pulse Jet Fabric Filter - \$.90 - \$1.1/yr-ACFM
Development Status: Commercial. FF's have been used extensively for many years in different industries. The power generation sector while predominantly dominated by ESP's has started to utilize FF's in the last 20 years.
Practical Considerations: FF size is determined by the choice of air-to-cloth ratio (A/C), or the ratio of air flow to cloth area, typically expressed in feet per minute (cubic feet per minute of flow divided by square feet of fabric area). The selection of air-to-cloth ratio depends on the particulate loading and characteristics, and the cleaning method used. A high particulate loadings will require the use of a larger FF (lower A/C) in order to avoid forming too heavy a dust cake, resulting in an excessive pressure drop Pulse-jet FF's are smaller (higher A/C) than reverse-air FFs due to the higher cleaning intensity and resulting bags being cleaner
Compatibility with other air pollution control technologies: FF's are compatible with other PM controls. FF's are also choices for applications downstream of dry SO2 controls (e.g. spray dryers) as well as in combination with sorbent injection techniques for SO2 and/or Hg control Adding a FF downstream from an existing electrostatic precipitator is a strategy gaining some acceptance in the power industry. Because the ESP removes the bulk of the particulate, the baghouse can be relatively small, and thus less expensive. One commercial approach to this is the installation of a small pulse-jet fabric filter downstream of an ESP, known as a Compact Hybrid Particulate Collector (COHPAC). Physically, it may be separate from the precipitator, or even fully integrated into the last field of the existing ESP, further reducing the over cost and space requirements.
Secondary Environmental Impacts: As mentioned above FF's can represent a complementary option to sorbent injection technologies where they enhance the contact (reaction) times between the sorbent and the flue gas contaminant of interest. This results in enhanced collection efficiency for the pollutant (e.g. mercury), as well as reduced quantities of sorbent needed

Process: Fabric Filter
References: EPRI, "Economic Evaluation of Particulate Control Technologies", Final Report, September 1992. Staehle, R., "Particulate Control Options for Dry FGD Systems", EPRI/DOE/EPA Mega Symposium, Washington, May 2003. IEA Coal Research, "Particulate control Handbook", Final report, July 1997. IEA Coal Research, "Prevention of Particulate Emissions", Final report, December 2000. ICAC, "ESPs vs. Fabric Filters: A Symposium and Debate", March 1994. http://www.icac.org http://www.IEA-coal.org.UK/ http://www.croll.com

Process: PM Scrubber				
Category	**PM, TPY (WRAP 1996 >100 TPY)**	**%PM reduction**	**Cost,**	**Status**
Mineral Processing	24,499	50%-99+%	See below	Commercial
Petrochemical	10,836	50%-99+%	See below	Commercial
Wood/Biomass boilers	5,718	50%-99+%	See below	Commercial
Primary Metal production	4,476	50%-99+%	See below	Commercial
Pulp & Paper	4,476	50%-99+%	See below	Commercial

Process Description:

Scrubbers work on the principle of rapid mixing and impingement of the particulate with the liquid droplets and subsequent removal with the liquid waste. For particulate controls the "venturi scrubber" is an effective technology whose performance is directly related to the pressure loss across the venturi section of the scrubber.

Venturi scrubbers are one type of the more commonly used "scrubbers" for particulate collection. As the name implies, the scrubbing liquid and flue gases accelerate through a converging section into a narrow throat. In the throat, very high gas velocity shears the scrubbing liquid into many very fine droplets, which collect particles through numerous "collisions".

PM Reduction:

Scrubbers have varying PM reduction capabilities based on deign operating conditions and particle characteristics. Performance can range 50% for the small size fraction (< 2microns) to over 99% for the larger sizes.

Higher collecting efficiencies and a wider range of particulate sizes, require higher operating pressures. . High-energy scrubbers refer to designs operating at pressure drop of 50-70 inches of water. Of course, higher pressure translates to higher energy consumption.

Cost Information:

The following values represent typical costs for several of these technologies (these numbers reflect unit sizes ranging from utility-size units up to about 2,000,000 ACFM to smaller process down to about 10,000 ACFM)

- Capital: Venturi Scrubber - $5 - $20/ACFM
- Fixed O&M: Venturi Scrubber - $0.25 - $0.65/yr-ACFM
- Variable O&M: Venturi Scrubber - $1.2 - $1.8/yr-ACFM

Development Status:

Commercial

Wet scrubbers are widely used in various industries. One advantage of scrubbers is their ability to treat wet gases which are not conducive to other technologies such as dry ESPs and FFs.

Practical Considerations:

For applications where variation in flow require throat velocity compensation to maintain specified scrubbing efficiencies, automatic and manually variable throat designs are available.

Process: PM Scrubber
The automatic throat is used where flow conditions vary widely and frequent adjustments are required. When occasional variations occur, a manually controlled throat is generally sufficient.
Compatibility with other air pollution control technologies: Scrubbers are compatible with other PM controls. However, dry ESP's and FF's would not be deployed downstream of a scrubber without prior reheating of the flue gas which would make such application economically questionable in general
Secondary Environmental Impacts: Liquid waste disposal requires consideration on a case-by-case basis. Since scrubbers have the capability to reduce acid gases, applications where this is important must be considered.
References: IEA Coal Research, "Particulate control Handbook", Final report, July 1997. http://www.icac.org http://www.IEA-coal.org.UK/ http://www.croll.com

APPENDIX A-8. SO2 MILESTONES/BACKSTOP

This appendix contains work products and references relied upon by Arizona in the development of Chapter 8 of the Regional Haze SIP.

Appendix A-8a. WRAP Market Trading Forum Non-Utility Sector Allocation Final Report from the Allocations Working Group (November 2002)

Market Trading Forum Non-Utility Sector Allocation

Final Report from the Allocations Working Group

PECHAN

5528-B Hempstead Way
Springfield, VA 22151

703-813-6700 telephone
703-813-6729 facsimile

3622 Lyckan Parkway
Suite 2002
Durham, NC 27707

919-493-3144 telephone
919-493-3182 facsimile

P.O. Box 1575
Shingle Springs, CA 95682

530-672-0441 telephone
530-672-0504 facsimile

Prepared for:

Western Governors' Association
1515 Cleveland Place
Denver, CO 80202

Prepared by:

E.H. Pechan & Associates, Inc.
5528-B Hempstead Way
Springfield, VA 22151

November 2002

WGA Contract No. 30204-48
Pechan Rpt. No. 02.11.001/9422.000

CONTENTS

CONTENTS (continued)

TABLES

ACRONYMS AND ABBREVIATIONS

BACT	Best Available Control Technology
BART	Best Available Retrofit Technology
BLS	Black liquor solids
CAA	Clean Air Act
CWPB	center-worked prebake cells
DCE	Direct contact evaporator
dscf	dry standard cubic foot
ESPs	electrostatic precipitators
FCCU	fluid catalytic cracking unit
GCVTC	Grand Canyon Visibility Transport Commission
H_2S	hydrogen sulfide
HSS	horizontal stud Soderberg
ICI	industrial, commercial, and institutional
kg	kilogram
LAER	Lowest Achievable Emission Reduction
lbs/MMBtu	pounds per million British thermal units
Mg	megagram
MTF	Market Trading Forum
NO_x	oxides of nitrogen
NSPS	New Source Performance Standards
ppm	parts per million
ppmv	parts per million volume
PTE	potential to emit
RECLAIM	Regional Clean Air Incentives Market
SCC	Source Classification Code
SIC	Standard Industrial Classification
SIP	State Implementation Plan
SO_2	sulfur dioxide
SRU	Sulfur Recovery Unit
SWPB	side-worked prebake cells
tpy	tons per year
VSS	vertical stud Soderberg
WGA	Western Governors' Association
WRAP	Western Regional Air Partnership

EXECUTIVE SUMMARY

This study was performed for a Working Group of the Western Regional Air Partnerships' (WRAP) Market Trading Forum. It provides a current, best estimate of the floor allocation for non-utility sources in the region that would be established if western States and tribes adopt a regional, backstop trading program for sulfur dioxide (SO_2) to meet the requirements of Section 309 of the regional haze rule. The major SO_2 emitting non-utility source categories evaluated in this study include the following: petroleum refineries, lime manufacturing, industrial boilers and co-generators, pulp and paper manufacturing, cement manufacturing, natural gas processing and oil and gas production, elemental phosphorus production, glass manufacturing, aluminum smelters, sulfuric acid plants, and coke production. Of these industry sectors, phosphorus, aluminum smelters, sulfuric acid plants, and coke production plants were not considered in the original source categories for the Market Trading Forum. The floor control technology (or emission rate or SO_2 control effectiveness) was determined by evaluating the emissions performance of other sources in that source category in the western States. The floor is defined to be best available control technology (BACT), best available retrofit technology (BART), or lowest achievable emission rate (LAER) for existing sources. For some sources, EPA has not determined what these levels of emissions are. SO_2 floor allocations were computed for each of about 200 major non-utility sources in the western States, where major is defined as those sources emitting greater than 100 tons per year (tpy).

While this analysis uses plant and process-level information to estimate floor allocations, if the backstop trading program is triggered, SO_2 allowances under the trading program will be allocated by the participating transport region States and Tribes at that time. This study is only an approximation of how the allocations might be made based upon the limited information that we have today. It is expected that the States and Tribes would be able to obtain more detailed information about current emissions and controls for these non-utility sources than has been available for the current project.

The floor allocation analysis has been performed separately for each of the 12 major non-utility source categories in the west. The text below summarizes the key findings for each source category.

To simplify the analysis, it was determined that California SO_2 sources are already highly controlled. The California floor allocation of 27,335 tpy is based on the opt-in/out 2018 SO_2 allocation that has been estimated previously by the WRAP Market Trading Forum.

Petroleum Refining: There are ten petroleum refineries outside California in the WRAP transport region. Data were received from all of these refineries for the allocation process. These floor allocations were computed for each of the four major SO_2 emitting processes at refineries: sulfur plants, fluidized catalytic cracking units (FCCUs), fuel combustion units, and flares. The SO_2 floor allocation for these ten refineries is 11,418 tpy, or about 5,400 tpy less than historic emissions during 1996 to 2000. This is one of the best characterized source categories.

Cement Manufacturing: The control technology analyses for cement kilns showed that there was no demonstrated SO_2 control technique at western State sources that could be applied to reduce SO_2 across the source population. There are widely varying SO_2 emissions rates from these kilns, and the process itself removes sulfur from the off gas. As a result, this sector's floor allocation of 7,761 tpy was based on recent historic emissions. *The analysis for lime manufacturing reached the same conclusion as that for cement.* The lime manufacturing floor allocation is 2,103 tpy.

Boilers and Co-generators: The floor for boilers and co-generators at industrial facilities was estimated by applying the equivalent of 85 percent SO_2 control to coal and oil-fired sources not already at, or near, this control level. Average capacity factors were used to estimate boiler utilization for estimating the floor with a 5 percent growth margin. This assumption is consistent with that used in the utility boiler floor allocations. Some non-utility boilers are operating at low utilization rates. The industrial boiler and cogenerator floor allocation is 7,910 tpy.

Pulp and Paper Industry: Recovery furnaces and lime kilns are the SO_2 sources at the Kraft pulp mills in the west. Most of these mills are in Oregon. Floor allocations for recovery furnaces and lime kilns are based on standard U.S. Environmental Protection Agency (EPA) emission factors and 100 percent capacity utilization (or recent annual throughput, if capacity estimates were not available). The pulp and paper floor allocation is 7,184 tpy.

Natural Gas Processing Plants and Oil and Gas Production: SO_2 emissions from natural gas processing plants result from combustion of sour gases. It was decided that the current New Source Performance Standard (NSPS) would serve as the floor. The NSPS requires a variable sulfur removal efficiency based on the hydrogen sulfide (H_2S) content of the acid gas and the amount of sulfur in the gas. If a facility had current control levels higher than the assumed floor, the actual average emissions over the past three years were used to estimate the floor. Since emissions from flaring operations both in the plant and the well field are not amenable to control, floor emissions are assumed to be the average of the emissions in three recent years. Data availability was a significant issue in determining the floor allocations for some gas plants. The floor allocation for this source category is 28,884 tpy.

Elemental Phosphorus Production: One of the two U.S. elemental phosphorus production facilities is in Idaho. Because of the uniqueness of this facility, no floor control technology was identified. The floor allocation is set at year 2000 SO_2 emissions, which were 15,861 tpy. It is expected that the State of Idaho will perform a more detailed evaluation of this facility during preparation of its regional haze State Implementation Plan (SIP).

Glass Manufacturing: The major source of SO_2 emissions in the glass industry is the glass melting operation. There are only two active glass manufacturing facilities in the 8 non-California WRAP States. With a lack of information about SO_2 control techniques in practice, the floor allocation for glass manufacturing plants was set according to historical SO_2 emissions. The glass manufacturing floor allocation is 368 tpy.

Copper Smelters: Because of the uniqueness of the existing copper smelters, retrofit technology analysis must be performed on a smelter-by-smelter basis. A double contact acid plant is considered the appropriate retrofit control equipment. All copper smelters in the western States are currently equipped with double contact acid plants. The current year SO_2 allocation for the six copper smelters in the 9-State region is 86,000 tons. This allocation is reduced to 78,000 tons by 2013 and is the same in 2018.

Aluminum Production: There are only 2 primary aluminum plants in the study region and both are located in Oregon. The primary SO_2 source in aluminum production is the sulfur in the coke, and the coal tar pitch binder used to produce the anodes. The floor control technology for aluminum smelters was determined by evaluating the emissions performance at the two Oregon facilities. One facility uses a wet scrubber to achieve a 70 percent SO_2 emission reduction. Therefore, a wet scrubber with a 70 percent SO_2 reduction was selected as the floor technology for aluminum smelters. The aluminum smelter floor allocation is 2,076 tpy.

Sulfuric Acid Plants: The only significant source of air emissions from a contact sulfuric acid plant is the tail gas leaving the final absorbing tower. This gas contains small amounts of SO_2 and even smaller amounts of sulfur trioxide, sulfuric vapor, and sulfuric acid mist. Based on the information available for the 4 sulfuric acid plants in the west, it was decided that the floor allocation should be estimated by applying the NSPS requirements to each sulfuric acid plant. Achieving this standard requires a conversion efficiency of 99.7 percent in an uncontrolled plant, or the equivalent SO_2 collection mechanism in a controlled facility. However, recent historical SO_2 emissions for these facilities were lower than the NSPS emission rate times capacity estimated values, so the sulfuric acid plant floor was estimated using these historical SO_2 emission values. The resulting floor allocation for these sulfuric acid plants is 5,386 tpy.

Metallurgic Coke Production: SO_2 emissions from coke oven operations primarily result from combustion of the byproduct coal gas in the oven. There were three coke production facilities operating in the west during the 1990s. Coke production has recently ceased at two of these facilities. The only facility that continues to operate is a rotary calciner in Wyoming. Because of the uniqueness of this operation, the floor allocation is based on recent historic SO_2 emissions, and is 631 tpy.

There are two benchmarks that can be used to put the floor allocations in perspective. One is year 2000 historic emissions and the other is the non-utility SO_2 emissions forecast for 2018. The floor allocation estimate in this report is about 2,500 tons higher than year 2000 historical emissions. However, this comparison of the respective emission totals is skewed by the fact that year 2000 copper smelter emission were about one-half of the 78 thousand ton allocation for this sector. When copper smelters are removed from the totals, the floor allocation is about 45 thousand tons lower than year 2000 emissions. A comparison of the floor allocation with the SO_2 emissions in the 2018 opt-in/out emission allocations shows that the floor allocation is approximately the same.

CHAPTER I
INTRODUCTION

This report describes an analysis that was prepared for a Working Group of the Western Regional Air Partnership's (WRAP) Market Trading Forum (MTF). It provides the current best estimate of the floor allocation for non-utility sources in the region that would be established if western States and tribes adopt a regional, backstop trading program for sulfur dioxide (SO_2) to meet the requirements of Section 309 of the regional haze rule. Note that this does not establish final allocations for sources in the region. Each State and tribe will determine the appropriate floor level for sources within their jurisdiction, and will include this information in their State or tribal implementation plan. The program is voluntary for western States and tribes. Information is provided to assist eligible States and tribes evaluate the impacts of the program, but decisions to participate in the program will be made by each separate jurisdiction.

The distribution of regional SO_2 allowances to existing sources in the nine Commission Transport States is composed of two portions: floor and reducible allocation. There are two components of the floor allocation - an allocation for the California Regional Clean Air Incentives Market (RECLAIM) program, and source-specific floor allocations for non-RECLAIM sources. The floor allocation is a minimum allocation for all existing sources, which will be calculated to ensure that well-controlled sources will receive a full allocation.

California RECLAIM Program: 3,462 SO_2 allowances will be included in the California budget for RECLAIM sources. These credits will be a subset of the existing source pool for the State of California and, hence, will not consume any extra credits from the total credit pool.

Source-specific Floor Allocation: A floor allocation will be calculated for all existing sources in the region based on some specified level of control (e.g., Best Available Control Technology [BACT], Best Available Retrofit Technology [BART], Lowest Achievable Emission Reduction [LAER]) for non-utility sources.

The sources affected by the backstop trading programs are all those stationary sources in participating States and tribes that emit SO_2 in an amount greater than or equal to 100 tons per year (tpy). The 100 ton cut off will be assessed at the plant level to correspond with the methodology used in the 1990 emissions inventory. Among the source types covered by this definition are utility and industrial boilers, refineries, smelters, pulp and paper mills, cement and lime kilns, and all of the other source categories listed in section 169(g)(7) of the Clean Air Act (CAA).

In this report, the geographic area of analysis is defined to be the nine Commission Transport Region States, which are Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Wyoming. Facilities included in the analysis are those that emitted 100 tpy or more of SO_2 sometime during the period 1990 to 2000. Plants that are electric utilities are excluded from this analysis.

A. ANALYSIS METHODS

The floor allocation analysis for the non-utility sector was performed using the following steps:

1. It was assumed that the SO_2 sources in the State of California are already at the floor. This is expected because of the stringency of the air emission regulations in that State.

2. Because copper smelter allocations for 2018 have already been determined, no additional analyses were performed for copper smelters. Smelter allocations are presented in Chapter X.

3. The focus of the analysis was on non-California, non-smelter facilities that had at least 100 tpy of SO_2 emissions during at least one year in the period 1990 to 2000. States included in this analysis were Arizona, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Wyoming.

4. The major SO_2 emitting non-utility source categories evaluated in this study included the following: petroleum refineries, lime manufacturing, industrial boilers and co-generators, pulp and paper manufacturing, cement manufacturing, natural gas processing and oil and gas production, elemental phosphorus production, glass manufacturing, aluminum smelting, sulfuric acid production, and metallurgical coke production.

5. The floor control technology or emission rate or SO_2 control effectiveness was determined by evaluating the emissions performance of other sources in that source category in the western States. The floor is defined to be BACT, BART, or LAER for *existing* sources. The floor for each of the major source categories is summarized in Table I-1.

6. The primary source of emissions information for the western States is the 1996 WRAP point source inventory. The 1996 emission estimates were prepared under contract to the Western Governors' Association (WGA) by Pacific Environmental; Services and Eastern Research Group, Inc. under contract to the WGA (PES, 2001). However, this data set was not sufficient for providing all of the information needed to compute the floor allocation for each source. The State air pollution control agencies in each of the 8 States were contacted to obtain supplementary data. For most source categories, this additional information included estimates of unit capacities. This could be either the design capacity for boilers, or the production capacity for industrial processes.

7. Once data was received from the State agencies, it was used to estimate the floor allocation by source and facility based on the control technologies listed in Table I-1 and the unit or plant-specific information about existing capacities and SO_2 control techniques.

The chapters that follow explain the floor allocation analyses for each of the key industrial sector source categories in the western United States.

Table I-1
Methodology for the Calculation of the Floor Allocations for Non-Utility Sources

Source Category	Technologies or Standard for Floor	
Copper Smelters	Due to the uniqueness of the existing smelters, retrofit technology analysis must be performed on a smelter-by-smelter basis. Currently, the Hidalgo smelter is the only BART-eligible source on the list in this category. A double-contact acid plant will be considered the appropriate retrofit control equipment (all smelters in the region are currently equipped with double-contact acid plants). On August 21, 2000, New Mexico completed an engineering analysis that verified earlier determinations by the MTF that the fugitive SO_2 capture system at Hidalgo satisfies BART at 96% overall capture.	
Refineries	There are four sources of SO_2 emissions at the refinery level. Floor based upon New Source Performance Standards (NSPS) where applicable.	
	Description	Assumed Average Control Level
	Sulfur Recovery Unit (SRU)	Meet NSPS Subpart J or the equivalent of 3-stage Claus units with a tail gas unit (NSPS and the tail gas unit does not apply to Claus units smaller than 20 long tons/day or less).
	Fuel gas combustion units	Fix at the NSPS emission limit rate of 0.027 pounds per million British thermal units (lbs/MMBtu) assuming fuel gas input and not fuel oil.
	Catalytic crackers	NSPS (J) selected 9.8 lbs of SO_2 per 1,000 lbs of coke burned.
	Flares	Based upon average of the last 5 years' emission, AP42 factors for calculated. No additional controls.
Natural Gas Processing	Description	Assumed Average Level of Control
	Process Emissions	Reduction to satisfy NSPS. Variable reduction depending on hydrogen sulfide (H_2S) content and plant size.
	Flaring	Based upon average of the last 5 years' emission.
Oil & Gas Production	Description	Assumed Average Level of Control
	Flaring	Based upon average of the last 5 years' emission.
Lime Plants	No additional reduction. Approximately 50% control inherent in the process. Additional SO_2 controls are not in place at lime plants in the western States.	

Table I-1 (continued)

Source Category	Technologies or Standard for Floor
Industrial Boilers (Cogens)	Technology determination dependent upon current level of control. Description — Assumed Average Level of Control Uncontrolled Units — 85% Units controlled at less than 70% — Treat as uncontrolled (see above). Units controlled between 70-80% — Increase reductions by 5% (i.e., if a unit is at 72%, would be assumed to control to 77%). Units controlled greater than 80% — No additional reductions.
Pulp and Paper	Sulfur sources are recovery furnaces and boilers. Boiler discussions covered with industrial boilers. Recovery Furnaces: No additional reduction. Low emissions coupled with lack of more than one example of scrubbing.
Cement Plants	No additional reduction. Approximately 70-90 percent control inherent in the process. Additional SO_2 controls are not typically applied to these levels of processes.
Aluminum Smelters	A wet scrubber with a 70 percent SO_2 emission reduction selected as the floor based on achieved control levels at NW Aluminum in Oregon.
Sulfuric Acid Plants	No additional reduction. Existing units are already controlled to NSPS levels (4 lbs per ton of 100% acid produced).
Coke Production	Only one facility is still operating. Because of the uniqueness of this rotary calciner, the floor allocation is established at historic SO_2 emission levels.

CHAPTER II
PETROLEUM REFINING

A. SECTOR DESCRIPTION AND SIGNIFICANT SO_2 SOURCES

The petroleum refining industry involves numerous processes that convert crude oil into more than 2,500 products, including gasoline, liquefied petroleum gas, kerosene, jet fuel, diesel fuel, other fuel oils, lubricating oils, and feed stock for the petrochemical industry. Petroleum refinery activities include the storage of crude oil at the refinery, petroleum handling and refining operations, and storage of the refined products prior to shipment. As of January 1990, there were 189 operating refineries in the United States with a total crude capacity of 15.4 million barrels per calendar day.

Removal of sulfur from refinery streams is a part of refining. It would be desirable to remove all sulfur compounds before any crude processing begins, but because this is impractical, sulfur is removed throughout the refining process. There are several reasons, besides air pollution control, for removing sulfur from intermediate fractions and products of crude oil. Sulfur removal reduces corrosion, odor, breakdown frequency, catalyst poisoning, and gum formation and improves octane rating, color, and lube oil life.

B. FLOOR ALLOCATION ESTIMATION METHODS

There are four possible unit types (SO_2 emission points) within a refinery, as noted in the methodology for the calculation of the floor allocations for non-utility sources. These four SO_2 sources are: (1) the SRU; (2) fuel gas combustion units; (3) catalytic crackers; and (4) flares. The approach for estimating SO_2 floor allocations is unique for each of these four SO_2 source types within the refinery. Floor calculation methods are presented below for each of these four source types.

1. Sulfur Recovery Units

Sulfur recovery refers to conversion of H_2S to elemental sulfur. H_2S is a by product of processing natural gas and refining high sulfur crude oils. The most common conversion method used is the Claus process. Approximately 90 to 95 percent of recovered sulfur is produced by the Claus process. The Claus process typically recovers 95 to 97 percent of the H_2S feed stream.

The average production rate of a sulfur recovery plant in the United States varies from 51 to 203 megagrams (Mg) (56 to 224 tons) per day. Some of the small to mid-sized refineries in the western States have sulfur plant capacities that are lower than these average values.

The SO_2 floor allocation for SRUs depends on the size of the sulfur plant. For sulfur plants of 20 long tons per day or larger, the NSPS require a 3-stage Claus unit with a tail gas unit. Existing NSPS limit sulfur emissions from Claus sulfur recovery plants of greater than 20.32 Mg (22.40 tons) per day capacity to 0.025 percent by volume (250 parts per million volume [ppmv]). The NSPS and tail gas unit do not apply to Claus units smaller than 20 long tons per day or less. For these smaller sulfur plants, the SO_2 floor allocations are estimated as 95 percent SO_2 control.

Table 8.13-1 in AP-42 provides the following SO_2 emission factors for modified Claus Recovery Plants:

Emission Factors for Modified Claus Sulfur Recovery Plants

		SO_2 Emissions	
Number of Catalytic Stages	**Average % Sulfur Recovery**	**Kilograms (kg)/Mg of Sulfur Produced**	**lbs/ton of Sulfur Produced**
1, Uncontrolled	93.5	139	278
3, Uncontrolled	95.5	94	188
4, Uncontrolled	96.5	73	145
2, Controlled	98.6	29	57
3, Controlled	96.8	65	129

The SO_2 emission factor for 99.8 percent sulfur recovery is 8 lbs/ton and for 96.8 percent sulfur recovery is 132 lbs/ton of sulfur produced. This emission factor value is multiplied by the sulfur plant capacity in tons per day, 365 days per year, and 1 ton per 2,000 lbs to arrive at an annual SO_2 emissions floor estimate. Equation (1) below shows the above description as a formula:

$$\text{Sulfur plant capacity}\left(\frac{tons}{day}\right) * \frac{lbs\ SO_2}{ton} * \frac{365\ days}{year} * \frac{1\ ton}{2{,}000\ lbs} = \frac{SO_2\ tons}{year} \quad (1)$$

For refineries with sulfur plants smaller than 20 long tons per day, and lower H_2S contents in their acid gas, an SO_2 control level of 96.8 percent may not be achievable. In that situation, an alternative way to calculate the floor is to use the sulfur feed rate and the H_2S content of the acid gas of the affected facility to compute the appropriate minimum SO_2 reduction efficiency using the relationships shown in Table II-1. This table is from the NSPS for onshore natural gas production.

Table II-1
Sulfur Plants - Required Minimum SO_2 Emission Reduction Efficiency

H_2S Content of Acid Gas (Y), %	Sulfur Feed Rate (x), Long Tons per Day			
	$2.0 \le X \le 5.0$	$5.0 < X \le 15.0$	$15.0 < X \le 300.0$	$X > 300.0$
$Y \ge 50$	74.0	.... $85.35X^{0.0144}Y^{0.0128}$ .... or 99.8, whichever is smaller		
$20 \le Y < 50$	74.0	.... $85.35X^{0.0144}Y^{0.0128}$ .... or 97.5, whichever is smaller		97.5
$10 \le Y < 20$	74.0	$85.35X^{0.0144}Y^{0.0128}$ or 90.8, whichever is smaller	90.8	90.8
$Y < 10$	74.0	74.0	74.0	74.0

2. Fuel Gas Combustion Units

Fuel gas combustion units in refineries were defined to include all process heaters and boilers, and their combined oil and gas combustion capacity. SO_2 floor allocations are estimated as the combined oil and gas combustion capacity multiplied by 0.027 lbs/MMBtu. This emission rate is an approximation of the SO_2 emission factor for a fuel gas combustion unit meeting the NSPS of 0.10 grains H_2S per dry standard cubic foot (dscf) as required by 40 CFR 60 Subpart J.

This H_2S value is converted to an SO_2 emission rate in lbs/MMBtu using the equation below:

$$SO2\left(\frac{lb}{MMBtu}\right) = \frac{010\ grains\ H2S}{dscf}\ x\ \frac{1\ lb}{7{,}000\ grains}\ x\ \frac{64\ lb\ moles\ SO2}{34\ lb\ moles\ H2S}\ x\ \frac{1000\ scf}{MMBtu} = \frac{0.027\ lb}{MMBtu}$$

In the floor allocation estimates for fuel gas combustion units, the fuel gas combustion capacity is based on reported values for the refineries in Colorado, New Mexico, and Utah as well as for Wyoming Refining and Frontier Refining in Wyoming. Where this value has not been reported, it is estimated to be 5 percent of the crude oil processing capacity at that refinery. The industry norm is reported to be in the range of 5 to 10 percent. The 5 percent value was used because it is the average value for the western State refineries for which data on fuel gas combustion capacity were provided.

3. Catalytic Crackers

The SO_2 floor allocation for catalytic crackers at petroleum refineries is computed using the NSPS for fluid catalytic cracking units (FCCUs). The NSPS for FCCUs without add-on controls is 9.8 kg SO_x per 1,000 kg coke burn-off. For FCCUs without add-on control devices, EPA decided that the regulated pollutant should be SO_x, because SO_3 could constitute a significant portion of the total SO_2 emissions from FCCUs using SO_x reduction catalysts. The standard for FCCUs without add-on controls requires the use of Method 8 to determine the total SO_x emissions from affected facilities.

One of the issues in applying the NSPS emission rate to estimate the SO_2 floor allocation is the availability of information about the amount of coke burn-off for each FCCU. The Source Classification Code (SCC) units used in emission inventories, and AP-42 SO_2 emission factors, are expressed as lbs/1,000 barrels of fresh feed. Therefore, it is necessary to develop a conversion factor to go from an emission limit expressed as an SO_x emission rate per 1,000 kg coke burn-off to an emission limit expressed in AP-42 or SCC units if the coke burn rate is not available for a refinery.

In order to apply the NSPS SO2 emission rate to estimate the floor allocation for FCCUs, information about the coke burn rate was needed for each refinery. For 10 of the Western State refineries listed in Table II-1, estimates of the coke burn rate in pounds per hour were available from a data set that the American Petroleum Institute provided to EPA as part of the MACT standard setting process. These coke burn rates are based on 1997 operations. For the refineries with FCCUs and no coke burn rate available, the coke burn rates were estimated using the relationship between the FCCU feed capacity in barrels per calendar day and the coke burn rate (pounds per hour) for the 10 western refineries with reported values. The relationship used was 16 pounds coke per barrel of oil. Refineries where this default value was applied included the two Colorado refineries and Flying J, Inc. in Utah. Wyoming Refining provided a design coke burn rate for its FCCU.

4. Flares

Flares are commonly used for the disposal of waste gases during process upsets and emergencies. They are basically safety devices that are also used to destroy organic constituents in waste emission streams. The AP-42 SO_2 emission factor for a vapor recovery system and flaring is 26.9 lbs per 1,000 barrels refinery feed. This emission factor is applied to estimate the SO_2 emissions floor for flares at each refinery.

C. FLOOR ALLOCATION RESULTS

Table II-2 includes the floor allocation calculation for the refineries in the 8 non-California Western Regional Air Partnership (WRAP) States. The *Oil & Gas Journal Worldwide Refining Survey for 2000* provided the values for sulfur plant capacity, catalytic cracking unit capacity, and crude capacity listed in Table II-2 where they were not otherwise provided by State air agencies or refinery companies. Fuel gas combustion capacities in MMBtu/hour (hr) are estimated using information provided by State air pollution control agencies. Sinclair Corporation provided data for its two Wyoming refineries (Greene, 2002).

Table II-2
Petroleum Refining Floor Allocation Calculation

Plant Name	City	State	Source Type	Plant/Unit Capacity	Capacity Notes	Floor Allocation Emission Rate	Emission Rate Units	Floor allocation tons/year
Conoco Inc.	Commerce City	CO	Sulfur Recovery Unit	70	Sulfur plant capacity tons sulfur per day	8	lbs of SO_2 per ton sulfur produced	102.2
			Fuel Gas Combustion					
			Gas		MMBtu/hr	0.027	lbs of SO_2 per million Btu	112.9
			Oil		MMBtu/hr			
			Total	955	MMBtu/hr			
			FCCU	12,666	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per ton coke burn off	554.8
			Flares	57,500	From the December 2000 Oil and Gas Journal (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	282.3
			All Sources Combined					1,052.2
Colorado Refining	Denver	CO	Sulfur Recovery Unit	4	Sulfur plant capacity tons sulfur per day	132	lbs of SO_2 per ton sulfur produced	96.4
			Fuel Gas Combustion					
			Gas		MMBtu/hr	0.027	lbs of SO_2 per million Btu	60.2
			Oil		MMBtu/hr			
			Total	509	MMBtu/hr			
			FCCU	5,333	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per coke burn off	233.6
			Flares	35,000	From the December 2000 Oil and Gas Journal (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	171.8
			All Sources Combined					562.0
Giant Refining Co.	Bloomfield	NM	Sulfur Recovery Unit	2	Sulfur plant capacity tons sulfur per day	132	lbs of SO_2 per ton sulfur produced	48.2
			Fuel Gas Combustion					
			Gas	328	MMBtu/hr	0.027	lbs of SO_2 per million Btu	38.8
			Oil		MMBtu/hr			

Table II-2 (continued)

Plant Name	City	State	Source Type	Plant/Unit Capacity	Capacity Notes	Floor Allocation Emission Rate	Emission Rate Units	Floor allocation tons/year
			Total	328	MMBtu/hr			
			FCCU	5,400	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per ton coke burn off	236.5
			Flares	18,500	From the December 2000 Oil and Gas Journal (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	90.8
			All Sources Combined					414.3
Giant Refining Co.	Gallup	NM	Sulfur Recovery Unit	2	Sulfur plant capacity tons sulfur per day	132	lbs of SO_2 per ton sulfur produced	48.2
			Fuel Gas Combustion					
			Gas		MMBtu/hr	0.027	lbs of SO_2 per million Btu	37.3
			Oil		MMBtu/hr			
			Total	315	MMBtu/hr			
			FCCU	8,200	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per ton coke burn off	359.2
			Flares	32,200	From the December 2000 Oil and Gas Journal (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	158.1
			All Sources Combined					602.7
Navajo Refining Co.	Artesia	NM	Sulfur Recovery Unit	140	Sulfur plant capacity tons sulfur per day	8	lbs of SO_2 per ton sulfur produced	204.4
			Fuel Gas Combustion					
			Gas		MMBtu/hr	0.027	lbs of SO_2 per million Btu	109.3
			Oil		MMBtu/hr			
			Total	924	MMBtu/hr			
			FCCU	13,000	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per ton coke burn off	569.4
			Flares	70,000	From the December 2000 Oil and Gas Journal (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	343.6

Table II-2 (continued)

Plant Name	City	State	Source Type	Plant/Unit Capacity	Capacity Notes	Floor Allocation Emission Rate	Emission Rate Units	Floor allocation tons/year
			All Sources Combined					1,226.7
BP/now Tesoro Petroleum	Salt Lake City	UT	Sulfur Recovery Unit	17.4	Sulfur plant capacity tons sulfur per day	132	lbs of SO_2 per ton sulfur produced	419.2
			Fuel Gas Combustion					
			Gas		MMBtu/hr	0.027	lbs of SO_2 per million Btu	100.0
			Oil		MMBtu/hr			
			Total	846	MMBtu/hr			
			FCCU	14,000	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per ton coke burn off	613.2
			Flares	52,000	From the December 2000 Oil and Gas Journal (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	255.3
			All Sources Combined					1,387.7
Chevron Products Co.	Salt Lake City	UT	Sulfur Recovery Unit	22.4	Sulfur plant capacity tons sulfur per day	132	lbs of SO_2 per ton sulfur produced	539.6
			Fuel Gas Combustion					
			Gas		MMBtu/hr	0.027	lbs of SO_2 per million Btu	145.9
			Oil		MMBtu/hr			
			Total	1,234	MMBtu/hr			
			FCCU	6,500	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per ton coke burn off	284.7
			Flares	55,000	From the December 2000 Oil and Gas Journal (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	270.0
			All Sources Combined					1,240.3
Silver Eagle Refining Inc.	Woods Cross	UT	Sulfur Recovery Unit	0	Sulfur plant capacity tons sulfur per day	132	lbs of SO_2 per ton sulfur produced	0.0
			Fuel Gas Combustion					
			Gas		MMBtu/hr	0.027	lbs of SO_2 per million Btu	15.6

Table II-2 (continued)

Plant Name	City	State	Source Type	Plant/Unit Capacity	Capacity Notes	Floor Allocation Emission Rate	Emission Rate Units	Floor allocation tons/year
			Oil		MMBtu/hr			
			Total	132	MMBtu/hr			
			FCCU	0	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per ton coke burn off	0.0
			Flares	12,500	From the December 2000 Oil and Gas Journal (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	61.4
			All Sources Combined					77.0
Flying J Inc.	Salt Lake City	UT	Sulfur Recovery Unit	7	Sulfur plant capacity tons sulfur per day	132	lbs of SO_2 per ton sulfur produced	168.6
			Fuel Gas Combustion					
			Gas		MMBtu/hr	0.027	lbs of SO_2 per million Btu	57.8
			Oil		MMBtu/hr			
			Total	489	MMBtu/hr			
			FCCU	7,533	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per ton coke burn	329.9
			Flares	24,000	From the December 2000 Oil and Gas Journal (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	117.8
			All Sources Combined					674.2
Phillips Petroleum Co.	Woods Cross	UT	Sulfur Recovery Unit	14	Sulfur plant capacity tons sulfur per day	132	lbs of SO_2 per ton sulfur produced	337.3
			Fuel Gas Combustion					
			Gas		MMBtu/hr	0.027	lbs of SO_2 per million Btu	83.4
			Oil		MMBtu/hr			
			Total	705	MMBtu/hr			
			FCCU	5,000	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per ton coke burn off	219.0
			Flares	25,000	From the December 2000 Oil and Gas Journal (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	122.7

Table II-2 (continued)

Plant Name	City	State	Source Type	Plant/Unit Capacity	Capacity Notes	Floor Allocation Emission Rate	Emission Rate Units	Floor allocation tons/year
			All Sources Combined					762.4
Frontier Refining Inc.	Cheyenne	WY	Sulfur Recovery Unit	110	Sulfur plant capacity tons sulfur per day	8	lbs of SO_2 per ton sulfur produced	160.6
			Fuel Gas Combustion					
			Gas		MMBtu/hr	0.027	lbs of SO_2 per million Btu	155.5
			Oil		MMBtu/hr			
			Total	1,315	MMBtu/hr			
			FCCU	7,330	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per ton coke burn off	321.1
			Flares	46,000	From the December 2000 Oil and Gas Journal (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	225.8
			All Sources Combined					863.0
Sinclair Oil Corp.	Casper	WY	Sulfur Recovery Unit	21.7	Sulfur plant capacity tons sulfur per day	132	lbs of SO_2 per ton sulfur produced	522.8
			Fuel Gas Combustion					
			Gas		MMBtu/hr	0.027	lbs of SO_2 per million Btu	77.1
			Oil		MMBtu/hr			
			Total	652	MMBtu/hr			
			FCCU	7,590	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per ton coke burn off	332.4
			Flares	22,000	Based on 2001 operations (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	108.0
			All Sources Combined					1,040.3
Sinclair Oil Corp.	Sinclair	WY	Sulfur Recovery Unit	52.6	Sulfur plant capacity tons sulfur per day	8	lbs of SO_2 per ton sulfur produced	76.8
			Fuel Gas Combustion					

Table II-2 (continued)

Plant Name	City	State	Source Type	Plant/Unit Capacity	Capacity Notes	Floor Allocation Emission Rate	Emission Rate Units	Floor allocation tons/year
			Gas		MMBtu/hr	0.027	lbs of SO_2 per million Btu	119.9
			Oil		MMBtu/hr			
			Total	1,014	MMBtu/hr			
			FCCU	13,120	Coke Burn Rate (lbs/hr)	20	lbs of SO_2 per ton coke burn off	574.7
			Flares	60,000	Based on 2001 operations (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	294.6
			All Sources Combined					1,066.0
Wyoming Refining Co.	Newcastle	WY	Sulfur Recovery Unit	3	Sulfur plant capacity tons sulfur per day	132	lbs of SO_2 per ton sulfur produced	72.3
			Fuel Gas Combustion					
			Gas	0	MMBtu/hr	0.027	lbs of SO_2 per million Btu	51.6
			Oil	0	MMBtu/hr			
			Total	436.6	MMBtu/hr			
			FCCU	6,028.5	Data provided by Wyoming Refining (lbs/hr) design coke burn rate	20	lbs of SO_2 per ton coke burned	264.0
			Flares	12,500	From the December 2000 Oil and Gas Journal (bbls/cd)	26.9	lbs/1,000 bbl refinery feed	61.4
			All Sources Combined					449.3
Total Floor Allocation (CO, NM, UT, WY)								**11,418**

D. COMPARISON WITH HISTORICAL EMISSIONS

Table II-3 summarizes historical SO_2 emissions from petroleum refineries located in the 9 WRAP States. California refineries are included in this table. This table provides a point of comparison with the floor allocations shown in Table II-2.

E. EXAMPLE CALCULATION

This section provides an example calculation of the refinery floor allocation using the data provided for this project by Wyoming Refining. This refinery is located in Newcastle, Wyoming. This same information can be found in Table II-2 in condensed form.

1. Sulfur Recovery Unit

The SO_2 floor allocation for the SRU is based on the capacity of the unit. Because the capacity of the Wyoming Refining sulfur plant is less than 20 long tons per day, a sulfur recovery efficiency of 96.8 percent is applied in the floor calculation. (If the sulfur plant was larger than 20 long tons per day, a 99.8 percent sulfur recovery value would be applied.)

The SO_2 emission factor for 96.8 percent sulfur recovery is 132 lbs SO_2 per ton of sulfur produced as shown below:

$$\frac{\mathbf{3.2}\ \textit{tons S emitted}}{\mathbf{96.8}\ \textit{tons S removed}} * \frac{\mathbf{2000}\ \textit{lbs}}{\textit{ton}} \times \frac{\mathbf{64}\ \textit{lbs moles } SO_2}{\mathbf{32}\ \textit{lbs moles S}} = \frac{\mathbf{132}\ \textit{lbs } SO_2}{\textit{ton S produced}}$$

Then, the SO_2 floor allocation is the sulfur plant capacity (3 short tons per day) multiplied by the SO_2 emission factor and 365 days per year, as follows:

$$SO_2\ \textit{Floor (tons per year)} = \textit{Sulfur plant capacity (tons / day)} * SO_2\ \textit{emission factor (lbs / ton)} * \frac{1\ \textit{ton}}{2000\ \textit{lbs}} \times 365\ \textit{days / year}$$

$$= (3.0)\,(132)\,(365) \div 2000 = 72.3$$

2. Fuel Gas Combustion

The SO_2 floor allocation for fuel gas combustion is based on the combined boiler and process heater combustion capacity with each refinery. Wyoming Refining estimates that its total boiler plus process heater fired duty capacity at the refinery is 436.6 MMBtu per hour. The SO_2 floor allocation is estimated to be the combined oil and gas combustion capacity multiplied by 0.027
lbs/MMBtu.

$$SO_2\ \textit{Floor (tons per year)} = \textit{Combustion Capacity (MMBtu / hr)} * SO_2\ \textit{emission factor (lbs / MMBtu)} * \frac{1\ \textit{ton}}{2000\ \textit{lbs}} * \frac{8760\ \textit{hrs}}{\textit{year}}$$

$$= (436.6)\,(0.027)\,(5 \times 10^{-4})\,(8760)$$

$$= 51.6$$

Table II-3
Petroleum Refineries – Historical Emissions – 1990 to 2000

State	State ID	County ID	Facility ID	IAS Region	SIC	MTF Sector	Sector Description	Facility Name (1990)	Current Facility Name (if different from 1990)	SO_2 tpy 1990	SO_2 tpy 1996	SO_2 tpy 1998	SO_2 tpy 2000
AZ	4	005	0001	42	2911	6	Oil/Gas	Intermountain Refining		803	0	0	0
CA	6	037	800012	14	2911	6	Oil/Gas	ARCO (NSR USE ONLY)	ARCO PRODUCTS CO	1,919	2,359	1,706	2,315
CA	6	037	800030	14	2911	6	Oil/Gas	CHEVRON U.S.A. INC (EIS USE) - EL SEGUNDO	CHEVRON PRODUCTS CO.	833	1,795	938	1,208
CA	6	013	10	11	2911	6	Oil/Gas	CHEVRON USA INC - RICHMOND	CHEVRON PRODUCTS COMPANY	1,291	1,018	1,413	1,244
CA	6	095	15	11	2911	6	Oil/Gas	EXXON CORPORATION - BENICIA		4,922	6,042	5,779	5,779
CA	6	029	37	13	2911	6	Oil/Gas	KERN OIL & REFINING CO.		319	425	443	364
CA	6	037	800089	14	2911	6	Oil/Gas	MOBIL OIL CORP (EIS USE) - TORRANCE	MOBIL OIL CORP (EIS USE)	256	807	725	1,018
CA	6	013	32	11	2911	6	Oil/Gas	PACIFIC REFINING COMPANY	NOW PLANT ID 11587	278	290	0	0
CA	6	029	25	13	2911	6	Oil/Gas	SAN JOAQUIN REFINERY	SAN JOAQUIN REFINING COMPANY	337	313	138	0
CA	6	013	11	11	2911	6	Oil/Gas	SHELL OIL COMPANY - MARTINEZ	MARTINEZ REFINING COMPANY	2,790	2,518	2,374	1,159
CA	6	037	800223	14	2911	6	Oil/Gas	TEXACO REFINING & MARKETING IN - WILMINGTON		546	727	590	953
CA	6	029	33	13	2911	6	Oil/Gas	TEXACO REFINING AND MARKETING - BAKERSFIELD	EQUILON ENTERPRISES LLC	471	190	94	72
CA	6	013	12758	11	2911	6	Oil/Gas	TOSCO CORP AVON REFINERY		7,661	4,459	5,422	5,422
CA	6	037	800026	14	2911	6	Oil/Gas	ULTRAMAR INC (NSR USE ONLY)		341	959	669	620
CA	6	037	800144	14	2911	6	Oil/Gas	UNION OIL CO OF CAL (NSR USE O	TOSCO REFINING COMPANY	724	1,005	806	806
CA	6	079	4	13	2911	6	Oil/Gas	UNOCAL CARBON	TOSCO SANTA MARIA REFINERY	0	0	0	0
CA	6	079	4	13	2911	6	Oil/Gas	UNOCAL CHEM DIV-UNOCAL CORP - ARROYO GR	TOSCO	3,034	3,950	0	0
CA	6	013	16	11	2911	6	Oil/Gas	UNOCAL CORPORATION - RODEO	TOSCO RODEO REFINERY	584	728	675	615
CA	6	037		14	2911	6	Oil/Gas	UNOCAL REFINING & MARKETING CO	TOSCO REFINING (L.A.)	0	343	508	587
CA	6	079	13	13	2911	6	Oil/Gas	UNOCAL- SANTA MARIA REFINERY	TOSCO SANTA MARIA REFINERY	647	225	3,501	3,727
CA	6	037	800047	14	2911	6	Oil/Gas	FLETCHER OIL & REF CO (EIS USE		107	0	0	0
CA	6	037	800184	14	2911	6	Oil/Gas	GOLDEN WEST REF CO (EIS USE)		232	0	0	0
CA	6	037	800103	14	2911	6	Oil/Gas	POWERINE OIL CO (EIS USE)		196	0	1	1
CA	6	037	800115	14	2911	6	Oil/Gas	SHELL OIL CO (EIS USE) - CARSON	SHELL OIL PRODUCTS	778	0	0	0
CO	8	001	0004	53	2911	6	Oil/Gas	COLO REFINING		632	664	526	545
CO	8	001	0003	53	2911	6	Oil/Gas	CONOCO DENVER		2,336	2,610	2,496	1,972
CO	8	077	0001	55	2911	6	Oil/Gas	LANDMARK PETROLEUM		157	0	0	0
NM	35	045	0023	60	2911	6	Oil/Gas	GIANT INDUSTRIES/BLOOMFIELD REF		676	772	920	920
NM	35	031	0008	61	2911	6	Oil/Gas	GIANT REFINING/CINIZA REFINERY		1,346	1,115	1,779	1,779
NM	35	015	0010	65	2911	6	Oil/Gas	NAVAJO REFINING/ARTESIA REFINERY		1,549	1,552	969	980
UT	49	035	0004	32	2911	6	Oil/Gas	Amoco Petroleum Products	TESORO PETROLEUM	6,701	983	1,116	1,368
UT	49	011	0003	31	2911	6	Oil/Gas	Chevron Products Company		2,424	1,116	845	1,242
UT	49	011	0008	31	2911	6	Oil/Gas	Flying J Incorporated		312	574	225	300
UT	49	011	0013	31	2911	6	Oil/Gas	Phillips 66 Company		5,672	864	862	601
WY	56	021	0001	9	2911	6	Oil/Gas	FRONTIER OIL & REFINING - CHEYENNE		1,521	1,769	1,422	1,396
WY	56	025	0001	9	2911	6	Oil/Gas	LITTLE AMERICA REFINING COMPANY	SINCLAIR - CASPER	1,899	1,629	1,305	1,458
WY	56	007	0011	9	2911	6	Oil/Gas	SINCLAIR @ SINCLAIR		5,917	3,990	3,524	3,407
WY	56	045	0001	9	2911	6	Oil/Gas	WYOMING REFINING CO	WYOMING REFINING - NEWCASTLE	630	930	804	876
WY	56	025	0002	9	2911	6	Oil/Gas	AMOCO REFINERY		1,153	0	0	0
Totals										**61,994**	**46,721**	**42,575**	**42,734**

3. Catalytic Crackers

The SO_2 floor allocation for catalytic crackers is based on the coke burn rate at the FCCU and the NSPS SO_2 emission rate. The FCCU for Wyoming Refining has a design feed rate of 5,300 barrels per day, or 6,029 lbs per hour. The NSPS SO_2 emission rate is 20 lbs SO_2 per ton coke burn-off.

$$SO_2\ Floor\ (tons\ per\ year) = Coke\ burn\ rate\ (lbs/hr) * \frac{1\ ton}{2000\ lbs} * SO_2\ emission\ factor\ (lbs/ton) * \frac{1\ ton}{2000\ lbs} * \frac{8760\ hrs}{year}$$

$$= (6029)(5 \times 10^{-4})(20)(5 \times 10^{-4})(8760)$$

$$= 264.0$$

4. Flares

The SO_2 floor allocation for the flares at Wyoming Refining is estimated according to the total crude processing capacity of the facility. The estimated crude processing capacity for Wyoming Refining is 12,500 barrels per calendar day. This capacity value is multiplied by the AP-42 SO_2 emission factor for a vapor recovery system and flaring of 26.9 lbs per 1,000 barrels refinery feed.

$$SO_2\ Floor\ (tons\ per\ year) = refinery\ capacity \left(\frac{1000\ bbls}{cd}\right) * 26.9 \left(\frac{lbs}{1000\ bbls}\right) * \left(\frac{1\ ton}{2000\ lbs}\right) * \left(\frac{365\ days}{year}\right)$$

$$= (12.5)\ (26.9)\ (5 \times 10^{-4})\ (365)$$

$$= 61.4$$

REFERENCES

40 CFR Part 60, 2001a: Code of Federal Regulations, "Subpart J - Standards of Performance for Petroleum Refineries," (60.100-60.109), 2001.

40 CFR Part 60, 2001b: Code of Federal Regulations, "Subpart LLL - Standards of Performance for Onshore Natural Gas Processing: SO_2 Emissions," 2001.

EPA, 1989: U.S. Environmental Protection Agency, "Sulfur Oxides Emissions from Fluid Catalytic Cracking Unit Regenerators – Background Information for Promulgated Standards – Final EIS," EPA-450/3-82-013b, Office of Air Quality Planning and Standards, Research Triangle Park, NC, April 1989.

EPA, 1993: U.S. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors (AP-42), Section 8.13 Sulfur Recovery," Office of Air Quality Planning and Standards, Research Triangle Park, NC, 1993.

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Greene, 2002: Letter from Samuel B. Greene, P.E., Sinclair Oil Corporation, Salt Lake City, UT, to Jim Wilson, E.H. Pechan & Associates, Inc., Springfield, VA, Re: Sinclair Oil Corporation Western Regional Air Partnership - Market Trading Forum, Non-Utility SO_2 Floor Allocation Study, Transmittal of Requested Information, September 30, 2002.

Oil & Gas Journal, 2000: *Oil & Gas Journal*, "2000 Worldwide Refining Survey," December 18, 2000, Volume 98.51, 2000.

CHAPTER III
LIME MANUFACTURING

A. SECTOR DESCRIPTION AND SIGNIFICANT SO_2 SOURCES

Lime is the high temperature product of the calcination of limestone. Although limestone deposits are found in every State, only a small portion is pure enough for industrial lime manufacturing. The Standard Industrial Classification (SIC) code for lime manufacturing is 3274. The six-digit SCC for lime manufacturing is 3-05-016.

The heart of a lime plant is the kiln. The prevalent type of kiln is the rotary kiln, accounting for about 90 percent of all U.S. lime production. This kiln is a long, cylindrical, slightly inclined, refractory-lined furnace, through which the limestone and hot combustion gases pass concurrently. Coal, oil, and natural gas may all be fired in rotary kilns. Product coolers and kiln feed preheaters of various types are commonly used to recover heat from the hot lime product and hot exhaust gases, respectively.

The next most common type of kiln in the United States is the vertical, or shaft, kiln. This kiln can be described as an upright heavy steel cylinder lined with refractory material. The limestone is charged at the top and is calcined as it descends slowly to discharge at the bottom of the kiln. A primary advantage of vertical kilns over rotary kilns is higher average fuel efficiency. The primary disadvantages of vertical kilns are their relatively low production rates and the fact that coal cannot be used without degrading the quality of the lime produced. There have been few recent vertical kiln installations in the United States because of high product quality requirements.

Other, must less common, kiln types include rotary hearth and fluidized bed kilns. Both kiln types can achieve high production rates, but neither can operate with coal. The "calcimatic" kiln, or rotary hearth kiln, is a circular kiln with a slowly revolving doughnut-shaped hearth. In fluidized bed kilns, finely divided limestone is brought into contact with hot combustion air in a turbulent zone, usually above a perforated grate. Because of the amount of lime carryover into the exhaust gases, dust collection equipment must be installed on fluidized bed kilns for process economy.

SO_2 emissions are influenced by several factors, including the fuel sulfur content, the sulfur content and numeralogical form (pyrite or gypsum) of the stone feed, the quality of lime being produced, and the type of kiln. The dominant source of SO_2 emissions is the kiln's fuel, and the vast majority of the fuel sulfur is not emitted because of reactions with calcium oxides in the kiln. SO_2 emissions may be further reduced if the pollution equipment uses a wet process or if it brings calcium oxides and SO_2 into intimate contact.

Table III-1 provides SO_2 emission factors for lime manufacturing. This table shows that there is a wide range of SO_2 emissions performance depending on the kiln type, pollution control equipment, feedstock, and fuel.

Because of differences in the sulfur content of the raw material and fuel and in process operations, a mass balance on sulfur may yield a more representative emission factor for a specific facility than AP-42 emission factors.

B. FLOOR ALLOCATION ESTIMATION METHODS

With the wide range of SO_2 emission factors for lime manufacturing, the SO_2 control that is inherent in the lime manufacturing process, and additional controls are not typically applied to lime plants, the SO_2 floor allocation for lime plants will be based on historical emissions. The historical emissions for the 1990 to 2000 period are listed in Table III-2. The calendar year 2000 SO_2 emission total for lime manufacturing is 2,316 tons.

REFERENCES

AWMA, 2000: Air & Waste Management Association, “Air Pollution Engineering Manual,” 2nd edition, edited by Wayne T. Davis, 2000.

EPA, 1998: U.S. Environmental Protection Agency, “Compilation of Air Pollutant Emission Factors, AP-42, Section 11:17: Lime Manufacturing,” Office of Air Quality Planning and Standards, Research Triangle Park, NC, 1998.

Table III-1
Emission Factors for Lime Manufacturing[a]

Source	SO_2[b]	Emission Factor Rating
Coal-fired rotary kiln (SCC 3-05-016-18)	5.4	D
Coal-fired rotary kiln with fabric filter (SCC 3-05-016-18)	1.7	D
Coal-fired rotary kiln with wet scrubber (SCC 3-05-016-18)	0.30	D
Gas-fired rotary kiln (SCC 3-05-016-19)	ND	
Coal- and gas-fired rotary kiln with venturi scrubber (SCC 3-05-016-20)	ND	
Coal- and coke-fired rotary kiln with venturi scrubber (SCC 3-05-016-21)	ND	
Coal-fired rotary preheater kiln with dry PM controls (SCC 3-05-016-22)	2.3	E
Coal-fired rotary preheater kiln with multiclone, water spray, and fabric filter (SCC 3-05-016-22)	6.4	E
Gas-fired calcimatic kiln (SCC 3-05-016-05)	ND	
Gas-fired parallel flow regenerative kiln with fabric filter (SCC 3-05-016-23)	0.0012	D
Product cooler (SCC 3-05-016-11)	ND	

NOTES: [a]Factors represent uncontrolled emissions unless otherwise noted. Factors are lbs/ton of lime produced unless noted. ND = no data. Classification Code.
[b]Mass balance on sulfur may yield a more representative emission factor for a specific facility.

Table III-2
Lime Manufacturing - Historical Emissions - 1990 to 2000

State	State ID	County ID	Facility ID	IAS Region	SIC	MTF Sector	Sector Description	Facility Name (1990)	Current Facility Name (if different from 1990)	SO_2 tpy 1990	SO_2 tpy 1996	SO_2 tpy 1998	SO_2 tpy 2000	Floor Allocation*
AZ	4	025	0011	41	3274	10	Metals/Mining/Minerals	CHEMICAL LIME (CHEMSTAR)	CHEMICAL LIME CO - NELSON PLANT	141	122	562	702	632
AZ	4	003	0003	47	3274	10	Metals/Mining/Minerals	CHEMICAL LIME (DOUGLAS)	CHEMICAL LIME CO - DOUGLAS PLANT	212	634	724	742	733
CA	6	053	12	12	3274	10	Metals/Mining/Minerals	NATIONAL REFRACTORIES&MINERALS	CHEMICAL LIME CO - NATIVIDAD PLANT	243	<100	69	82	76
NV	32	003	0003	22	3274	10	Metals/Mining/Minerals	CHEMSTAR APEX	CHEMICAL LIME CO - APEX PLANT	783		175	210	193
NV	32	007	0261		3274	10	Metals/Mining/Minerals	CONTINENTAL LIME INC., PILOT PEAK PLANT	GRAYMONT WESTERN US INC, PILOT PEAK PLANT	<100	136	235	249	242
UT	49	027		35	3274	10	Metals/Mining/Minerals	CONTINENTAL LIME INC., CRICKET MOUNTAIN PLANT	GRAYMONT WESTERN US, INC., CRICKET MOUNTAIN PLANT	115	297	275	331	303
Totals										**1,594**	**1,289**	**2,040**	**2,316**	**2,179**

NOTE: *Based on 1998 and 2000 historical SO_2 emission estimates.

CHAPTER IV
INDUSTRIAL BOILERS AND COGENERATORS

A. SECTOR DESCRIPTION AND SIGNIFICANT SO_2 SOURCES

Industrial, commercial and institutional (ICI) boilers produce steam or heat water for use in industrial processes, electrical/mechanical power generation, or space heating. Some have a dual functionality such as the cogeneration of steam and electricity. Auxiliary boilers provide backup power and power for startup/shutdown of large units. Large boilers ($\geq$150 MMBtu/hr) are generally field-erected units while small boilers are preassembled, packaged units. The design of an individual ICI boiler is often dependant on the application of steam and the space limitations in a particular plant.

ICI boilers generate steam at lower temperatures and pressures than utility boilers, therefore, their heat inputs are smaller. Industrial boilers generally have heat input rates ranging from 30 to 250 MMBtu/hr, but may be as high as 1,500 MMBtu/hr (EPA, 1994). Commercial and institutional boilers typically have heat input rates ranging from 0.4 to 12 MMBtu/hr, but may be as high as 100 MMBtu/hr (EPA, 1994). The overall population of ICI boilers have small heat inputs, with 80 percent of the population operating at less than 5 MMBtu/hr per boiler (STAPPA, 1994). Over 80 percent of the ICI boilers burn oil and gas. The remaining boilers burn primarily coal, with a small number burning biomass, waste or other non-fossil fuel. ICI combustion units often burn a mixture of conventional fuels and biomass or waste. Pulverized coal-fired units account for approximately 1 percent of the total ICI boiler population. However, they have large heat inputs, greater than 100 MMBtu/hr, therefore, they represent 14 percent of the total ICI boiler capacity. Oil and gas fired ICI boilers are smaller in size than coal-fired boilers, typically less than 250 MMBtu/hr.

The use of ICI boilers varies with the industrial application. In addition, the application of steam from an industrial boiler can change with the seasons, and can vary through the course of a day as well, depending on the processes and activities underway at a given moment and their demand for steam. Therefore, ICI boilers may have a much lower annual operating load or capacity factor than a typical utility boiler.

B. FLOOR ALLOCATION ESTIMATION METHODS

The analysis was limited to facilities which emit greater than 100 tpy of SO_2 in total, and/or individual units which emit greater than 25 tpy of SO_2. In addition, only coal and oil fired units were analyzed. Auxiliary boilers were included in the floor allocation estimation if the unit had a potential to emit (PTE) greater than 25 tpy. This includes boilers larger than 5 MMBtu/hr firing fossil fuel with a sulfur content of 1 percent or more.

The air pollution agencies for each WRAP State provided information for each ICI boiler being analyzed. This information included the boiler design capacity, annual fuel consumption for recent calendar years, fuel type (coal or oil), fuel sulfur content, SO_2 control device information, and the control device SO_2 control efficiency, or permitted SO_2 emissions limit for each unit.

The SO_2 floor allocations are calculated for each facility based on the current level of control. An average level of control is then assumed for each facility, according to Table IV-1 below:

Table IV-1
Assumed Level of Control for SO_2 Floor Allocation

Current Facility Level of Control	Assumed Average Level of Control for Estimating the Floor
Uncontrolled, 0%	85% Reduction
Units controlled at 0% to <70%	85% Reduction
Units controlled at 70% to 80 %	Increase reduction by 5%
Units controlled at 80% or greater	No additional reduction

Floor allocations for industrial boilers/cogenerators were also based on the average capacity utilization during the most recent calendar years. Some States were able to provide as many as five years worth of boiler utilization data. The recent years of boiler utilization (fuel consumption) data were used to estimate an average capacity factor for each unit. This average capacity factor was used, along with a 5 percent margin for growth, in the SO_2 floor allocation calculation for each boiler/cogenerator.

1. Coal Fired Units

Coal fired units were assumed to fire subbituminous coal with a heating value of 9,000 Btu/lb (18 MMBtu/ton) of coal burned, unless a specific coal type or heating value was reported (AWMA, 2000). The ICI boilers in the WRAP States were assumed to burn subbituminous coal since it has a low sulfur content. In addition, a lower grade of subbituminous coal, class C coal, was assumed to be used for ICI applications. The fuel sulfur content used to calculate the floor allocation was facility-specific, where available. For facilities that did not report sulfur content, an average sulfur content (1 percent) for the type of coal being fired was used (AWMA, 2000).

The SO_2 emission factor for subbituminous coal fired boilers in pounds of SO_2 emitted per ton of coal burned is given in AP-42 as:

$$EF_{SO2}\left(\frac{\text{lb of SO2}}{\text{ton}}\right) = 35 \times S$$

where S is the percentage sulfur content of the coal burned by each combustion unit (EPA, 1998a).

2. Oil Fired Units

Oil fired units were assumed to have a heating value of 0.15 MMBtu/gal unless a specific oil type or heating value was reported (AWMA, 2000). The fuel sulfur content used to calculate the floor allocation was facility-specific. For facilities not reporting sulfur content, an average sulfur content for the type of oil being fired was used (AWMA, 2000).

The SO_2 emission factor for No. 2 and No. 6 oil fired boilers in pounds of SO2 emitted per 1,000 gallons of oil burned is given in AP-42 as:

$$EF_{oil}\left(\frac{\text{lb of SO2}}{\text{1,000 gal}}\right) = 157 \times S$$

where S is the percentage sulfur content of the oil burned by each combustion unit (EPA 1998b).

Units that burn natural gas and oil are assumed to burn natural gas as a primary fuel, if the emission data indicated SO_2 emission < 5 tpy. If natural gas is the primary fuel, no allocations are computed.

C. FLOOR ALLOCATION RESULTS

Table IV-2 summarizes the floor allocation calculation for the ICI boilers in the 8 non-California Western Regional Air Partnership (WRAP) States.

D. COMPARISON WITH HISTORICAL EMISSIONS

Table IV-3 summarizes historical SO_2 emissions from industrial boilers located in Arizona, Colorado, Idaho, Oregon, Utah, and Wyoming. This table provides a point of comparison with the floor allocations shown in Table IV-2 and historical emissions at each facility. Note that the historical emissions are the total plant emissions, not just those resulting from operation of the boiler. In general, boilers which currently have a scrubber are able to meet their SO_2 floor allocations based on historical emissions.

E. EXAMPLE USE OF CAPACITY UTILIZATION DATA FOR FLOOR ALLOCATION ESTIMATES

The floor allocation estimation method for boilers and cogenerators takes into account utilization of these fuel combustion units in the most recent historical years. This section provides an example of how the capacity factor calculation was performed for one boiler at Abitibi Consolidated in Arizona.

In order to estimate the average annual capacity factors of each unit, Pechan requested the actual fuel throughput data for the last 5 years for each boiler. The data was supplied by the air pollution agencies for each WRAP State. The fuel throughput data supplied by the Arizona DEQ for Abitibi Consolidated is listed in Table IV-4.

Fuel throughput for all fuel types, coal, oil and natural gas were used to estimate the annual heat input for each unit using the following equation:

$$Q_{annual} = \left(T_{coal} \times HC_{coal}\right) + \left(T_{oil} \times HC_{oil}\right) + \left(T_{gas} \times HC_{gas}\right)$$

where:

Q_{annual} = annual heat input for each boiler (MMBtu/yr),
T = throughput for given fuel type, and
HC = heat content for a given fuel type.

Most States did not specify the heat content for each fuel, therefore, the following default values were used:

Coal	Heat content = 18.0 MMBtu/ton
Oil	Heat content = 0.15 MMBtu/gal
Natural Gas	Heat content = 1,020 MMBtu/MMscf

The boiler design capacity at Abitibi Power boiler #2 is 1,132 MMBtu per hour. In this exercise, the annual fuel consumption is compared with this boiler design capacity to estimate the percentage of total capacity that is used in each year. The Arizona DEQ was able to provide fuel throughput, or fuel consumption, estimates for four calendar years: 1998 through 2001. This particular unit burns coal and oil, but not natural gas. Fuel consumption estimates were provided by the State in tons for coal and gallons for oil. The average heat contents of these two fuels are listed in Table IV-4 and are used to compute an *All Fuels Combined Throughput* value in column J. Column K contains the boiler design capacity value converted to an annual equivalent. The capacity factor for each calendar year is computed (in column L) as the ratio of column J to column K. For Abitibi Power boiler #2, these capacity factors range from 60 to 70 percent, with an average capacity factor of 64 percent. The 64 percent average capacity factor value is used in the floor allocation estimate. (Note that during a leap year (2000), the potential hours of operation are greater.)

This average capacity factor is used to calculate the SO_2 floor allocation. This value is multiplied by 1.05 to provide some margin for future increases in operations. Only the primary fuel (coal in this example) is assumed to burned by the boiler in the floor allocation estimation. The SO_2 allocations are calculated using the assumed control efficiency (85 percent) as specified in Table IV-1. The SO_2 floor allocation is calculated using the following equation:

$$SO_2 = \frac{Q_{design}}{HC_{prime}} \frac{EF_{SO2}}{2000 \ \frac{\text{lb}}{\text{ton}}} \left(1.05 \times CF\right) \left(\frac{100 - \text{CE}}{100}\right)$$

where:

SO_2 = SO_2 floor allocation (tons/yr),
Q_{design} = annual heat input (MMBtu/yr),
HC_{prime} = heat content of primary fuel (MMBtu/ton, MMBtu/gal),
EF = SO_2 emissions factor (lb/ton, lb/gal),
CF = average capacity factor (%), and
CE = required control efficiency (%).

For Abitibi Power boiler #2, the appropriate values for the above equation are:

Q_{design} = 9,916,320
HC_{prime} = 18
EF = 35
CF = 0.64
CE = 85

As is shown in column P of Table IV-4, the SO_2 floor allocation estimate for Abitibi Power boiler #2 is 978 tpy.

REFERENCES

AWMA, 2000: Air and Waste Management Association, Davis, Wayne T. ed., “Air Pollution Engineering Manual,” Second Edition, John Wiley and Sons, Inc., New York, 2000.

EPA, 1994: U.S. Environmental Protection Agency, “Alternative Control Techniques Document – NO_x Emissions from Industrial/Commercial/Institutional Boilers,” EPA-453/R-94-022, Emission Standards Division, Office of Air Quality Planning and Standards, Research Triangle Park, NC, March 1994.

EPA, 1998a: U.S. Environmental Protection Agency, “Compilation of Air Pollutant Emission Factors (AP-42), Section 1.1 Bituminous And Subbituminous Coal Combustion,” Office of Air Quality Planning and Standards, Research Triangle Park, NC, 1998.

EPA, 1998b: U.S. Environmental Protection Agency, “Compilation of Air Pollutant Emission Factors (AP-42), Section 1.3 Fuel Oil Combustion,” Office of Air Quality Planning and Standards, Research Triangle Park, NC, 1998.

STAPPA, 1994: State and Territorial Air Pollution Program Administrators (STAPPA) and Association of Local Air Pollution Control Officials (ALAPCO), “Controlling Nitrous Oxides,” July 1994.

Table IV-2
Facility SO_2 Floor Allocation Estimation for ICI Boilers

Facility	Unit	Capacity in MMBtu/hr	Fuel	Sulfur Content	Current SO_2 Controls	Percent Reduction	SO_2 Limit	Average Capacity Factor (%)	Assumed Percent Reduction	Floor Allocation (tpy)
Arizona										
Abitibi Consolidated	No. 2 Power Boiler	1,132	Coal	1.0	None	0		64	85	978
Colorado										
TRIGEN - Colorado Energy Corp	Boiler #3	225	Coal	0.39		0		43	85	
TRIGEN - Colorado Energy Corp	Boiler #4	360	Coal	0.38		0		62	85	
TRIGEN - Colorado Energy Corp	Boiler #5	650	Coal	0.43		0		59	85	387
Idaho										
Amalgamated Sugar, Nampa	S-B1	105	Coal	1.0	None	0		34	85	
Amalgamated Sugar, Nampa	S-B2	105	Coal	1.0	None	0		35	85	
Amalgamated Sugar, Nampa	S-B3	250	Coal	1.0	None	0		43	85	242
Amalgamated Sugar Company, Paul	S-B1	200	Coal	1.0	None	0		35	85	
Amalgamated Sugar Company, Paul	S-B2	200	Coal	1.0	None	0		23	85	155
Amalgamated Sugar Company, Twin Falls	P-B1	280	Coal	1.0	None	0		30	85	
Amalgamated Sugar Company, Twin Falls	P-B2	285	Coal	1.0	None	0		24	85	203
Oregon										
Boise Cascade [c]	Power Boiler 6-9	N/A	Oil	2.0	No	0	4125 tpy	--	85	411
Amalgamated Sugar	B&W Boilers	204	Coal	1.5	Wet Scrubber	45	200 tpy	12	85	
Amalgamated Sugar	Foster Riley Boiler	136	Coal	1.5		0	265 tpy	20	85	
Amalgamated Sugar	Foster Wheeler Boiler	300	Coal	1.5		0	775 tpy	21	85	74
Georgia Pacific West	Power Boiler #1	Unknown	Oil	2.0	None	0	429.6 tpy	--	85	143
Pope & Talbot	Power Boiler #1	Unknown	Oil	2.0	None	0	391 tpy	--	85	107
West Linn Paper Co.	Boilers 1 & 2		Oil	2.0	None	0	492.74 tpy	46	85	211
Georgia-Pacific Wauna	Power Boiler	Unknown	Oil	2.0	None	0	641.1 tpy	--	85	
Georgia-Pacific Wauna	Package Boiler	Unknown	Oil	2.0	None	0	0.5 tpy	0	85	277
Weyerhaeuser Springfield	Power Boiler	Unknown	Oil	2	None	0	590 tpy	--	85	
Weyerhaeuser Springfield	Package Boiler	Unknown	Oil	0.55	None	0	73 tpy	--	85	
Weyerhaeuser Springfield	Package Boiler	16	Oil	2	None	0	39 tpy	0	85	362
Utah										
Sunnyside Cogeneration Associates	FBC Boiler #1	700	Coal	1.0	Scrubber	86	462 lbs/hr	84	86	1,270
Kennecott Utah Copper Corp N. Concentator	Unit 1	431	Coal	0.68	None [a]	0	1258 tpy	41	85	
Kennecott Utah Copper Corp N. Concentator	Unit 2	431	Coal	0.68	None [a]	0	1258 tpy	33	85	
Kennecott Utah Copper Corp N. Concentator	Unit 3	431	Coal	0.68	None [a]	0	1258 tpy	28	85	
Kennecott Utah Copper Corp N. Concentator	Unit 4	838	Coal	0.68	None [a]	0	2445 tpy	39	85	700
Brigham Young University	Units #2, #3, and #5	128	Coal	0.70	None [a]	0	217 tpy	0	85	
Brigham Young University	Auxiliary #7	5	Oil	1.5		0		6	85	0
Brush Wellman Incorporated	S-11 - Main Boiler	81.2	Oil	1.5	None	46	0.85 lb/MBtu	32	85	
Brush Wellman Incorporated	S-10 Backup Boiler	12.66	Oil	1.5	None	46	0.85 lb/MBtu	19	85	23

Table IV-2 (continued)

Facility	Unit	Capacity in MMBtu/hr	Fuel	Sulfur Content	Current SO_2 Controls	Percent Reduction	SO_2 Limit	Average Capacity Factor (%)	Assumed Percent Reduction	Floor Allocation (tpy)
Geneva Steel	Power Boiler 1	411	Coal/Gas	1.0	None	0		4		
Geneva Steel	Power Boiler 2	411	Coal/Gas	1.0	None	0		4		
Geneva Steel	Power Boiler 3	411	Coal/Gas	1.0	None	0		4		
Geneva Steel	Power Boiler 4	205	Coal/Gas	1.0	None	0		0		
Geneva Steel	Power Boiler 5	205	Coal/Gas	1.0	None	0	520.2 tpy	0	96	17
Wyoming										
Solvay Minerals, Inc.	Boiler #18	350	Coal	0.7	Scrubber	85	0.2	62	85	
Solvay Minerals, Inc.	Boiler #19	350	Coal	0.7	Scrubber	85	0.2	61	85	294
General Chemical	Boiler C	534	Coal	0.5	No	0	1.2	74	85	
General Chemical	Boiler D	880	Coal	0.5	No	0	1.2	71	85	750
Holly Sugar-Torrington Plant		221.2	Coal	0.7	No	0	None	17	85	23
FMC Corp - Green River Plant	Boiler #6	887	Coal	0.5	Scrubber [b]	0	1.2	70	85	
FMC Corp - Green River Plant	Boiler #7	887	Coal	0.5	Scrubber [b]	0	1.2	70	85	956
University of Wyoming Central Heating Plant	Boiler #2	73.1	Coal	0.5	No	0	1.2	18	85	
University of Wyoming Central Heating Plant	Boiler #3	73.1	Coal	0.5	No	0	1.2	25	85	22
University of Wyoming Central Heating Plant	Boiler #4	73.1	Coal					20		
FMC Granger	Boiler #1	358	Coal	1.0	Scrubber	99	0.2 lb/MMbtu	48	99	
FMC Granger	Boiler #2	358	Coal	1.0	Scrubber	99	0.2 lb/MMbtu	48	99	305
Total Floor Allocation										**7,910**

NOTES: [a]Natural gas is fired during winter months per SIP requirements.
[b]Scrubber is for the entire plant not just the boiler.

Table IV-3
Comparison of SO_2 Floor Allocation with Historical Emissions for ICI Boilers

Facility	Unit	Capacity (MMBtu/hr)	SO_2 Floor Allocation (tpy)	Historical SO_2 Emissions 1990 (tpy)	1996 (tpy)	1998 (tpy)	2000 (tpy)
Arizona							
Abitibi Consolidated	Power Boiler #2	1,132	978		2,455	2,448	1,893
Colorado							
TRIGEN - Colorado Energy Corp [b]	Boiler #3	225					
TRIGEN - Colorado Energy Corp [b]	Boiler #4	360					
TRIGEN - Colorado Energy Corp [b]	Boiler #5	650	387	2,675		3,708	2,583
Idaho							
Amalgamated Sugar, Nampa	S-B1	105					
Amalgamated Sugar, Nampa	S-B2	105					
Amalgamated Sugar, Nampa	S-B3	250	242	1,008	1,660	1,787	1,697
Amalgamated Sugar Company, Paul	S-B1	200					
Amalgamated Sugar Company, Paul	S-B2	200	155	608	306	217	1,322
Amalgamated Sugar Company, Twin Falls	P-B1	280					
Amalgamated Sugar Company, Twin Falls	P-B2	268	203	599	1,364	1,053	1,053
Oregon							
Boise Cascade [c]	Power Boiler 6-9	N/A	411	2,453	685	746	1,834
Amalgamated Sugar [c]	B&W Boilers	204					
Amalgamated Sugar [c]	Foster Riley Boiler	136					
Amalgamated Sugar [c]	Foster Wheeler Boiler	300	74	594	625	1,235	987
Georgia Pacific West [c]	Power Boiler #1	Unknown	143				
Pope & Talbot [c]	Power Boiler #1	Unknown	107			39	161
West Linn Paper Co. [a]	Boilers 1 & 2	365	211				
Georgia-Pacific - Wauna [c]	Power Boiler	Unknown					
Georgia-Pacific - Wauna [c]	Package Boiler	18	277			254	165
Weyerhaeuser Springfield	Power Boiler	Unknown	297				
Weyerhaeuser Springfield	Package Boiler	Unknown	65				
Weyerhaeuser Springfield	Package Boiler	16	0				
Utah							
Sunnyside Cogeneration Associates [b]	FBC Boiler #1	700	1,270	0	1,006	970	1,054
Kennecott Utah Copper Corp, N. Concentator [b]	Unit 1	431					
Kennecott Utah Copper Corp, N. Concentator [b]	Unit 2	431					
Kennecott Utah Copper Corp, N. Concentator [b]	Unit 3	431					
Kennecott Utah Copper Corp, N. Concentator [b]	Unit 4	838	700	2,905	2,141	2,200	2,534
Brigham Young University	Units 2, 3, and 5	128					
Brigham Young University	Auxiliary #7	5	0	248	90	158	125
Brush Wellman Incorporated	S-11 Main Boiler	81.2					
Brush Wellman Incorporated	S-10 Back-up Boiler	12.66	23	161	175	208	179

Table IV-3 (continued)

Facility	Unit	Capacity (MMBtu/hr)	SO_2 Floor Allocation (tpy)	Historical SO_2 Emissions 1990 (tpy)	1996 (tpy)	1998 (tpy)	2000 (tpy)
Geneva Steel	Power Boiler 1	411					
Geneva Steel	Power Boiler 2	411					
Geneva Steel	Power Boiler 3	411					
Geneva Steel	Power Boiler 4	205					
Geneva Steel	Power Boiler 5	205	17	8,473	2,020	881	979
Wyoming							
Solvay Minerals, Inc. [b]	Boiler #18	350					
Solvay Minerals, Inc. [b]	Boiler #19	350	294		101	72	52
General Chemical [b]	Boiler C	534					
General Chemical [b]	Boiler D	880	750	4,196	5,651	4,538	5,000
Holly Sugar-Torrington Plant [b]		221.2	23	374	266	154	178
FMC Corp - Green River Plant [b]	Boiler #6	887					
FMC Corp - Green River Plant [b]	Boiler #7	887	956	4,795	5,256	4,533	4,901
University of Wyoming Central Heating Plant [a]	Boiler #2	73.1					
University of Wyoming Central Heating Plant [a]	Boiler #3	73.1	22	152	154	223	193
University of Wyoming Central Heating Plant [a]	Boiler #4	73.1					
FMC Granger	Boiler #1	358					
FMC Granger	Boiler #2	358	305	475	473	149	212

NOTES: [a]Facility with boilers as only SO_2 source.
[b]Facility has multiple sources, emissions are total plant.
[c]Facility has multiple sources, emissions are boilers only.

Table IV-4
Example Use of Capacity Utilization Data for Floor Allocation Estimates

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
			Coal		Oil		Natural Gas								
Facility	Unit	Year	Throughput (ton/yr)	Heat Value (MMBtu/ton)	Throughput (gal/yr)	Heat Value (MMBtu/gal)	Throughput (MMcf/yr)	Heat Value (MMBtu/ft^3)	Throughput All Fuels Combined (MMBtu/yr)	Design Capacity (MMBtu/yr)	Capacity Factor	Primary Fuel Sulfur Content (%)	SO_2 EF (lb/ton)	SO_2 Reduction (%)	SO_2 Allocation (tons)
Arizona															
Abitibi Consolidated	Power Boiler # 2	1998	387,532	18.0	44,000	0.15	0.0		6,982,176		70%				
	1,132 MMBtu/hr	1999	353,163	18.0	-	0.15	0.0		6,356,934		64%				
		2000	350,531	18.0	29	0.15	0.0		6,309,562		64%				
		2001	327,428	18.0	193,000	0.15	0.0		5,922,654		60%				
				18.0						**9,916,320**	**64%**	**1.00**	**35.0**	**85.0**	**978**

NOTE: Throughput is the annual fuel consumption in the calendar year.

CHAPTER V
PULP AND PAPER INDUSTRY

A. SECTOR DESCRIPTION AND SIGNIFICANT SO_2 SOURCES

The processing of wood for a variety of products is one of the ten largest industries in the United States. To produce paper or paperboard, wood must be pulped first. In general, the pulp and paper production processes can be divided into three steps: pulp making, pulp processing, and paper/paperboard processing. The three basic types of pulping processes, which are the major sources of SO_2, are chemical pulping, mechanical pulping, and semi-chemical pulping. Chemical wood pulping involves cooking wood chips or sawdust in an aqueous chemical solution to dissolve the lignin that binds the cellulose fibers together. There are two major types of chemical pulping used: Kraft/soda pulping and sulfite pulping. Kraft pulping accounts for over 80 percent of the chemical pulp produced in the United States.

Sources of SO_2 in a Kraft mill include: (1) boilers generating steam for power and heat, using coal, oil, natural gas, or bark/wood waste as fuel; (2) recovery furnaces where SO_2 emissions occur from the oxidation of reduced sulfur compounds; and (3) lime kilns when fuel oil is being combusted.

Allocations for boilers are discussed in Chapter IV, "Industrial Boilers and Cogenerators." Floor allocations for recovery furnaces and lime kilns are described in this chapter. Note that the calculations for these sources are the same as those for like configurations set forth in other chapters.

1. Recovery Furnaces

After the cooking period, the pulp and the liquor in which it cooked are separated, the spent liquor (black liquor) is evaporated and concentrated to about 65 percent solids. Concentrated black liquor is then sprayed into the furnace and the organic compounds are combusted. The combustion of black liquor in a recovery furnace results in SO_2 emissions that vary with liquor properties (i.e., sulfidity, heat value), combustion air and liquor firing patterns, furnace design and operational patterns.

SO_2 reduction is achieved by altering the process, rather than applying control technology. Strategies to lower liquor sulfidity and optimize combustion and firing patterns in such way that yields maximum and uniform temperatures in the lower furnace are used to minimize SO_2 emissions. Flue gas desulfurization is energy intensive and its efficiency uncertain, considering the generally low concentrations and fluctuating levels of SO_2 in the furnace flue gases.

2. Lime Kilns

In a pulp and paper lime kiln, the inorganic molten smelt that forms and collects at the bottom of the furnace is withdrawn through spouts into a smelt-dissolving tank where jets of water are used to quench the molten smelt, forming green liquor. The green liquor is then combined with quicklime (CaO), resulting in a white liquor solution containing NaOH, Na_2S and lime mud precipitate (mainly $CaCO_3$). This lime mud is washed, dried and calcined in the lime kiln to regenerate quicklime. The regenerated quicklime in the kiln acts as an in-situ-scrubbing agent and the Venturi scrubber that usually follows the kiln further reduces SO_2 levels. Emissions from smelt-dissolving tanks and lime kilns are generally negligible.

B. FLOOR ALLOCATION ESTIMATION METHODS

The analysis was limited to pulp and paper facilities that emit greater than 100 tpy of SO_2 from all processes. There are seven pulp and paper facilities evaluated – six located in the State of Oregon and one in Idaho. The Oregon Department of Environmental Quality provided data on the unit capacity for each Oregon facility. However, the data given were the permitted SO_2 emission levels and the design capacity of production of each recovery furnace or kiln.

Abitibi in Navajo County, Arizona no longer operates a recovery furnace. They are no longer pulping and have converted to recycled paper processing. Therefore, they receive no floor allocation for recovery furnace operation.

1. Recovery Furnaces

The floor allocation for recovery furnaces is determined assuming that the process provides sufficient SO_2 reductions. No further SO_2 reductions will be required when estimating the floor allocations. Pechan estimated the floor allocation using the emission factor given in AP-42 in lbs/air-dried ton of pulp (ADT) and the designed pulp production capacity. The SO_2 floor allocations are given by the equation:

$$A_F(tpy) = EF_{SO_2}\left(\frac{lb}{ADT\ of\ pulp}\right) x\ capacity \left(\frac{ADT\ of\ pulp}{day}\right) x\ \%\, capacity\ x\ \frac{1\ ton}{2{,}000\ lb}\ x\ \frac{365\ days}{1\ year}$$

where:

A_F = SO_2 allocation for recovery furnaces in the facility, and
EF_{SO2} = AP-42 emission factor = 7 lbs/ADT.

For facilities where pulp production capacity was not given, but fuel throughput was reported in its place, SO_2 allocations are estimated as the fuel throughput multiplied by the EPA AP-42 SO_2 emission factor.

2. Lime Kilns

The floor allocation for lime kilns is determined in the same manner as recovery furnaces. The floor allocation for lime kilns assumes no further SO_2 reductions will be required when estimating the floor allocations. Using the emission factor for lime kilns given in AP-42, the SO_2 floor allocation equation for lime kilns is given by:

$$A_K(tpy) = EF_{SO_2}\left(\frac{lb}{ADT\ of\ pulp}\right) x\ capacity \left(\frac{ADT\ of\ pulp}{day}\right) x\ \%\, capacity\ x\ \frac{1\ ton}{2000\ lb}\ x\ \frac{365\ days}{1\ year}$$

where:

A_K = SO_2 allocation for lime kilns in the facility, and
EF_{SO2} = AP-42 emission factor = 0.3 lbs/ADT.

For facilities where pulp production capacity was not given, but fuel throughput was reported in its place, SO_2 allocations are estimated as the fuel throughput multiplied by the EPA AP-42 SO_2 emission factor.

C. FLOOR ALLOCATION RESULTS

Table V-1 presents the floor allocation calculations for pulp and paper plants in Oregon based on the permitted capacity of the recovery furnaces and kilns. Unit capacity values were given in air-dried tons of pulp per day. For the floor calculations, it was assumed that the furnace was operated 365 days per year at 100 percent capacity.

Table V-2 presents the floor allocation for facilities where the pulp production capacity was not given, but fuel throughput was reported instead. The Potlatch facility listed in Table V-2 is located in Idaho. All other pulp and paper mills listed in Tables V-1 and V-2 are in Oregon. Therefore, the computed floor allocations by State are 1,807 tpy for Idaho, and 5,377 tpy for Oregon. The California allocation for pulp/paper is based on the 1996, 1998, and 2000 historical SO_2 emissions data in Table V-3, and is 324 tpy.

Table V-1
Facility SO_2 Floor Allocation Estimation for Pulp and Paper Facilities Based on Unit Capacity Values

Facility	Unit	Capacity* (ADTP/day)	SO_2 Allocations (tpy)
Boise Cascade Corporation	Recovery Furnace#2	450	575
	Recovery Furnace#3	700	894
	Lime Kiln#4	1,150	63
Georgia-Pacific (Wauna Mill)	Recovery Furnace	1,015	1,297
	Lime Kiln	1,174	64
Weyerhauser Springfield	#3 Recovery Boiler	1,150	760
	#4 Recovery Boiler	1,150	790
	Lime Kilns	2,156	118

NOTE: *Design and actual capacity are unknown, the values given are the permitted levels.

Table V-2
Facility SO_2 Floor Allocation Estimation for Pulp and Paper Facilities Based on Fuel Throughput

Facility	Unit	Fuel	Throughput	SO_2 Allocations (tpy)
Georgia-Pacific West, Inc.	Recovery Furnace#1	DCE-BLS	242,725 tpy	129
		Nat. gas		
	Recovery Furnace#2	DCE-BLS	242,725 tpy	129
		Nat. gas		
	Lime Kiln#2	Nat. gas	553.7*10E6 ft³/y	0
		RFO		
		#6 oil		
	Lime Kiln#3	Nat. gas	553.7*10E6 ft³/y	0
		RFO		
		#6 oil		
Willamette Industries, Inc.	Recovery Furnace#5	BLS	495,000 tpy	235
		Nat. gas	350 MMft³	0
		No.2 fuel oil	1E06 gal/y	39
	Lime Kiln #3	Oil/nat.gas/LPG	1.35E05 ton lime mud/y	36
Pope & Talbot, Inc.	Recovery Furnace	BLS	461,081 tpy	67
		Oil	1.2E06 gal/y	173
	Lime Kiln	CaO	55,536 tpy	0
		Oil	1.8E06 gal/y	1
		NCG/CaO	5,662 tpy	7
Potlatch	#4 Recovery Boiler	BLS	117,113 tpy	410
	#5 Recovery Boiler	Pulp	393,548 tpy	1,377
	#2 Lime Kiln	CaO	10,247 tpy	2
	#3 Lime Kiln	CaO	61,467 tpy	9
	#4 Lime Kiln	CaO	60,147 tpy	9

D. COMPARISON WITH HISTORICAL EMISSIONS

Table V-3 summarizes historical SO_2 emissions from pulp and paper facilities. This table provides a point of comparison with the floor allocations shown in Tables V-1 and V-2 and historical emissions at each facility. Note that the historical emissions are the total plant emissions, not just those resulting from operation of the recovery furnace and lime kiln.

REFERENCES

AWMA, 2000: Air and Waste Management Association, "Air Pollution Engineering Manual," 2nd edition, Chapter 18 -Wood Processing Industry, 2000.

EPA, 1998: U.S. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Source, Section 10.2 Chemical Wood Pulping," Office of Air Quality Planning and Standards, Research Triangle Park, NC, 1998.

Table V-3
Pulp and Paper - Historical Emissions - 1990 to 2000

State	State ID	County ID	Facility ID	IAS Region	SIC	MTF Sector	Sector Description	Facility Name (1990)	Current Facility Name (if different from 1990)	SO_2 tpy 1990	SO_2 tpy 1996	SO_2 tpy 1998	SO_2 tpy 2000
AZ	4	017	0007	43	2611	3	Wood/Paper/Pulp	STONE CONTAINER	ABITIBI	8,536	2,455	2,448	1,893
CA	6	023	21	10	2611	3	Wood/Paper/Pulp	SIMPSON PAPER COMPANY	SIMPSON PAPER CO	1,021	315	315	
CA	6	089	23		2611	3	Wood/Paper/Pulp	SHASTA PAPER-ANDERSON					216
CA	6	013	3257	11	2611	3	Wood/Paper/Pulp	GAYLORD CONTAINER CORPORATION		263	0	0	
CA	6	023	37	10	2611	3	Wood/Paper/Pulp	LOUISIANA-PACIFIC CORP.		302	<100	42	42
CA	6	077	191	11	2621	3	Wood/Paper/Pulp	NEWARK SIERRA PAPERBOARD CORP.		270	0	0	
ID	16	045			2611	3	Wood/Paper/Pulp	BOISE CASCADE - EMMETT					252
ID	16	069	0001	3	2621	3	Wood/Paper/Pulp	POTLATCH		1,379	700	700	1,694
OR	41	009	1849	6	2621	3	Wood/Paper/Pulp	Boise Cascade Company		2,453	685	746	1,834
OR	41	041	0005	5	2631	3	Wood/Paper/Pulp	Georgia-Pacific West, Inc.		56	207	322	452
OR	41	019	0036	5	2631	3	Wood/Paper/Pulp	International Paper		874	602	1,006	0
OR	41	007	0004	5	2621	3	Wood/Paper/Pulp	James River II, Inc.	Georgia- Pacific (Wauna Mill)	331	573	617	643
OR	41	043	3501	5	2621	3	Wood/Paper/Pulp	Pope & Talbot Pulp, Inc.		485	133	92	293
OR	41	071	6142	5	2621	3	Wood/Paper/Pulp	Smurfit Newsprint Corporation 2		592	368	461	519
OR	41	043	0471	5	2631	3	Wood/Paper/Pulp	Willamette Industries, Inc.		396	54	485	327
OR	41	039	8850	5	2631	3	Wood/Paper/Pulp	Collins Products LLC	Weyerhaeuser Co. (Particleboard)	202	0	3	1,721
OR	41	047	5398	5	2621	3	Wood/Paper/Pulp	Ogden Martin Systems of Marion, Inc.	Covanta Marion, Inc.	127	18	22	
										17,287	**6,210**	**7,259**	**9,886**

CHAPTER VI
CEMENT MANUFACTURING

A. SECTOR DESCRIPTION AND SIGNIFICANT SO_2 SOURCES

The cement industry involves the calcining of limestone in clinker and the subsequent crushing of the clinker into cement. Cement manufacturing activities include the process the mining and mixture of raw materials such as limestone and other materials, the pryoprocessing of the raw materials into a clinker, and the grinding of the clinker and other materials such as silicates into the final cement. As of December 2000, there were 201 kilns with a total capacity of 84 million tpy. The kiln is a predominate source of SO_2 emissions. The SO_2 emissions result from the combustion of the sulfur in the fuel and the sulfur (generally in the form of pyrite) that can occur in the feedstock.

Kilns generally take five forms:

- wet (where the feedstock contains up to 43 percent water);
- dry;
- semi-dry;
- dry with a pre-heater;
- and dry with a pre-calciner.

SO_2 emissions vary by kiln type generally based on how effectively the kiln type mixes the SO_2 containing gases with the alkaline calcium compounds. The pre-heater and pre-calciner kilns can remove 90+ percent of the SO_2 in the gas stream while the dry process kiln removes about 70 percent. In addition, the type of particulate control devices can impact the amount of SO_2 removed in the process. Fabric filters, both because they mix the SO_2 containing gases with the particles collected on the filter, and because they operate at a generally lower temperature then electrostatic participators (ESPs), collect more SO_2 than ESPs.

B. FLOOR ALLOCATION ESTIMATION METHODS

Estimation of the floor allocation procedure for the cement industry poses several difficulties. First, there is no demonstrated control technology for control of SO_2 emissions from cement kilns. Second, emissions from kilns vary considerably due to numerous variables including kiln type and sulfur content of feedstock. According to EPA AP-42 emission factors, emissions can vary by as much as a factor of 20. Emission data from two similar kilns in Utah shows that changes in feedstock can cause a change in emissions up to a factor of 100. Because of this variability and lack of predictability of emissions, the floor allocation was based on the average emissions from each plant over the past several years.

C. FLOOR ALLOCATION RESULTS

Table VI-1 shows the allocation results of the emissions to each plant. As discussed above, the data are based on the emissions reported in State inventories unless otherwise indicated (See Table VI-2). Several of the sources added new kilns in the past several years. For these sources only emission data after the new kiln were included. Permit

Table VI-1
Floor Allocations

State	Plant Name	SO_2 Floor Allocation (tpy)	State Totals (tpy)
AZ	Phoenix Cement Portland Cement Plant	320[1]	
			320
CO	Holcim Portland	3,374	
CO	Holcim Laporte	1,402	
CO	Cemex	160	
			4,936
ID	Ash Grove Inkom	522	
			522
NV	Nevada Cement	305	
NV	Royal Cement	143[2]	
			448
NM	Rio Grande	1,103[3]	
			1,103
UT	Holcim	267[2]	
			267
WY	Centex	165[4]	
			165
TOTAL		**7,761**	**7,761**

NOTES: [1]Permit limited potential to emit.
[2]Only two years after new kiln included.
[3]Only one year of data available.
[4]New kiln in 1997.

Table VI-2
Cement Manufacturing - Historical Emissions - 1990 to 2000

State	State ID	County ID	Facility ID	IAS Region	SIC	MTF Sector	Sector Description	Facility Name (1990)	Current Facility Name (if different from 1990)	SO_2 tpy 1990	SO_2 tpy 1996	SO_2 tpy 1998	SO_2 tpy 2000
AZ	4	019			3241	4	Cement/Concrete	Arizona Portland Cement		101	13	10	8
AZ	4	025		41	3241	4	Cement/Concrete	Phoenix Cement		<100	197	339	539
CA	6	029	9	13	3241	4	Cement/Concrete	CAL PORTLAND CEMENT CO.		429	245	245	245
CA	6	029	20	13	3241	4	Cement/Concrete	CALAVERAS CEMENT CO		286	286	286	286
CA	6	085	17	11	3241	4	Cement/Concrete	KAISER CEMENT CORPORATION	HANSON PERMANENTE CEMENT	474	464	416	474
CA	6	087	11	11	3241	4	Cement/Concrete	LONE STAR INDUST CEMENT PLANT	RMC PACIFIC MATERIALS	250	286	393	314
CA	6	071	7000000	15	3241	4	Cement/Concrete	MITSUBISHI CEMENT		28	574	946	298
CA	6	071	1200003	15	3241	4	Cement/Concrete	RIVERSIDE CEMENT COMPANY		0	527	527	164
CA	6	071	100005	15	3241	4	Cement/Concrete	CEMEX-CALIFORNIA CEMENT		0	0	0	427
CA	6	071		15	3241	4	Cement/Concrete	SOUTHWESTERN PORTLAND CEMENT C	SOUTHDOWN-VICTORVILLE PLANT	108	0	0	0
CO	8	069	0002	52	3241	4	Cement/Concrete	HOLNAM LAPORTE	HOLCIM	623	623	375	404
CO	8	043	0001	58	3241	4	Cement/Concrete	HOLNAM PORTLAND	HOLCIM	4,069	3,615	3,219	3,288
CO	8	013	0003	53	3241	4	Cement/Concrete	SOUTHWEST PORTLAND	CEMEX-LYONS PLT.	967	160	160	50
ID	16	005	0004	7	3241	4	Cement/Concrete	ASHGROVE CEMENT		790	200	200	1,327
NV	32	019	0387	20	3241	4	Cement/Concrete	NEVADA CEMENT COMPANY	FERNLEY PLANT	360	340	346	172
NM	35	001			3241	4	Cement/Concrete	RIO GRANDE PORTLAND CEMENT		0	0	0	1,103
UT	49	029	0001	31	3241	4	Cement/Concrete	Holnam Incorporated	HOLCIM	911	3	247	288
										9,496	**7,533**	**7,709**	**9,387**

limits were selected, since the kiln is under construction and there was no actual emission data. Table VI-3 provides an example of this calculation.

Table VI-3
Example Calculation

Facility	SO_2 tpy 1996	SO_2 tpy 1998	SO_2 tpy 2000	Floor Estimate[1]
Nevada Cement	340	346	172	286
Holcim Laporte	632	375	404	470

[1]Floor estimate based on the average of these 3 years.

D. COMPARISON WITH HISTORICAL EMISSIONS

Table VI-2 shows a comparison of emissions to the historical emissions based on State emissions inventories. Since the floor is based on historical emissions, the general match is very close, but for any individual plant, the floor may be higher or lower than recent emissions.

REFERENCES

EPA, 1995: U.S. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors (AP-42)," Chapter 11.6, Cement Manufacturing, Office of Air Quality Planning and Standards, Research Triangle Park, NC, 1995.

PCA, 2001: Portland Cement Association, U.S. and Canadian Portland Cement Industry Plant Information Summary, Data as of December 31, 2000, Portland Cement Association, Economic Research Department, 2001.

CHAPTER VII
NATURAL GAS PROCESSING PLANTS

A. SECTOR DESCRIPTION AND SIGNIFICANT SO_2 SOURCES

SO_2 emissions from natural gas processing plants result from the combustion of sour gases. Sour gases may contain less than 1 percent H_2S to over 20 percent H_2S.

H_2S is removed from the natural gas by scrubbing with an amine solution. The amine solution is heated to regenerate the amine solution. Heating the amine also produces a very concentrated H_2S stream. This H_2S stream can be treated to produce sulfur. The most common treatment is by using a Claus plant. The Claus plant can convert about 80-98.6 percent of the H_2S to sulfur depending on the number of stages and the concentration of H_2S. The average recovery percentage for a 3-stage Claus plant would be about 96 percent, on average. The residual H_2S after the Claus plant is either flared or converted to additional sulfur in a "tail gas" treatment plant like the SCOT or Stretford-Beavon process. H_2S conversion efficiencies of up to 99.9 percent are possible. Residual H_2S may be flared.

In addition to the plant tail gas flare, SO_2 emissions also result from upset conditions at the plant, or in the well field, or emissions when new wells are brought in. Upsets at the plant cause the sulfur recovery plant to be bypassed and the H_2S is flared to produce SO_2. Upsets in the well field may result in sour natural gas being flared as a safety precaution to reduce exposure to toxic levels of H_2S.

B. FLOOR ALLOCATION ESTIMATION METHODS

The requirements for, and the economics of, sour gas control are a function of a number of variables, including the amount of H_2S in the offgas, the size and age of the facility, and the air pollution control requirements in existence at the time the facility was built. Existing sour gas processing plants may have been built in situations where no regulations existed, under the 1987 NSPS, or under a BACT review under prevention of significant deterioration regulations.

It was decided that the current NSPS would serve as the floor. The NSPS requires a variable sulfur removal efficiency based on the H_2S content of the acid gas and the amount of sulfur in the gas. The required emission reduction for each facility was based on the equations in Table VII-1 since these are the long term reductions called for in the NSPS. If a facility had current control levels higher than the assumed floor, the actual average emissions over the past three years were assumed to be the floor. Since emissions from flaring operations, both in the plant and the well field, are not amenable to control, floor emissions will be assumed to be the average of three years emissions, whenever the data is available.

Table VII-1
Sulfur Plants - Required Minimum SO_2 Emission Reduction Efficiency

<table>
<tr><th rowspan="2">H_2S Content of Acid Gas (Y), %</th><th colspan="4">Sulfur Feed Rate (x), Long Tons per Day</th></tr>
<tr><th>$2.0 \leq X \leq 5.0$</th><th>$5.0 < X \leq 15.0$</th><th>$15.0 < X \leq 300.0$</th><th>$X > 300.0$</th></tr>
<tr><td>$Y \geq 50$</td><td>74.0</td><td colspan="3">. . . . . . . $85.35X^{0.0144}Y^{0.0128}$ . . . .
or 99.8, whichever is smaller</td></tr>
<tr><td>$20 \leq Y < 50$</td><td>74.0</td><td colspan="2">. . . . $85.35X^{0.0144}Y^{0.0128}$ . . . .
or 97.5, whichever is smaller</td><td>97.5</td></tr>
<tr><td>$10 \leq Y < 20$</td><td>74.0</td><td>$85.35X^{0.0144}Y^{0.0128}$
or 90.8, whichever is smaller</td><td>90.8</td><td>90.8</td></tr>
<tr><td>$Y < 10$</td><td>74.0</td><td>74.0</td><td>74.0</td><td>74.0</td></tr>
</table>

Data availability was a significant issue in determining the floor allocation for some plants. The data from New Mexico was not adequate to distinguish between process plant, upset flare, and well field emissions.

C. FLOOR ALLOCATION RESULTS

1. General Plants

Table VII-2 shows the floor allocation calculation for the natural gas processing plants in the 8 non-California Western Regional Air Partnership (WRAP) States.

In Table VII-2, the plant name and SCC code are those provided in the State inventory. The emission source column (process or flare) notes whether the emissions are likely to come from the normal processing of natural gas (process) or the result of upset or well field emissions (flare). The distinction was made on the basis of comments in the emission inventory and confirmed in conversations with the State. Current emissions are based on the average of several years data (2000, 1998, 1996) if available, and on one year's data if that was all that was available. In some cases, new plants were under construction and permit levels were used in lieu of actuals. Current reductions were based on data in the State inventories and confirmed via conversations with State agencies.

Floor emissions vary by the H_2S content of the gas, the amount of sulfur produced by the plant, the age of the plant (older plants are not subject to the NSPS), and State regulations. In Wyoming, although individual plants vary, the average H_2S content of natural gas is higher than in other States and the degree of control required under the NSPS is greater. In addition, newer plants tend to be larger and have undergone a BACT review. In New Mexico, the relatively low H_2S content means that less control may be required under the NSPS. This is due both to the H_2S content as well as the small amount of sulfur produced by the processing plants. However, a State rule (20.2.35 NMAC) requires a minimum of a 90 percent reduction for plants that release more than 5 tons per day of sulfur from existing plants regardless of the H_2S content of the gas.

The level of control assumed to be the floor will be the most stringent of all of the potential regulatory requirements. However, the application of the potential floor procedures can result in no SO_2 controls having to be applied on some sources. For example, the Duke Energy Artesia plant in New Mexico processes less than 2 long tons per day of sulfur (this is equivalent to about 1,600 tpy of SO_2 emissions) and therefore the NSPS does not apply. State regulations do not apply, since the sulfur throughput is below the regulatory threshold. The floor for this plant is based on the average emissions over the past three years.

2. Specific Example

The Burlington Northern Lost Cabin facility in Wyoming provided additional information needed to demonstrate how the floor calculations could be applied to a specific facility. The Lost Cabin facility consists of two existing gas processing lines with a capacity of 133 MMCF/day and has one new train with a capacity of 133 MMCF/day. Both lines process a gas with a methane concentration of 68 percent, a carbon dioxide concentration of 20 percent, and an H_2S content of 12 percent.

Each train is controlled by a three stage Claus unit followed by a SCOT tail gas unit. The unit is required to have a conversion efficiency of 99.8 percent. Plantwide emissions are limited to 642 lbs/hr and 1,367 tpy.

The plant underwent a BACT review under PSD and exceeds all requirements of the NSPS. Under the NSPS, a reduction of 97.5 percent would have been required since the H_2S content of the acid gas stream is 37 percent (which is defined as the gas stream leaving the amine regenerator and can be calculated as the ratio of the acid gases [H_2S and CO_2] in the input gas stream) and the sulfur production exceeds 300 long tons per day (see Table VII-1). Since the required reduction exceeds the floor level, the permitted levels represent the floor.

Since much of the plant is new, no data on upset emissions is available. Emissions from well-field activities are very variable. Wells are very large at this plant and one very large well can have up to 1,000 tons of emissions. The plant estimates that annual SO_2 emissions of about 500 tpy from well field activities can be expected.

D. COMPARISON WITH HISTORICAL EMISSIONS

Table VII-3 summarizes historical SO_2 emissions from natural gas processing plants located in the 9 WRAP States. California facilities are included in this table. This table provides a point of comparison with the floor allocations shown in Table VII-2. For Wyoming, the historic emissions are close to floor for most sources due to the high level of control. However, a direct comparison is difficult since the historical emissions may include well field and upset emissions. Two New Mexico sources will require additional control or additional emission allocations.

Table VII-2
Possible Floor - Natural Gas Processing Units

State	Plant	SCC	Emission Source (Process vs Flare)	Current % Reduction	Permit Emissions	Floor Emission Reduction	Possible SO_2 Floor (tpy)
NM	Conoco-Maljamar	31000028	Plant	0	3,574	87	222
NM	Western Gas Resources	31000208	Plant	90	3,127	90	3,127
NM	Agave Energy	31000205	Plant	0	2,983	86.3	365
NM	Duke Energy Eunice	31000208	Plant	90	2,756	90	2,250
NM	Duke Energy Artesia	31000208	Plant	0	1,459	0	1,192
NM	Dynergy Midstream Monument	31000208	Plant	90	1,431	90	675
NM	Dynergy Midstream Saunders	31000208	Plant	90	1,387	90	163
NM	Duke Energy Plant 5	31000205	Plant	96.4	1,300	96.4	1,181
NM	Sid Richardson	31000201	Plant	91.7	1,206	91.7	1,206
NM	JL Davis Gas Processing Denton Plant	31000205	Plant	0	1,158	0	840
NM	Marathon Oil	31000201	Plant	90	1,100	90	665
NM	Duke Energy Lee Gas	31000299	Plant	93	818	93	0[4]
NM	ARCO Permian Empire Abo Plant	31000208	Plant	96	565	96	431
NM	Duke Energy Burton Flats	31000205	Plant	0	246	0	164
NM	Duke Energy Dagger Draw Plant	31000208	Plant	98	243	98	218
NM	Duke Energy Huber Gas Plant	31000205	Unknown	0	231	0	163
UT	Tom Brown- Lisbon Plant		Plant	95	1,593[2]	95	1,593
WY	Howell Petroleum - Elk Basin	31000205	Plant	93.5	1,200	93.5	1,200
WY	Burlington Resources Lost Cabin		Plant	99.8	1,367[2]	99.8	1,367
WY	Burlington Resources Lost Cabin		Flare	0	500[1]	0	500
WY	KCS Mountain Ainsworth Flare	31000205	Flare	0	843	0	843
WY	KCS Mountain Rushmore Flare	31000205	Flare	0	118[1]	0	118
WY	Marathon Pitchfork Battery	31000205	Flare	0	61[1]	0	61
WY	Exxon Shute Creek	31000205	Plant	99.7	1,206	99.7	1,206
WY	Exxon Shute Creek	31000205	Flare	0	330[1]	0	330
WY	Amoco Whitney Canyon	31000205	Plant	99	5,379	99	5,379
WY	Amoco Whitney Canyon	31000205	Flare	0	223[1]	0	223
WY	Texaco Byron	31000205	Plant	0	200	0	200

Table VII-2 (continued)

State	Plant	SCC	Emission Source (Process vs Flare)	Current % Reduction	Permit Emissions	Floor Emission Reduction	Possible SO_2 Floor (tpy)
WY	Chevron Carter Creek	31000205	Plant	99+	0[3]		0
WY	Chevron Carter Creek	31000205	Flare	0	200	0	200
WY	Hallwood Petroleum Federal Packsaddle 1-24	31000205	Flare	0	133	0	133
WY	Hallwood Petroleum Federal Packsaddle 1	31000205	Flare	0	960[1]	0	960
WY	Oregon Basin Gas Plant	31000205	Plant	90	391	90	391
WY	KCS Gold Eagle Flare	31000205	Flare	0	790	0	790
WY	Interenergy Hiland Gas Plant	31000205	Flare	0	281[1]	0	281
WY	Marathon Oil Mill Iron	31000205	Flare	0	247	0	247
	Emission Totals				**39,606**		**28,884**

NOTES: 1. Only one year of data available; 2. Floor based on permit levels; 3. Plant does not incinerate tail gas - no SO_2 emitted; 4. Plant has no emissions listed for the past three years.
State SO_2 floor allocations based on the estimates in this table are NM (12,862 tpy), UT (1,593 tpy), and WY (14,429 tpy).

Table VII-3
Oil and Gas Production - Historical Emissions - 1990 to 2000

State	State ID	County ID	Facility ID	IAS Region	SIC	MTF Sector	Sector Description	Facility Name (1990)	Current Facility Name (if different from 1990)	SO_2 tpy 1990	SO_2 tpy 1996	SO_2 tpy 1998	SO_2 tpy 2000
CA	6	029	1141	13	1311	6	Oil/Gas	SANTA FE ENERGY	TEXACO CA INC	1,539	855	2,050	2,050
CA	6	029	1129	13	1311	6	Oil/Gas	TEXACO EXPLOR & PROD INC		1	89	112	63
CA	6	029	206	13	1311	6	Oil/Gas	BERRY PETROLEUM COMPANY		237	0	0	0
CA	6	019	71	12	1311	6	Oil/Gas	CHEVRON USA INC. - COALINGA		809	0	0	
CA	6	029	272	13	1311	6	Oil/Gas	M H WHITTIER	SENECA RESOURCES	347	0	0	
CA	6	053	19	12	1311	6	Oil/Gas	MOBIL OIL CORP - SAN ARDO	AERA ENERGY	304	0	1	6
CA	6	029	1135	13	1311	6	Oil/Gas	SHELL KERNRIDGE	AERA ENERGY LLC	294	<100	82	55
CA	6	019	64	12	1311	6	Oil/Gas	SHELL WESTERN E&P INC. - COALINGA		144	0	0	
CA	6	029	331	13	1311	6	Oil/Gas	SWEPI-WEST COAST DIVISION	AERA ENERGY LLC	775	<100	10	
CA	6	053	30	12	1311	6	Oil/Gas	TEXACO INC - SAN ARDO		100	<100	36	32
CA	6	029	299	13	1311	6	Oil/Gas	UNOCAL - BAKERSFIELD	UNOCAL OIL & GAS DIVISION	159	0	0	
CA	6	059	42775	14	1311	6	Oil/Gas	WEST NEWPORT OIL CO		297	<100	10	11
CO	8	045	24	51	1311	6	Oil/Gas	UNOCAL RETORT-PARACHUTE		679	0	0	0
CO	8	045	0025	51	1311	6	Oil/Gas	UNOCAL UPGRADE		177	0	0	0
NM	35	015	0024	65	1311	6	Oil/Gas	AGAVE ENERGY/YATES PLANT		962	962	962	2,983
NM	35	015	0002	65	1311	6	Oil/Gas	ARCO PERMIAN/EMPIRE ABO GAS PLNT		700	565	565	565
NM	35	015	0006	65	1311	6	Oil/Gas	GPM GAS/INDIAN HILLS AMINE PLNT		900	450	450	900
NM	35	025	0046	65	1311	6	Oil/Gas	GPM GAS/LEE GAS PLANT		818	0	818	818
NM	35	025	0007	65	1311	6	Oil/Gas	J.L. DAVIS GAS PROCESS/DENTON		385	890	891	1,158
NM	35	025	0052	65	1311	6	Oil/Gas	TEXACO/EUNICE NORTH GAS PLANT		673	1,076	1,346	673
NM	35	025	0051	65	1311	6	Oil/Gas	TEXACO/EUNICE SOUTH GAS PLANT		4,019	4,386	3,355	5,476
NM	35	015	0003	65	1311	6	Oil/Gas	TRANSWESTERN PIPE	DUKE ENERGY/HUBER GAS	221	231	231	231
NM	35	041	0001	63	1311	6	Oil/Gas	WARREN PETROLEUM/BLUITT GAS PLANT		270	3,348	582	270
NM	35	025	0061	65	1311	6	Oil/Gas	WARREN PETROLEUM/MONUMENT PLANT	MONUMENT PLANT	1,460	1,709	1,432	1,432
NM	35	045	0247	60	1311	6	Oil/Gas	WESTERN GAS PROCESSORS/SAN JUAN RVR		5,475	980	980	3,138
NM	35	025	0128	65	1311	6	Oil/Gas	CITATION/ANTELOPE RDG GAS PLANT		291	0	NA	
NM	35	025	0118	65	1311	6	Oil/Gas	CONOCO/BELL LAKE 2 WELL #6		129	0	NA	
NM	35	015	0125	65	1311	6	Oil/Gas	FEAGAN ENERGY/W DAGGER DRAW GAS PLT		240	0	NA	
NM	35	005	0050	65	1311	6	Oil/Gas	YATES PETROLEUM/PATHFINDER AMINE		227	57	57	

Table VII-3 (continued)

State	State ID	County ID	Facility ID	IAS Region	SIC	MTF Sector	Sector Description	Facility Name (1990)	Current Facility Name (if different from 1990)	SO_2 tpy 1990	SO_2 tpy 1996	SO_2 tpy 1998	SO_2 tpy 2000
UT	49	037		35	1311	6	Oil/Gas	UNOCAL CORPORATION	TOM BROWN - LISBON PLANT	1,575	1,391	1,478	1,252
WY	56	029	0012	9	1311	6	Oil/Gas	AMOCO - ELK BASIN	HOWELL PETROLEUM - ELK BASIN	1,096	1,218	1,422	2,638
WY	56	041	0012	9	1311	6	Oil/Gas	AMOCO - WHITNEY CANYON		6,401	5,835	11,130	6,889
WY	56	041	0009	9	1311	6	Oil/Gas	CHEVRON - CARTER CREEK		1,537	1,165	3,330	2,096
WY	56	023	0013	8	1311	6	Oil/Gas	EXXON - SHUTE CREEK		1,078	1,999	2,015	1,383
WY	56				1311	6	Oil/Gas	EXXON BLACK CANYON DEHY & WELL FIELD					167
WY	56	017		9	1311	6	Oil/Gas	KCS MOUNTAIN RESOURCES - GOLDEN EAGLE			558	942	17
WY	56	003		9	1311	6	Oil/Gas	KCS MOUNTAIN RESOURCES - AINSWORTH			807	845	0
WY	56	029	0007	9	1311	6	Oil/Gas	MARATHON GAS PLANT - OREGON BASIN		406	456	388	358
WY	56	017		9	1311	6	Oil/Gas	MARATHON OIL - MILL IRON			234	260	0
WY	56	003	0012	9	1311	6	Oil/Gas	TEXAS-BYRON PLANT	BIG HORN GAS PROCESSING - BYRON	192	169	605	257
WY	56	037	0008	9	1311	6	Oil/Gas	UNION PAC - BRADY	RME PETROLEUM - BRADY	415	331	576	300
WY	56	013	008	9	1311	6	Oil/Gas	DEVON SFS OPERATING CO.	BEAVER CREEK				831
WY	56	037	0014	9	1311	6	Oil/Gas	COLORADO INTERSTATE GAS - TABLE ROCK		522	20	39	
WY	56	003	0013	9	1311	6	Oil/Gas	MARATHON OIL COMPANY - GARLAND		257	7	10	
WY	56	013		9	1311	6	Oil/Gas	LOUISIANA LAND & EXPLOR - LOST CABIN	BURLINGTON RESOURCES-LOST CABIN		4,547	1,336	1,700
										36,111	**34,735**	**38,346**	**37,749**

CHAPTER VIII
ELEMENTAL PHOSPHORUS PRODUCTION

A. SECTOR DESCRIPTION AND SIGNIFICANT SO_2 SOURCES

P4 Production has an elemental phosphorus facility near Soda Springs, Idaho. This is one of the two elemental phosphorus production facilities in the United States. Year 2000 SO_2 emissions from this facility are estimated to be 15,861 tpy. This reflects increased utilization compared with 1996 and 1998 operations. This facility has no SO_2 emissions limit in its operating permit. The Idaho Department of Environmental Quality is currently evaluating this facility's SO_2 emissions situation. For the purposes of this report, the floor allocation for P4 Production is set at its year 2000 SO_2 emissions level of 15,861 tons. It is expected that the State of Idaho will perform a more detailed evaluation of this facility during preparation of its regional haze State Implementation Plan (SIP).

B. FLOOR ALLOCATION ESTIMATION PROCEDURES

Recent historical emissions for P4 Production are listed below in Table VIII-1.

Table VIII-1
Elemental Phosphorus Production - Historical Emissions - 1990 to 2000

State	State ID	County ID	Facility ID	IAS Region	SIC	MTF Sector	Sector Description	Facility Name (1990)	Current Facility Name (if different from 1990)	SO_2 tpy 1990	SO_2 tpy 1996	SO_2 tpy 1998	SO_2 tpy 2000
ID	16	029	0001	7	2819	5	Chemicals/Plastics	MONSANTO/P4 PRODUCTION	P4 PRODUCTION	7,543	7,988	7,601	15,861

CHAPTER IX
GLASS MANUFACTURING

A. SECTOR DESCRIPTION AND SIGNIFICANT SO_2 SOURCES

The air emissions from glass manufacturing are in three zones: (1) raw material blending and transport, (2) melting, and (3) forming and finishing. The majority of air emissions are in the melting furnace operation.

Melting for container and flat glass is generally conducted in a continuous reverbatory furnace fired by natural gas or oil. Electric boost furnaces have been introduced in some operations to minimize flue gas emissions.

The major source of SO_2 emissions in the glass industry is the glass melting operation. Forming and annealing operations are minor sources. Furnace emissions appear to be attributable to both the manufacturing process and the fuel burned. Fuel-derived SO_2 emissions are lower from natural gas-fired furnaces than from oil-fired furnaces, unless the oil has been desulfurized. Flue gases from furnaces burning natural gas have been reported to contain 2 parts per million (ppm) SO_2, or less. About 600 ppm SO_2 can be expected in flue gas from a furnace burning fuel oil containing one percent sulfur. Greater use of electric furnaces or electric boosting may decrease SO_2 emissions.

Process modifications that may reduce SO_2 emissions include altering the raw material charge to reduce the sulfur content or to increase the fraction of recycled glass, changing the furnace controls or equipment, and altering the pull rate. Process modifications that reduce the salt cake content in the raw batch can significantly reduce SO_2 emissions. For example, one California flat-glass plant reportedly reduced furnace emissions of SO_2 by 78 percent from 2.1 to 0.5 kilograms per megagram (kg/Mg) (5.0 to 1.1 lbs/ton) by reducing the salt cake in the raw batch 60 percent (from 12 to 5 kg/Mg, 30 to 12 lbs/ton of sand). Similarly, another California flat-glass plant has reportedly reduced its SO_2 emissions 75 percent (from 1.6 to less than 0.4 kg/Mg, 4 to less than 1 lbs/ton of batch constituents) by reducing the input of salt cake. Glass quality was not compromised in either case. The salt cake cannot be reduced below certain minimums without effecting glass quality. The minimum salt cake required varies depending upon furnace type, pull rate, glass type, and other variables.

Fuel changes have also been shown to reduce SO_2 emissions. These include switching to natural gas or low-sulfur fuel oil, switching to all-electric melting, and using electric boosting for melting. Electric melters significantly reduce SO_2, NO_x, and particulate emissions because they eliminate the combustion of fossil fuels. Electric melting also is reported to minimize SO_2 and other gaseous losses from the vaporization of raw materials because the surface of the melt is insulated by a semisolid crust. Gases discharged through the crust of the melt consist mainly of carbon dioxide and water. Today, borosilicate, opal, and green glass are produced with electric furnaces. The capacities of such furnaces are about 100 to 110 Mg/day (110 to 120 tons/day). Electric melters have not been demonstrated for larger operations, such as large container furnaces, the nominal capacities of which are about 220 Mg/day (240 tons/day), and flat-glass furnaces, which range from about 600 to 800 Mg/day (660 to 880 tons/day).

Several emission control systems that are available to the glass industry for particulate control are also capable of achieving various levels of secondary SO_2 control. For example, a venturi scrubber system can control SO_2 emissions from commercial glass plants. The system includes a packed tower where part of the sulfate particulates are removed from the hot furnace flue gases, a dual-throat venture scrubber, where SO_2 and additional particulates are removed by alkaline washing, and a cyclone for final particulate collection. Currently, only the container glass segment of the glass industry is reported to use scrubber systems for emission control.

Injecting a sorbent such as alumina, limestone, or nepheline syenite into a fabric filter system can effectively remove SO_2 from furnace flue gases. The spent sorbent may be landfilled or possibly recycled.

One patented system of dry removal involves the combined use of hydrated lime and nepheline syenite for acid gas neutralization and fine particle agglomeration. In this system, hot furnace flue gas is first mixed with quench water, hydrated lime for primary SO_2 removal, and secondary air to cool the gas stream to a temperature range of 94° to 427°C (200° to 800°F). Next, nepheline syenite is added to the gas stream to capture residual SO_2 and submicrometer particulates. The gas stream enters the fabric filter where the solid product is removed for either recycling to the furnace or landfilling.

Dry sorbent systems at several commercial glass furnaces reduced SO_2 by 80 to 95 percent at a container glass furnace, 50 to 90 percent at a fiberglass furnace, and 88 to 98 percent at a flat-glass furnace.

Mist eliminators apparently have no effect on SO_x gases. One sampling test indicated no decrease in SO_2 and SO_3 concentrations through the control device (EPA, 1981).

B. FLOOR ALLOCATION ESTIMATION METHODS

It is expected that the floor allocation for glass manufacturing plants will be set according to recent historical SO_2 emissions from these facilities. These SO_2 emissions are listed in Table IX-1.

REFERENCES

AWMA, 2000: Air and Waste Management Association, "Air Pollution Engineering Manual," 2nd edition, Chapter 15 - Mineral Products Industry, 2000.

EPA, 1981: U.S. Environmental Protection Agency, "Control Techniques for Sulfur Oxide Emissions from Stationary Sources," Second Edition, EPA-450/3-81-004, Office of Air Quality Planning and Standards, Research Triangle Park, NC, April 1981.

Table IX-1
Glass Manufacturing - Historical Emissions - 1990 to 2000

State	State ID	County ID	Facility ID	IAS Region	SIC	MTF Sector	Sector Description	Facility Name (1990)	Current Facility Name (if different from 1990)	SO_2 tpy 1990	SO_2 tpy 1996	SO_2 tpy 1998	SO_2 tpy 2000	Floor Allocation
CA	6	037	106797	14	3221	8	Glass	BALL-FOSTER GLASS CONTAINER CO	SAINT-GOBAIN CONTAINER	<100	<100	166	174	
CA	6	099	1662	11	3221	8	Glass	GALLO GLASS CO		61	271	269	440	
CA	6	039	801	12	3221	8	Glass	MADERA GLASS COMPANY		108	170	190	104	
CA	6	077	593	11	3221	8	Glass	OWENS ILLINOIS	OWENS-BROCKWAY GLASS CONTAINER	319	285	218	248	
CA	6	037	7427	14	3221	8	Glass	OWENS-BROCKWAY GLASS CONTAINER - VERNON		193	323	280	435	
CA	6	001	2086	11	3221	8	Glass	ANCHOR GLASS CONTAINER CORPORA		119	0	0		
CA	6	001	30	11	3221	8	Glass	OWENS-BROCKWAY GLASS CONTAINER - OAKLAND		122	128	64	57	
CO	8	059	0008	53	3221	8	Glass	COORS GLASS	ROCKY MOUNTAIN BOTTLE	159	221	234	255	237
OR	41	051	1876	5	3221	8	Glass	Owens-Brockway Glass Container, Inc.		103	169	116	108	131
										1,284	**1,667**	**1,537**	**1,821**	

CHAPTER X
COPPER SMELTERS

A. SECTOR DESCRIPTION AND SIGNIFICANT SO_2 SOURCES

Primary copper smelters in the WRAP States process copper sulfide ore concentrate to produce anode copper. There are six primary copper smelters in the WRAP region. Five of the primary copper smelters are near the copper mines in the southwest United States. These smelters use a batch copper converting process (either Pierce-Smith or Hoboken converter designs) to produce blister copper. Currently, only two of these smelters are producing copper (the ASARCO smelter in Hayden, Arizona and the Phelps Dodge smelter in Miami, Arizona). The other three smelters have suspended operations and are not producing copper at this time.

The sixth primary copper smelter in the WRAP States is the Kennecott Utah Copper Corporation near Garfield, Utah. The Kennecott smelter was built during the mid-1990s (replacing the existing smelter at the site) and uses a flash copper converting technology. This technology allows blister copper to be produced in a continuous process.

All primary copper smelters in the region control SO_2 emissions by routing the process off-gases from the smelting and converting processes to double contact sulfuric acid plants.

B. FLOOR ALLOCATION ESTIMATION METHODS

Because of the uniqueness of the existing copper smelters, retrofit technology analysis must be performed on a smelter-by-smelter basis. Currently, the Hidalgo smelter is the only BART-eligible source in this category. A double contact acid plant is considered the appropriate retrofit control equipment (all smelters in the western States are currently equipped with double contact acid plants). On August 21, 2000, New Mexico completed an engineering analysis that verified earlier determinations by the MTF that the fugitive SO_2 capture system at Hidalgo satisfies BART at 96 percent overall SO_2 capture.

The Annex to the Grand Canyon Visibility Transport Commission's (GCVTC) recommendations defines stepped reduction milestones through 2018 for SO_2 emissions from large industrial sources in the 9-State Commission Transport Region. The current year SO_2 allocation for the six copper smelters in the 9-State region is 86,000 tons. This allocation is reduced to 78,000 tons by 2013 and is the same in 2018. For the recent Emission Forecasts to 2018 analysis, the plant-level difference SO_2 emissions difference between 86,000 tons and 78,000 tons was simulated by subtracting 2,000 tons each from the four largest smelters, which are ASARCO-Hayden, BHP-San Manuel, Phelps-Dodge Chino Mines, and Phelps Dodge-Hidalgo. The resulting allocations of 2018 SO_2 emissions by facility are shown in Table X-1. Note that the 78,000 tons of SO_2 allocation for copper smelters is an aggregate value for the region, rather than a requirement for each smelter to reduce emissions to prescribed levels. Table X-1 illustrates one way that this regional allocation might be met. Many other examples are provided in the EPA regional haze rule.

Table X-1
Copper Smelter SO_2 Emission Projections (tpy)

State	Facility Name	2018
AZ	ASARCO Smelter-Hayden	21,000
AZ	BHP-San Manuel	14,000
AZ	Cyprus Miami Mine	8,000
NM	Phelps Dodge-Chino Mines	14,000
NM	Phelps Dodge-Hidalgo Smelter	20,000
UT	Kennecott Utah Copper Corp.	1,000
	Total Copper Smelter	78,000

C. COMPARISON WITH HISTORICAL EMISSIONS

Table X-1 SO_2 emission estimates can be compared with recent historical (1990 to 2000) emissions for those smelters shown in Table X-2.

Table X-2
Recent Historical Copper Smelter SO_2 Emissions

State	State ID	County ID	Facility ID	IAS Region	SIC	MTF Sector	Sector Description	Facility Name (1990)	Current Facility Name (if different from 1990)	SO_2 tpy 1990	SO_2 tpy 1996	SO_2 tpy 1998	SO_2 tpy 2000
Smelter Sector													
AZ	4	007	0004	45	3331	2	Copper	ASARCO SMELTER - HAYDEN		29,814	33,124	22,077	16,753
AZ	4	021	0032	46	3331	2	Copper	BHP(Magma Metals)	BHP - San Manuel	15,900	16,678	10,409	0
AZ	4	007	0006	45	3331	2	Copper	CYPRUS MIAMI MINE		5,676	5,737	6,097	6,810
AZ	4	019	0040	46	1021	2	Copper	Cyprus Sierrita		800	548	<100	<100
NM	35	017	0001	64	3331	2	Copper	PHELPS DODGE/CHINO MINES		28,058	14,784	15,685	11,420
NM	35	023	0003	64	3331	2	Copper	PHELPS DODGE/HIDALGO SMELTER		41,433	32,121	29,188	0
UT	49	035	0030	32	3331	2	Copper	Kennecott Utah Copper Corp.		26,829	1,556	762	937
										148,510	**104,549**	**84,218**	**35,920**

CHAPTER XI
ALUMINUM PRODUCTION

A. SECTOR DESCRIPTION AND SIGNIFICANT SO_2 SOURCES

Primary aluminum production plants in the United States produce aluminum metal by electrolytically reducing alumina that have been refined from bauxite ore. There are 23 primary aluminum plants in the United States. There are only 2 plants in the study region and both are located in Oregon.

Aluminum production is carried out in a semibatch manner in large electrolytic cells called pots with a direct current input of up to 280,000 amperes at about 5 volts. The pot, a rectangular steel shell ranging in size from 30-50 feet long, 9-12 feet wide, and 3-4 feet high, is lined with a refractory insulating shell on which carbon blocks are placed to form the cathode.

An aluminum pot will typically emit 20-35 kg per metric ton of gaseous and particulate fluoride and roughly an equal amount of particulate matter. The NSPS limits emissions to no more than 1 kg fluoride/Mg (2.0 lbs/ton) of aluminum produced for potroom groups at Soderberg plants, 0.95 kg/Mg (1.9 lbs/ton) of aluminum produced at pre-bake plants, and 0.05 kg/Mg (0.1 lbs/ton) of aluminum equivalent for anode bake plants.

The reduction cells in use for aluminum production in the United States are of two basic types – prebake and Soderberg. There are two types of Soderberg cells that are designated according to the manner of mounting the stud in the carbon anode: vertical stud Soderberg (VSS) or horizontal stud Soderberg (HSS).

Prebake cells are so named because the anodes are preformed and then baked in a separate facility often referred to as an anode bake plant. The anodes are then mounted in the cell and are consumed in the aluminum production. The anode butts, which remain after the anode is consumed, are recycled for use in the preparation of new anodes.

In the Soderberg process, continuously formed, consumable anodes are used. The anode paste is baked by the heat generated in the reduction cell.

The primary source of sulfur oxide emissions in aluminum production is the sulfur in the coke (normally petroleum coke) and the coal tar pitch binder used to produce the anodes. In the prebake process, the combustion fuel to bake the anodes may be a significant SO_2 emission source. Petroleum coke usually contains 2.5 to 5 percent sulfur, but may vary from 1.5 to 7 percent sulfur. Pitch normally contains about 0.5 percent sulfur. The sulfur content of the coke depends on the crude petroleum stock and the tendency of the sulfur to concentrate in the still bottoms at the refinery and thus in the coke.

As the coke is processed (during prebake) or consumed in the reduction cell, sulfur oxides are released. The emissions include those from the anode prebake operation (prebake), the “primary” emissions (which are captured by the pot hood exhaust system), and the “secondary” emissions (which escape the primary exhaust system and exit through the roof monitors). The great majority of SO_2 emissions are collected by the pot hood exhaust system.

One source reports uncontrolled SO_2 emissions from anode bake plants range from 5 to 47 ppm, which is 0.7 to 2 kg SO_2/Mg aluminum produced (1.4 to 4 lbs SO_2/ton aluminum produced). Other data indicate that emissions are in the range of 0.09 to 1.7 kg SO_2/Mg aluminum produced (0.18 to 3.4 lbs SO_2/ton aluminum produced).

The total amount of SO_2 generated per unit of aluminum produced is essentially the same for the prebake, VSS, and HSS cases. The "primary" cell hooding configuration for collection of process fumes is affected by the characteristics of the different cell types. There are two types of prebake cells, center-worked prebake cells (CWPB) and side-worked prebake cells (SWPB), as well as the two Soderberg processes, VSS and HSS, which are in use by the domestic aluminum industry. Information from seven primary aluminum plants indicates the following:

Cell Type	Primary Hood Collection Efficiency, %	Primary Collector Exhaust Rate (10^6 square cubic feet per ton of aluminum)
CWPB	65 to 98	(4.11 to 5.05)
SWPB	85	(3.44)
VSS	81	(0.67)
HSS	80 to 95	(5.06 to 7.85)

This information indicates that the gas volume associated with the production of a fixed amount of aluminum is in the range of 5 to 12 times (average 8 times) greater for CWPB, SWPB, or HSS than for VSS. Consequently, the concentration of SO_2 in a volume of exhaust gas in the primary collector system can be expected to be about 8 times greater for a VSS unit than for other units.

Reported data on uncontrolled "primary" exhaust system SO_2 emissions are as follows:

Unit	Source	SO_2 Concentration, ppm	Total SO_2 emissions, kg SO_2/Mg Aluminum (lbs SO_2/ton aluminum)
Prebake Cell	A	5	Not reported
	B	Not reported	20.9 to 23.4 (41.7 to 46.8) [average of 22.4 (44.8)]
	C	Not reported	30 (60) [3% sulfur in the coke]
VSS Cell	A	80	Not reported
	B	200 to 300	17.5 to 25 (35 to 50)
	C	200 (average)	Not reported

The trend in construction of new aluminum plants is toward prebake systems. A major factor influencing this trend is the lower power requirement of the prebake cell compared with Soderberg cells. It is reported that 9 of the 11 aluminum plants opened since 1960 are of the prebake type, and 99 percent of the 324 Gigagrams (357,000 tons) capacity added since 1973 has been at prebake facilities. Of the 23 primary aluminum production plants in the United States, 18 use the prebake process and 5 use the Soderberg process.

B. FLOOR ALLOCATION ESTIMATION METHODS

There are two aluminum smelters located within the study region, and they are both located in Oregon. The data provided by the Oregon Department of Environmental Quality on the unit capacities and SO_2 emissions potential for these two smelters is provided in Table XI-1. This table shows that the SO_2 emissions potential for Reynolds Metal, if operated at its design capacity, is 4,700 tpy. This is the same as their permitted SO_2 emission limit. For NW Aluminum, the SO_2 emissions potential is 518 tpy.

The NSPS for primary aluminum plants limits fluoride emissions, but does not affect SO_2 emissions. Washington is the only State that has established an SO_2 emission limit specifically for primary aluminum plants. The rule limits the maximum allowable total SO_2 emissions from all sources within the plant to 60 lbs per ton of aluminum produced on a monthly basis. Based on the SO_2 emission rates by process for Reynolds Metal, which is 65.3 lbs SO_2 per ton of aluminum produced, applying the State of Washington rule would only provide an 8 percent reduction in SO_2 emissions.

Comparing the capacity-based SO_2 emission estimates in Table XI-1 with recent historical emissions (see Table XI-2) shows that recent historic SO_2 emissions from Reynolds Metals are considerably below their capacity/permitted emission limit, and that they vary considerably from year-to-year. NW Aluminum SO_2 emissions in the period 1996 to 2000 average about 80 percent of total capacity.

The floor control technology for aluminum smelters was determined by evaluating the emissions performance of Reynolds Metals and NW Aluminum. NW Aluminum uses a wet scrubber to achieve a 70 percent SO_2 emission reduction. Therefore, a wet scrubber with a 70 percent SO_2 reduction was selected as the floor technology for aluminum smelters. The effect of this floor technology application is shown in the rightmost column of Table XI-1.

REFERENCES

CFR, 2001: Code of Federal Regulations, "Subpart S - Standards of Performance for Primary Aluminum Plants (60.190-60.195)," July 1, 2001.

EPA, 1981: U.S. Environmental Protection Agency, "Control Techniques for Sulfur Oxide Emissions from Stationary Sources," Second Edition, EPA-450/3-81-004, Office of Air Quality Planning and Standards, Research Triangle Park, NC, April 1981.

Table XI-1
Aluminum Plant Data Used to Estimate Floor Allocations

Company	Emissions Unit	Fuel Type	Actual Capacity	Capacity Units	Control Device	SO_2 Emission Factors (lbs/ton)	SO_2 Control Efficiency	SO_2 Emissions Actual Capacity (tons/yr)	Floor Allocation at 70% Control (tons/yr)
Reynolds Metals	Carbon bakes	Natural gas				0.18-.19		27	27
	Potroom fugitives	N/A			N/A	2.5	N/A	177	177
	Potroom emissions	N/A			N/A	62.5	N/A	4,488	1,346.4
	Backup fuel	#2 fuel oil				0.105		7.5	7.5
	Plant total							4,700	1,557.9
NW Aluminum	Cell line	N/A	97,500	TAP/yr	Wet scrubber		0.7	517	517
	Cell line	Propane	144,000	gallons/yr	No		N/A	<0.1	<0.1
	Casthouse furnace	Natural gas	80,000,000	cubic feet/yr	No		N/A	1	1
	Plant total							<518	518
Total								**5,218**	**2,076**

NOTES: Control Device: While there are no physical control devices, the most effective form of SO_2 control is limiting the amount of sulfur in fuel oil. For example, the sulfur content in distillate fuel oil sold in NW usually averages much less than 0.1, whereas the rule limit is 0.5. Actual Capacity Emission is limited by the SO_2 PSEL. SO_2 emission factors are in lbs per ton of aluminum produced.

Table XI-2
Aluminum Smelting - Historical Emissions - 1990 to 2000

State	State ID	County ID	Facility ID	IAS Region	SIC	MTF Sector	Sector Description	Facility Name (1990)	Current Facility Name (if different from 1990)	SO_2 tpy 1990	SO_2 tpy 1996	SO_2 tpy 1998	SO_2 tpy 2000
100 tpy or More SO_2													
OR	41	065	0001	5	3334	10	Metals/Mining/Minerals	Northwest Aluminum Company, Inc.		423	448	375	397
OR	41	051	1851	5	3334	10	Metals/Mining/Minerals	Reynolds Metals Company		3,340	0	503	1,510
										3,763	**448**	**878**	**1,907**

CHAPTER XII
SULFURIC ACID PLANTS

Sulfuric acid is the most widely used industrial chemical. The chief uses of sulfuric acid are in production of fertilizer, manufacture of chemicals, oil refining, pigment production, iron and steel processing, synthetic fiber production, and metallurgical operations. The predominant process used for the production of sulfuric acid is the contact process. The entire discussion in this chapter focuses on the contact process.

Sulfuric acid is produced by burning sulfur or sulfur-bearing materials to form SO_2. Sources of SO_2 include: (1) elemental sulfur; (2) spent acid; (3) smelter off-gas; (4) pyrites; and (5) waste gas from fossil-fuel-fired boilers.

A. SECTOR DESCRIPTION AND SIGNIFICANT SO_2 SOURCES

Contact sulfuric acid plants are classified as hot gas (sulfur burning) or cold gas (metallurgical and spent acid) systems. Plants operating on elemental sulfur receive hot SO_2 gas directly from the sulfur burner and waste heat recovery system. When SO_2 gas from a metallurgical operation or other byproduct source (such as spent acid or iron pyrites) is used, it is received cold from the wet scrubber-cooler and purification systems.

A basic variation of the contact process is the double absorption technique, also known as double catalysis. This design is largely based on the need to meet air pollution control regulations.

The only significant source of air emissions from a contact sulfuric acid plant is the tail gas leaving the final absorbing tower. This gas contains small amounts of SO_2 and even smaller amounts of SO_3, sulfuric vapor, and sulfuric acid mist.

SO_2 emissions are determined primarily by overall plant design (e.g., number of catalyst passes, amount of catalyst, dual or single absorption, etc.). New plants are usually designed to meet NSPS emission limits using the dual absorption process. In certain situations, plants can achieve better than NSPS limits using the dual absorption process. For example, in a metallurgical acid plant, lower SO_2 emissions can sometimes be achieved catalytically if the process gas from a smelter has a sufficiently high oxygen-to-SO_2 ratio. Proper catalyst volumes and interpass cooling can be incorporated into the initial design, however. Existing plants that are required to reduce their SO_2 emissions usually choose to convert to dual absorption or install a tail gas scrubber.

Dual absorption has been generally accepted as BACT. Conceptually, dual absorption is the addition of another converter and absorbing tower on the tail end of a single absorption plant (with appropriate heating and cooling of the gas stream) so there is no new technology involved. Only sulfuric acid is produced in the dual absorption equipment.

Various scrubbing, or tail gas, technologies are available for removing SO_2 from gas streams. Tail gas treatment is rarely used to achieve NSPS limits for new plants. A tail gas process at the end of a dual absorption plant may be the preferred technology where local regulations require substantially lower than NSPS emission rates.

Tail gas processes that produce a by-product that can be recycled to the acid plant (e.g., weak sulfuric acid) are of special interest because they eliminate the need for off-site by-product disposal. Two such processes are hydrogen peroxide scrubbing and SO_2 oxidation with activated carbon.

B. FLOOR ALLOCATION ESTIMATION METHODS

Based on the information available for sulfuric acid plants in the west, it was determined that it is appropriate to estimate the floor allocation by applying the NSPS requirements to each sulfuric acid plant.

Subpart H - Standards of Performance for Sulfuric Acid Plants

60.82 Standard for Sulfur Dioxide

On or after the date on which the performance test required to be conducted by Sec. 60.8 is completed, no owner or operator subject to the provisions of this subpart shall cause to be discharged into the atmosphere from any affected facility any gases which contain SO_2 in excess of 4 lbs per ton of acid produced. Achieving this standard requires a conversion efficiency of 99.7 percent in an uncontrolled plant, or the equivalent SO_2 collection mechanism in a controlled facility.

Table XII-1 lists the sulfuric acid plants, their characteristics, and the estimated annual SO_2 floor allocations. An initial SO_2 floor allocation was estimated by multiplying the daily throughput limit by the NSPS emission rate (4 lbs SO_2 per ton 100 percent acid produced), times 365 days per year, converted from lbs to tons by dividing by 2000. In equation form, this is:

$$\text{Daily throughput}\left(\frac{tons}{day}\right) * \frac{4\ lbs}{ton} * \frac{365\ days}{year} * \frac{1\ ton}{2000\ lbs}$$

This based on throughput initial floor allocation was found to exceed the annual SO_2 permit limits for each of these units. Therefore, the estimated floor allocations for these sulfuric acid plants was established using recent historic SO_2 emissions data. These historic emission values are all slightly below the annual SO_2 permit limits.

REFERENCES

AWMA, 2000: Air and Waste Management Association, "Air Pollution Engineering Manual," 2nd edition, Chapter 12 - Chemical Process Industry, 2000.

CFR, 2001: Code of Federal Regulations, Subpart H - Standards of Performance for Sulfuric Acid Plants (60.82), July 1, 2001.

Idaho DEQ, 2002a: State of Idaho, Department of Environmental Quality, Air Quality Tier 1 Operating Permit, J.R. Simplot Co. - Don Siding Plant, 2002.

Idaho DEQ, 2002b: State of Idaho, Department of Environmental Quality, Air Quality Tier 1 Operating Permit, Nu-West Industries, Inc.; Agrium Conda Phosphate Operations, 2002.

Table XII-1
Sulfuric Acid Plants

State	Facility Name	Start Date	Sulfuric Acid Plant ID	Process	Control Technique	Annual SO_2 Permit Limit (tons)	Daily Throughput Limit (tons)	Based on Throughput SO_2 Floor Allocation (tpy)	Floor Allocation Using Historic Emissions Average (tpy)
Idaho	Nu-West Industries		East	NA	NA	945	1,550	1,131	612
Idaho	JR Simplot		300	Single contact	2 stage scrubber system	750	1,750	1,277	1,939
			400	Double contact	Double contact with mist eliminator	1,458	NA	1,458	
Wyoming	SF Phosphates, Inc.	1995	Source 9b	MEC		963.6	1,320	964	1,638
		1984	Source 9a	Lurgi		1,387	1,900	1,387	
Wyoming	Koch Sulfur Products		EU-1		NA	719	NA	719	1,197
			EU-5		NA	721	NA	721	

NA = not available.

CHAPTER XIII
METALLURGIC COKE PRODUCTION

A. SECTOR DESCRIPTION AND SIGNIFICANT SO_2 SOURCES

Metallurgical coke is derived from coal and used in iron and steel industry processes. Coke is manufactured by pyrolysis, the heating of coal in the absence of air. In this process, high grade, bituminous coal is heated in a enclosed chamber to approximately 1050°C (1925°F), which removes all volatile components of the coal. The resulting product is a solid material consisting of elemental carbon and any minerals that were not volatilized in the heating process.

1. By Product Coke Ovens

In a typical coking operation, 35 to 100 coke ovens are located in a row referred to as the oven battery. Each oven has three main parts: coking chambers, heating chambers, and regenerative chambers. The coking chamber has ports in the top for charging (loading) of the coal. A typical U.S. coke oven produces 7.5 tons to 39 tons of coke per cycle. Most coke plants are co-located with iron and steel production facilities.

All ovens currently operating in the United States are by-product recovery ovens. These ovens operate by reusing gases (volatiles) emitted by the hot coal. In by-product recovery ovens, the volatiles from the coal are collected and sent to a by-product recovery plant. The off gas is condensed and separated into a liquid fraction (coal tar) and a gaseous fraction (coal gas). The coal gas contains a number of contaminants including hydrogen sulfide. Some by-product recovery processes remove the sulfur from the gas prior to combustion. Approximately 33 percent to 40 percent of the clean coal gas is then returned to the oven battery to be used as fuel. The remaining coal gas can be used as fuel for other processes at the plant or sold to other facilities.

Emissions of SO_2 from coke ovens operations primarily result from combustion of the byproduct coal gas in the oven. A small portion of SO_2 emissions comes from uncontrolled "charging", the process of loading coal into the oven. Control of SO_2 from combustion of coal gas is primarily accomplished by; (a) removing the sulfur from the gas prior to combustion or (b) utilizing low sulfur coal in the coking process. There are a number of methods for removing sulfur from the coal gas, such as wet scrubbing.

2. Rotary Calciners

There is only one known rotary calciner used for coke production in the United States, P4 Production in Rock Springs, WY. It uses a Salem Brosius, 65 foot diameter, continuous feed rotary hearth calciner. Basically, the process involves feeding a mixture of coal and petroleum (pet) coke onto a rotating table located inside a furnace. The coal is heated to a high temperature as it rotates to produce coke. The coke exits the hearth and enters a cooling chamber. Like byproduct recovery ovens, the furnace operates by reusing the volatile gases emitted from the coal. However, in this process, the furnace is initially started with natural gas. Once started, the coal gas being emitted during the coking process is utilized as fuel directly. The waste gas is then ducted to an incinerator. Byproducts of the process include fine coke, ash, CO_2, SO_2, and rock.

Emissions of $SO_2$from a rotary hearth calciner are primarily due to the volatiles from the heated coal. The waste gas is ducted to an incinerator and baghouse prior to being emitted to the atmosphere. There is no desulfurization of the waste gas. The amount of SO_2 emitted from the facility is a function of the properties of the feed coal.

B. FLOOR ALLOCATION ESTIMATION METHODS

The analysis was limited to facilities which emit greater than 100 tpy of SO_2 in total. There are three facilities which have been identified. Two are coking plants, Astaris Coking Plant in Wyoming and Geneva Steel in Utah. There is one rotary calciner in Wyoming, P4 Production, Rock Springs Coal Calcining Plant. The air pollution agencies for Wyoming and Utah provided information on the coking and calcining facilities for estimating floor allocations.

Astaris Coking Plant was shut down in April of 2001. Therefore, this facility does not receive an SO_2 allocation.

Geneva Steel has committed to ceasing all SO_2 emissions from the coke ovens and the sinter plant. These emissions have been banked for future use or trading as precursor pollutants within the current local Utah County PM_{10} SIP. The Utah Air Quality Board approved this change on June 5, 2002. Since the SO_2 emissions for coking and sintering at the plant are now essentially zero, the SO_2 floor allocation for coking is also zero.

The third facility is P4 Production, Rock Springs Coal Calcining Plant. The plant is designed to process 220,000 tpy of feed materials to produce 110,000 tpy of coke product. The plant operates for up to 8,000 hours per year. This works out to a design process rate of 27.5 tons per hour (tph) or 660 tons per day (tpd) of feed. According to the operating permit, the total facility potential to emit is 2,841.1 tpy of SO_2 based on 8,760 operating hours. There are no NSPS requirements the facility must comply with for SO_2. This rotary coker was built in 1972 and thus is "grandfathered" from the Wyoming Air Quality Division's permit requirements. The historical emissions for this facility are presented in Table XIII-1.

Table XIII-1
Historical SO_2 Emissions at P4 Production, Rock Springs, WY

Historical Emissions of SO_2 (tpy)					Average Annual SO_2 Emissions (tpy)
1990	**1996**	**1997**	**1998**	**2000**	**1996 - 2000**
933	663	586	642	633	631

As stated previously, the SO_2 emitted is a function of the feed coal. The plant uses a blend of coal and petroleum coke (pet coke). The 1994 annual inventory showed that the pet coke blend was 7.2 percent for the year, with SO_2 emissions of 420.0 tpy; up 15 percent from the 365.6 tpy emitted in 1993, when straight coal was used as 100 percent of the feedstock. The most recent year's data shows that the pet coke blend was 25 percent for 1998, the maximum allowable amount to maintain compliance with the SO_2 emissions limit.

The procedure for estimating the floor allocation for P4 Productions is difficult for several reasons. First, there are no identified control technologies available for the rotary calciner. Second, there are no NSPS requirements. Third, P4 Production has a potential to emit 2,841.1 tpy based on 8,760 hours of operation. This is much higher than the annual emissions reported by the plant. Lastly, the SO_2 emissions from the rotary calciner are a function of the sulfur content of the feed which varies over time. Since the coking process at P4 Production is unique and cannot be compared with emissions from other facilities, the SO_2 allocations for P4 Productions will be based on its average annual emissions. This is consistent with the allocation approach developed for source categories with no technology available for reducing sulfur and variable sulfur content in the feed such as flaring.

The allocation for P4 Production will be based on emissions of SO_2 from years 1996, 1997, 1998 and 2000. Averaging historical emissions results in a floor allocation of 631 tpy of SO_2 for the P4 Production facility. As stated previously, the SO_2 floor allocations for Astaris and Geneva Steel are zero.

C. COMPARISON WITH HISTORICAL EMISSIONS

Table XIII-2 presents the historical SO_2 emissions and the SO_2 floor allocations for all three coking facilities. Note that Geneva Steel has an SO_2 allocation for its boilers, which is discussed in Section IV.

Table XIII-2
Coking Plant - Historical Emissions - 1990 to 2000

State	County ID	Facility ID	SIC	MTF Sector	Sector Description	Facility Name (1990)	Current Facility Name (if different from1990)	SO_2 tpy 1990	SO_2 tpy 1996	SO_2 tpy 1998	SO_2 tpy 2000	SO_2 Floor Allocation
WY	037	0003		10	Metals/Mining/ Minerals	Sweetwater Resources	P4 Production - Rock Springs	933	663	642	633	631
WY	023	001		10	Metals/Mining/ Minerals	FMC Coking Plant	Astaris Coking Plant	1,194	1,413	1,454	1,409	0
UT	049	0027	3312	10	Metals/Mining/ Minerals	Geneva Steel		8,473	2,020	881	979	0

REFERENCES

AWMA, 2000: Air and Waste Management Association, “Air Pollution Engineering Manual,” 2nd edition, Chapter 14 - Metallurgical Industry, 2000.

EPA, 1981: U.S. Environmental Protection Agency, “Control Techniques for Sulfur Oxide Emissions from Stationary Sources,” Second Edition, EPA-450/3-81-004, Office of Air Quality Planning and Standards, Research Triangle Park, NC, April 1981.

EPA, 1998: U.S. Environmental Protection Agency, “Compilation of Air Pollutant Emission Factors,” AP-42, Fifth Edition, Volume I: Stationary Point and Area Source, Section 12.2 Coke Production” Office of Air Quality Planning and Standards, Research Triangle Park, NC, 1998.

CHAPTER XIV
FLOOR ALLOCATION SUMMARY

Table XIV-1 summarizes the SO_2 floor allocation estimates from all of the previous chapters by State and by sector. California estimates listed in Table XIV-1 are based on average SO_2 emissions in these sectors from 1996, 1998, and 2000. Table XIV-1 shows the estimated SO_2 floor allocation for non-utility sources in the 9-State Commission Transport Region to be about 195 thousand tons. If copper smelter SO_2 allocations in 2018 are subtracted from this amount, the floor allocation is 117 thousand tons. The non-smelter, non-California SO_2 emissions total is 89,000 tons.

Table XIV-2 provides a complete list of the facility-level SO_2 floor allocations, and includes year 2000 SO_2 emissions as a point of comparison.

Table XIV-1
State/Sector Summary of SO_2 Floor Allocations
(tons per year)

States	Sectors												Total
	Refineries	Lime Manufacturing*	Industrial Boilers	Pulp and Paper	Cement Manufacturing	Natural Gas Processing	Elemental Phosphorus**	Glass Manufacturing***	Copper Smelters	Aluminum Plants	Sulfuric Acid Plants	Coke Production	
Arizona		1,365	978		320				43,000				45,663
California													27,335
Colorado	1,614		387		4,936			237					7,174
Idaho			601	1,807	522		15,861				2,551		21,342
Nevada		435			448								883
New Mexico	2,244				1,103	12,862			34,000				50,209
Oregon			1,585	5,377				131		2,076			9,169
Utah	4,142	303	2,010		267	1,593			1,000				9,315
Wyoming	3,418		2,350		165	14,429					2,835	631	23,828
Total	**11,418**	**2,103**	**7,911**	**7,184**	**7,761**	**28,884**	**15,861**	**368**	**78,000**	**2,076**	**5,386**	**631**	**194,918**

NOTES: *Based on 1998 and 2000 historical SO_2 emission estimates.
**Based on year 2000 SO_2 emission estimates for P4 Production, which are substantially higher than 1996 or 1998 emissions.
***Based on 1996, 1998, and 2000 historical SO_2 emission estimates.

Table XIV-2
Facility-Level SO_2 Floor Allocations
Comparison with Year 2000 SO_2 Emissions (tons per year)

State	Facility ID	Sector Description	Facility Name (1990)	Current Facility Name	In Current Report	Comments	SO_2 Emissions Year 2000	SO_2 Non-Boiler Allocation	SO_2 Boiler Allocation	Total SO_2 Allocation	State Totals
AZ		Cement/Concrete	Arizona Portland Cement		X		320	0		0	
AZ	0011	Metals/Mining/Minerals	CHEMICAL LIME (CHEMSTAR)	CHEMICAL LIME - NELSON	X		702	632		632	
AZ	0003	Metals/Mining/Minerals	Chemical Lime (Douglas)		X		742	733		733	
AZ		Cement/Concrete	Phoenix Cement		X		539	320		320	
AZ	0007	Wood/Paper/Pulp	STONE CONTAINER	ABITIBI	X		1,893	0	978	978	
AZ	0001	Oil/Gas	Intermountain Refining		X	Closed	0	0		0	
AZ	0004	Copper	ASARCO SMELTER - HAYDEN		X		16,753	21,000		21,000	
AZ	0032	Copper	BHP(Magma Metals)	BHP - San Manuel	X		0	14,000		14,000	
AZ	0006	Copper	CYPRUS MIAMI MINE		X		6,810	8,000		8,000	
AZ	0040	Copper	Cyprus Sierrita		X		0	0		0	
											45,663
CO	0048	Metals/Mining/Minerals	CFI				267			0	
CO	0004	Oil/Gas	COLO REFINING		X	Refinery	545	562		562	
CO	0003	Oil/Gas	CONOCO DENVER		X	Refinery	1,972	1,052		1,052	
CO	0008	Glass	COORS GLASS	ROCKY MOUNTAIN BOTTLE	X		255	237		237	
CO	0002	Cement/Concrete	HOLNAM LAPORTE	HOLCIM LAPORTE	X		404	1,402		1,402	
CO	0001	Cement/Concrete	HOLNAM PORTLAND	HOLCIM PORTLAND	X		3,288	3,374		3,374	
CO	0097	Misc.	METRO WASTEWATER				56			0	
CO	0003	Cement/Concrete	SOUTHWEST PORTLAND	CEMEX-LYONS PLT.	X		50	160		160	
CO	9	Misc.	GENERAL SERVICES ADMINISTRATION				0			0	
CO	0001	Oil/Gas	LANDMARK PETROLEUM				0			0	
CO		CHP	TRIGEN-COLORADO ENERGY CORP.		X		2,583	0	387	387	
CO	24	Oil/Gas	UNOCAL RETORT-PARACHUTE		X		0			0	
CO	0025	Oil/Gas	UNOCAL UPGRADE		X		0			0	
CO	0001	Food	WESTERN SUGAR 1				19			0	
CO	0002	Food	WESTERN SUGAR 2				0			0	
											7,174
ID		Wood/Paper/Pulp/Cogeneration	Tamarack Energy				117			0	
ID	0004	Cement/Concrete	ASHGROVE CEMENT		X		1,327	522		522	
ID		Power	Avista				130			0	
ID		Food	Basic American Foods (Shelly)				149			0	
ID		Wood/Paper/Pulp	Boise Cascade - Emmett				252			0	
ID	0001	Misc.	DOE-INEEL				460			0	
ID	0005	Chemicals/Plastics	FMC	ASTARIS			0			0	
ID		Food	MAGIC VALLEY FOODS				0			0	
ID	0001	Chemicals/Plastics	MONSANTO/P4 PRODUCTION	P4 Production	X	Elemental Phosphorus	15,861	15,861		15,861	
ID	0003	Chemicals/Plastics	NU WEST INDUSTRIES			Sulfuric acid plants	86			612	
ID	0001	Wood/Paper/Pulp	POTLATCH		X	Paper Mill	1,694	1,807		1,807	
ID		Misc.	RICKS COLLEGE				0			0	
ID	0006	Chemicals/Plastics	SIMPLOT			Sulfuric acid plants	543			1,939	
ID	0010	Food	TASCO (NAMPA)	Amalgamated Sugar (Nampa)			1,697		242	242	
ID	0001	Food	TASCO (PAUL)	Amalgamated Sugar (Paul)			1,322		155	155	
ID	0001	Food	TASCO (TWIN)	Amalgamated Sugar (Twin)			1,053		203	203	
ID		Food	Idaho Supreme				0			0	
ID	0001	Misc.	MTN. HM. AFB				144			0	
											21,341
NV	0003	Metals/Mining/Minerals	CHEMSTAR APEX	CHEMICAL LIME CO-APEX PLANT	X	Lime plant	210	193		193	
NV	0387	Cement/Concrete	NEVADA CEMENT COMPANY	FERNLEY PLANT	X		172	305		305	
NV		Cement/Concrete	Royal Cement			Not in previous report		143		143	

Table XIV-2 (continued)

State	Facility ID	Sector Description	Facility Name (1990)	Current Facility Name	In Current Report	Comments	SO_2 Emissions Year 2000	SO_2 Non-Boiler Allocation	SO_2 Boiler Allocation	Total SO_2 Allocation	State Totals
NV	0261	Metals/Mining/Minerals	GRAYMONT WESTERN US INC	PILOT PEAK	X	Lime plant	249	242		242	
NV	0451	Metals/Mining	SANTA FE PACIFIC GOLD CORP	TWIN CREEKS/NEWMONT MINING CORP			113			0	
NV	0433	Metals/Mining/Minerals	BASIC INC.(Now PREMIER CHEMICALS LLC)	PREMIER SERVICES (Gabbs Facility)						0	
NV	0863	Misc.	HAWTHORNE ARMY							0	
NV		Metals/Mining	Independence Big Springs	ANGLO GOLD						0	
NV	0019	Metals/Mining/Minerals	TITANIUM METALS							0	
											883
NM	0024	Oil/Gas	AGAVE ENERGY/YATES PLANT	Agave Plant	X		2,983	365		365	
NM	0002	Oil/Gas	ARCO PERMIAN/EMPIRE ABO GAS PLNT		X		565	431		431	
NM	0004	Oil/Gas	CONOCO/MALJAMAR GAS PLANT	MALJAMAR GAS PLANT	X		3,574	222		222	
NM	0023	Oil/Gas	GIANT INDUSTRIES/BLOOMFIELD REF		X	Refinery	920	414		414	
NM	0008	Oil/Gas	Giant Refining/Ciniza Refinery	(Gallup)	X	Refinery	1,779	603		603	
NM	0044	Oil/Gas	GPM GAS EUNICE GAS PLANT	VERSADO GAS PRODUCERS LLC	X		2,759			0	
NM	0011	Oil/Gas	GPM GAS/ARTESIA GAS PLANT	DUKE ENERGY/ARTESIA GAS PLANT	X		1,459	1,192		1,192	
NM	0006	Oil/Gas	GPM GAS/INDIAN HILLS AMINE PLNT				900			0	
NM	0046	Oil/Gas	GPM GAS/LEE GAS PLANT	Duke Energy Lee Plant	X		818	0		0	
NM	0035	Oil/Gas	GPM GAS/LINAM RANCH GAS PLANT	Duke Energy Plant 5			1,304	1,181		1,181	
NM	0007	Oil/Gas	J.L. DAVIS GAS PROCESS/DENTON		X		1,158	840		840	
NM	0008	Oil/Gas	MARATHON OIL/INDIAN BSN GAS PLT		X		1,100	665		665	
NM	0010	Oil/Gas	NAVAJO REFINING/ARTESIA REFINERY		X	Refinery	980	1,227		1,227	
NM	138	Oil/Gas	PAN ENERGY/BURTON FLATS GAS PLT	Duke Energy Burton Plant	X		246	164		164	
NM	0285	Oil/Gas	PAN ENERGY/DAGGER DRAW GAS PLT	DUKE ENERGY/DAGGER DRAW	X		247	218		218	
NM		Cement/Concrete	RIO GRANDE PORTLAND CEMENT		X		1,103	1,103		1,103	
NM	0008	Oil/Gas	SID RICHARDSON GASOLINE/JAL#3		X		0	1,206		1,206	
NM	55	Oil/Gas	TEXACO/BUCKEYE GASOLINE PLANT	DYNERGY			673			0	
NM	0052	Oil/Gas	TEXACO/EUNICE NORTH GAS PLANT		X		5,476			0	
NM	0051	Oil/Gas	TEXACO/EUNICE SOUTH GAS PLANT		X		231			0	
NM	0003	Oil/Gas	TRANSWESTERN PIPE	DUKE ENERGY/HUBER GAS	X		270	163		163	
NM	0001	Oil/Gas	WARREN PETROLEUM/BLUITT GAS PLANT		X		1,226			0	
NM	0060	Oil/Gas	WARREN PETROLEUM/EUNICE GAS PLANT	Duke Energy EUNICE GAS PLANT			2,756	2,250		2,250	
NM	0061	Oil/Gas	WARREN PETROLEUM/MONUMENT PLANT	Dynergy MONUMENT PLANT	X		1,387	675		675	
NM	0063	Oil/Gas	WARREN PETROLEUM/SAUNDERS PLANT	Dynergy SAUNDERS PLANT			0	163		163	
NM	0064	Oil/Gas	WARREN PETROLEUM/VADA GAS PLANT				3,138			0	
NM	0247	Oil/Gas	WESTERN GAS PROCESSORS/SAN JUAN RVR	Western Gas Resources	X			3,127		3,127	
NM	0128	Oil/Gas	CITATION/ANTELOPE RDG GAS PLANT		X					0	
NM	0118	Oil/Gas	CONOCO/BELL LAKE 2 WELL #6		X					0	
NM	0125	Oil/Gas	FEAGAN ENERGY/W DAGGER DRAW GAS PLT	Duke Energy Dagger Draw	X					0	
NM	0050	Oil/Gas	YATES PETROLEUM/PATHFINDER AMINE		X		0	0		0	
NM	0001	Copper	PHELPS DODGE/CHINO MINES		X		11,420	14,000		14,000	
NM	0003	Copper	PHELPS DODGE/HIDALGO SMELTER		X		0	20,000		20,000	
											50,209
OR	0002	Food	Amalgamated Sugar Company, The		X		987	0	74	74	
OR		Wood/Paper/Pulp			X	Not in previous report		0			
OR	1849	Wood/Paper/Pulp	Boise Cascade Company		X		1,834	1,532	411	1,943	
OR		Oil/Gas			X	Not in previous report					
OR	0005	Wood/Paper/Pulp	Georgia-Pacific West, Inc.		X		452	258	143	401	
OR	0007	Metals/Mining	Glenbrook Nickel Company				0			0	
OR	2125	Metals/Mining/Minerals	Globe Metallurgical Inc.				197			0	
OR	0036	Wood/Paper/Pulp			X		0	0			
OR	0004	Wood/Paper/Pulp	James River II, Inc.	Georgia- Pacific (Wauna Mill)	X		643	1,361	277	1,638	
OR	0001	Metals/Mining/Minerals	Northwest Aluminum Company, Inc.		X		397	518		518	
OR	1876	Glass	Owens-Brockway Glass Container, Inc.		X		108	131		131	

Table XIV-2 (continued)

State	Facility ID	Sector Description	Facility Name (1990)	Current Facility Name	In Current Report	Comments	SO_2 Emissions Year 2000	SO_2 Non-Boiler Allocation	SO_2 Boiler Allocation	Total SO_2 Allocation	State Totals
OR	3501	Wood/Paper/Pulp	Pope & Talbot Pulp, Inc.		X		293	248	107	355	
OR	1851	Metals/Mining/Minerals	Reynolds Metals Company		X		1,510	1,558		1,558	
OR	6142	Wood/Paper/Pulp	Smurfit Newsprint Corporation 2		X	No longer pulping	519	0		0	
OR		Wood/Paper/Pulp	West Linn Paper Co.		X	Not in previous report		0	211	211	
OR	8866	Wood/Paper/Pulp	Weyerhaeuser Company	SierraPine, Ltd.	X		0	0	0	0	
OR	0471	Wood/Paper/Pulp	Willamette Industries, Inc.		X		327	310		310	
OR	8850	Wood/Paper/Pulp	Collins Products LLC	Weyerhaeuser Co.	X	Weyerhaeuser Springfield	1,721	1,668	362	2,030	
OR	5034	Misc.	Cascade Steel Rolling Mills, Inc.				0			0	
OR	2028	Oil/Gas		Kinder Morgan Energy Partners, L.P	X						
OR	0041	Chemicals/Plastics	Georgia-Pacific Resins, Inc.							0	
OR	0013	Wood/Paper/Pulp	J. Peterkort & Company	Collins Products LLC						0	
OR	5398	Wood/Paper/Pulp	Ogden Martin Systems of Marion, Inc.	Covanta Marion, Inc.	X					0	
OR	2050	Misc.	Oregon Health Sciences University	OHSU	X		0	0			
OR	0015	Wood/Paper/Pulp	Weyerhauser - Coos Bay			Hog waste-fired boiler	882			0	
											9,169
UT	10572	Copper	Kennecott Utah Copper Corp.		X	Smelter	2,534	1,000	700	1,700	
UT	10096	CHP	Sunnyside Cogeneration Associates		X		1,054		1,270	1,270	
UT	0004	Oil/Gas	Amoco Petroleum Products	Tesoro	X	Refining	1,368	1,388		1,388	
UT	0004	Misc.	Brigham Young University		X		125		1	1	
UT	0001	Metals/Mining/Minerals	Brush Wellman Inc.		X		179		23	23	
UT	0003	Oil/Gas	Chevron Products Company		X	Refining	1,242	1,240		1,240	
UT	-9902	Metals/Mining/Minerals	Continental Lime Inc.	Graymont	X	Lime	331	303		303	
UT	0008	Oil/Gas	Flying J Incorporated		X	Refining	300	674		674	
UT	0027	Metals/Mining/Minerals	Geneva Steel		X	Shutdown coke ovens and sinter plant	979		17	17	
UT	0001	Cement/Concrete	Holnam Incorporated	Holcim	X	Cement	288	267		267	
UT	0013	Oil/Gas	Phillips 66 Company		X	Refining	601	762		762	
UT		Oil/Gas	Silver Eagle Refining Inc.		X	Not in previous report (Refining)		77		77	
UT	-9901	Oil/Gas	Unocal Corporation	Tom Brown-Lisbon Plant	X	Natural gas processing	1,252	1,593		1,593	
UT	10676		Utelite Corporation				133	0		0	
											9,315
WY	0012	Oil/Gas	AMOCO - ELK BASIN	HOWELL PETROLEUM - ELK BASIN	X		2,638	1,200		1,200	
WY	0012	Oil/Gas	AMOCO - WHITNEY CANYON		X		6,889	5,602		5,602	
WY	0009	Oil/Gas	CHEVRON - CARTER CREEK		X		2,096	200		200	
WY		Cement/Concrete	Centex		X	Not in previous report		165		165	
WY	0013	Oil/Gas	EXXON - SHUTE CREEK		X		1,383	1,536		1,536	
WY		Oil/Gas	EXXON BLACK CANYON DEHY & WELLFIELD				167			0	
WY	0010	Metals/Mining/Minerals	FMC - GRANGER (TEXAS GULF)		X		212		305	305	
WY	48	Metals/Mining/Minerals	FMC - GREEN RIVER		X		4,901		956	956	
WY	0001	Metals/Mining/Minerals	FMC COKING PLANT	ASTARIS COKING PLANT	X	Shutdown April 2001	1,409			0	
WY	0001	Oil/Gas	FRONTIER OIL & REFINING - CHEYENNE		X	Refining	1,396	863		863	
WY	0002	Metals/Mining/Minerals	GENERAL CHEMICAL		X		5,000		750	750	
WY	0001	Food	HOLLY SUGAR - TORRINGTON		X		178		23	23	
WY		Oil/Gas	INTERENERGY - HILAND	WILDHORSE ENERGY - HILAND	X		269	281		281	
WY		Oil/Gas	KCS MOUNTAIN RESOURCES - GOLDEN EAGLE		X		17	790		790	
WY		Oil/Gas	KCS MOUNTAIN RESOURCES - AINSWORTH		X		0	843		843	
WY	1	Oil/Gas	KCS Mountain Resources Rushmore		X		118	118		118	
WY	0005	Chemicals/Plastics	KOCH SULFUR PRODUCTS COMPANY	PEAK SULFUR	X	Sulfuric acid plants	1,245	1,197		1,197	
WY		Oil/Gas	LOUISIANA LAND & EXPLOR - LOST CABIN [b]	BURLINGTON RESOURCES - LOST CABIN	X		213	1,867		1,867	
WY	0007	Oil/Gas	MARATHON GAS PLANT - OREGON BASIN	Oregon Basin Gas Plant	X		358	391		391	
WY		Oil/Gas	MARATHON OIL - MILL IRON		X		0	247		247	

Table XIV-2 (continued)

State	Facility ID	Sector Description	Facility Name (1990)	Current Facility Name	In Current Report	Comments	SO_2 Emissions Year 2000	SO_2 Non-Boiler Allocation	SO_2 Boiler Allocation	Total SO_2 Allocation	State Totals
WY	1	Oil/Gas	Marthon Oil Pitch Fork Battery		X		61	61		61	
WY	0003	Metals/Mining/Minerals	SWEETWATER RESOURCES	P4 PRODUCTION - ROCK SPRINGS	X	Rotary coker	633	631		631	
WY	0022	Chemicals/Plastics	SF PHOSPHATES, INC		X	Sulfuric acid plants	1,790	1,638		1,638	
WY	0001	Oil/Gas	LITTLE AMERICA REFINING COMPANY	SINCLAIR - CASPER	X	Refining	1,458	1,040		1,040	
WY	0011	Oil/Gas	SINCLAIR @ SINCLAIR		X	Refining	3,407	1,066		1,066	
WY		Oil/Gas	SNYDER OIL - RIVERTON DOME	DEVON SFS - RIVERTON DOME			492			0	
WY		Metals/Mining/Minerals	SOLVAY MINERALS		X		52		294	294	
WY	0012	Oil/Gas	TEXAS-BYRON PLANT	BIG HORN GAS PROCESSING - BYRON	X	Texaco	257	200		200	
WY	0008	Oil/Gas	UNION PAC - BRADY	RME PETROLEUM - BRADY	X		300			0	
WY	0005	Misc.	UW CENTRAL HEAT PLANT		X		193		22	22	
WY	0001	Oil/Gas	WYOMING REFINING CO	WYOMING REFINING - NEWCASTLE	X	Refining	876	449		449	
WY	008	Oil/Gas	DEVON SFS OPERATING CO.	BEAVER CREEK	X		831			0	
WY	0003	Metals/Mining/Minerals	AMERICAN COLLOID - WEST COLONY							0	
WY	0002	Oil/Gas	AMOCO REFINERY			Closed	0			0	
WY	0001	Metals/Mining/Minerals	BENTONITE CORPORATION	LOVELL			0			0	
WY	0014	Oil/Gas	COLORADO INTERSTATE GAS - TABLE ROCK				0			0	
WY	0013	Oil/Gas	MARATHON OIL COMPANY - GARLAND				0			0	
WY		Oil/Gas	Hallwood Petroleum-Federal Packsaddle 1-24		X	Not in previous report		133		133	
WY		Oil/Gas	Hallwood Petroleum-Federal Packsaddle 1		X	Not in previous report		960		960	
											23,828
TOTALS							**170,226**			**167,583**	**167,583**

[a]SO_2 Allocation based on historical emissions.
[b]Plant has just added capacity and allocation is based on current (July 2002 capacity).

Appendix A-8b. Western Emissions Backstop (WEB) Emissions & Allowance Tracking Systerm (EATS) Analysis

WESTERN REGIONAL AIR PARTNERSHIP

Western Backstop (WEB) Emissions and Allowance Tracking System (EATS) Analysis

Prepared by:
Perrin Quarles Associates, Inc.
675 Peter Jefferson Parkway, Suite 200
Charlottesville, VA 22911

July 18, 2003

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Western Backstop (WEB)
Emissions and Allowance Tracking System (EATS) Analysis

I. Introduction

This section of the State Implementation Plan/Tribal Implementation Plan (SIP/TIP) is an analysis of the information management needs of the Western Backstop Emissions and Allowance Tracking System (WEB EATS) which is a requirement for the program under 40 CFR 51.309. Section 309(d)(h)(4)(v) of the Regional Haze rule requires that "the Implementation Plan must provide for submitting data to a centralized system for the tracking of allowances and emissions." The purpose of this document is to describe the architectural and system requirements necessary to support a State/Regional emissions trading program information system. The document summarizes the overall needs and objectives of an emissions trading system to ensure successful implementation of the program. It is intended to serve as a roadmap to help WRAP implement the program once it has been triggered.

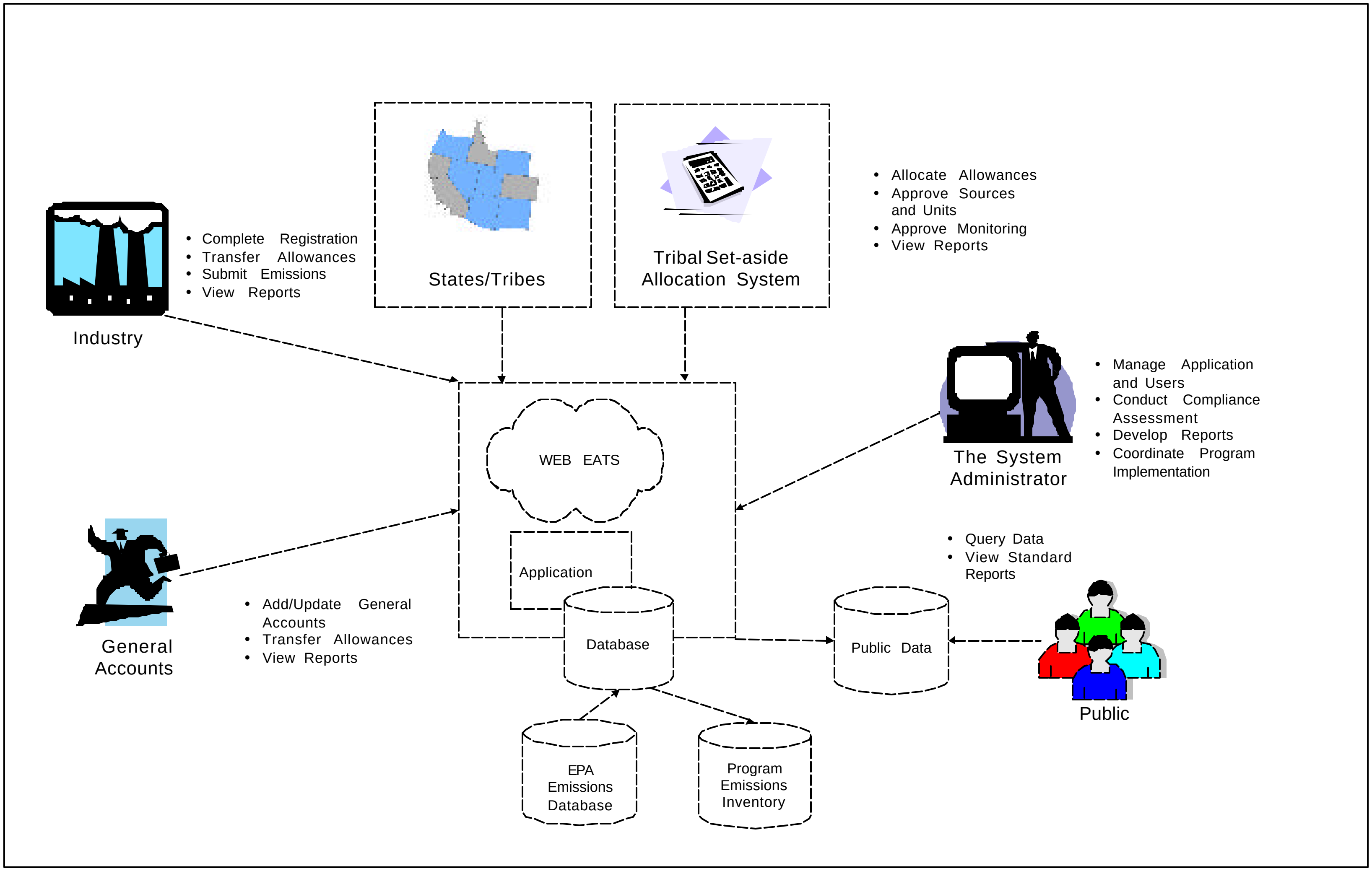
II. Overview of the System and Analysis

Figure 1 contains a graphical depiction of the overall information system, including the basic users, functionality needed for each of these user types, and a high level architecture. *Section III* describes each functional area of the application. *Section IV* describes the primary user groups and how they relate to the functional areas. *Section V* describes the considerations affecting the choice of technical architecture for the application. *Section VI* describes recommended design and development approaches, and *Section VII* addresses the overall responsibilities of the Tracking System Administrator (TSA).

The development and deployment of this application, if needed, would most likely occur after 2013, possibly later. It is assumed that currently available technology would not be used, nor is it possible to project what advancements in technology would be available. For this reason, this report does not address specific technologies, except as a reference point for better understanding or describing capability that would be needed. The focus is on general issues related to technology and the functional requirements for designing and implementing the program.

The scope of the application and information system needs which are described do not extend to several areas relating to the possible implementation of the Backstop Trading Program envisioned by Section 309. Excluded areas include the baseline emissions inventory for determining whether the program triggers, performing initial allowance allocations, and evaluating and tracking early reduction credits. Also, it has been assumed that it is not necessary to support a significant level of variation in requirements or needs from different States or tribes and that areas in which these requirements may vary, such as enforcement activities beyond the automatic provisions of the program, would be addressed in other systems.

Figure 1
Overall WEB EATS Model



III. Functional Areas

The system to support the WEB Trading Program must contain functionality to support implementation of the trading program in the following areas: source inventory, user management, account management, allowance allocations, allowance trading, emissions reporting and collection, compliance, and program assessment. At this time, the system functionality does not include consideration of allowance transfer price data. However, there may be a need to include this functional area in the final system design, and the overall system design needs to allow for this possible expansion of the functional areas. Because the core requirements for allowance transfer price tracking remain uncertain, this section does not discuss this functional area in further detail. Each of the other areas of functionality is described below. In addition, core requirements relating to the areas are defined.

A. Source Inventory

1. Description

a. Facilities and Units

The central focus of the system is the list or inventory of sources which are affected by the program. This inventory is initially derived from the baseline emissions inventory developed to support the development and approval of the WEB Trading Program as part of the SIP/TIP approval process. To this initial inventory, it is expected that States and Tribes may add sources, either during the period prior to triggering the program or after the Program Trigger Date. Throughout, it is expected that sources will permanently cease operation or "retire." To support the dynamic inventory, the information system must allow the addition of new sources and track the status, including the regulatory status, of all sources identified as potential program participants beginning with the baseline period.

To support changes in facility operation and ownership in both the pre-trigger and post-trigger period, it will be necessary to track basic changes in facility identity, including facilities which, due to these types of changes, change "identity" or divide into two facilities. This functionality would include tracking facility name changes.

It is assumed that States and Tribes would be responsible for identifying all "new" sources to the database and for making decisions and entering data about the applicability of the program to a new source. Once a source is identified as being subject to the program, the maintenance of these data would be the primary responsibility of the owners and operators of affected sources through the source representative. A single, secure portal for changing these data would be provided to authorized industry representatives.

b. Source Owners

The owners and operators of each source authorize individual(s) to represent them regarding allowance trading, emissions reporting and all other compliance activities. The identity of the owners and operators should be tracked to ensure that legal responsibility for compliance can be accurately determined at any point in time during which compliance is required. The WEB EATS should track changes in owners and operators for a source.

c. Source Representatives

The designated representatives appointed by the owners and operators of the source are also tracked so that appropriate communication about program activities involving the source and compliance is facilitated. Under the Duty to Register provisions, representatives of a source initially must register and use consistent source identifiers with the source program data first entered by the State or Tribe. The representative is responsible for the accuracy of submissions and certifying source compliance. Program rules should be structured to ensure that at no time during the operational phase of the program is an affected source unrepresented.

d. Source and Unit Detail

Additional information about the facility and units, including fuels, controls, and other operational information would be necessary for program implementation, particularly with respect to emissions monitoring, and for program assessment. During the design phase for WEB EATS development an assessment of these needs and the availability of information from other sources (for example, a shared air program database at EPA or in a State/Tribe) should be performed.

2. Core Data Entities and Attributes

- Facilities. Location, source category or type, permit IDs, size, Federal and State/Tribal cross identifiers with other data systems, program status, operational status (including retirement status), initial on-line date (for new sources).

- Units. Relationship to facilities, type, Federal and State/Tribal cross identifiers with other data systems, operational status (including retirement status), initial on-line date (for new units).

- People. Type and duration of relationship to facilities, type and duration of agent relationship to representatives, address, affiliation, security level, user ID, passwords (or equivalent), phone numbers, email or equivalent.

- Owners/operators. Address, relationship to facilities.

- Program applicability. Exemptions, opt-in or other program status information, including year affected (or non-affected), identification of Category 1 and 2 sources, etc. Could include permitted production capacity or other permit data.

3. Core Functional Requirements

- Populate initial facilities and units.
- Add and update facilities and units.
- Add and update owner/operator information.
- Change owner/operators for facilities.
- Add and update individual information for any person utilizing or identified in the application.
- Change representatives for facilities.
- For on-line changes, provide to users documentation of changes in owners and representatives to meet recordkeeping requirements. This could be email or other electronic format.
- Track changes in facility names and program identifiers and relationship to prior entities.
- Communicate/verify facility and unit inventory changes, particularly where change impacts regulatory status or responsibilities or triggers deadline.
- Add and update program applicability data.

B. User Management

1. Description

User security and authentication are key requirements for the WEB EATS. To support these requirements the application must contain functionality to store user identifying information and associate each user with the appropriate security level. A system administrator, or person designated by the system administrator, must use tools provided in the application to review and approve user accounts, and to access and monitor usage.

For any on-line access and submission by an industry user, the system should require appropriate compliance certifications and contain a record of certifications.

2. Core Data Entities and Attributes

- People. Relationship to facilities or to representatives and their agent, address, affiliation, type, security level, user ID, passwords (or equivalent), phone numbers, email or equivalent.

- User Access Requests. User identification (per People), information to facilitate approval, status of request (approval, denial).

- Certification Records. Content of certification, date, user identification.

3. Core Functional Requirements

- Receive requests for user registration.
- Approve/deny requests and establish security groups.
- Provide notification of request status and assigned user ID and passwords (or equivalent).
- Develop and apply user privileges for specific functional areas and categories of data.
- Delete or archive users.
- Revoke or modify user access privileges.
- Display appropriate certification statements for review and agreement.

C. Account Management

1. Description

In the model rule, an Allowance Tracking System account is defined as an account "established for purposes of recording the allocation, and for holding, transferring, or deducting allowances." The WEB EATS should contain at least four types of accounts: general, compliance, retirement and government accounts. It must include a range of functionality to support each type of account.

A *compliance account* holds allowances which are used for compliance purposes. There is one compliance account for each source subject to emissions trading requirements and the compliance account is assumed to have the identical owners and representatives as its associated source. A compliance account should be automatically created for each new source when a source has met the appropriate registration requirements. For specified periods, compliance accounts or the allowances in those accounts may be subject to restrictions on trading to facilitate annual compliance assessment.

A *general account* allows anyone to hold allowances separate from the compliance and true-up process. A representative for a facility must move allowances from a general account to a compliance account before the true-up deadline in order to use them for current year compliance. A general account is created upon request of any individual or entity, and like a facility's compliance account, must have a defined owner and an individual person named as an account representative. General accounts are populated through trading functions, described below. The system administrator should have the ability to archive or deactivate a general account if specified criteria are met (such as containing no allowances for a specified period of time). For analysis purposes, the type of general account holder should be identified.

A *retirement account* holds allowances which have been used for annual compliance to offset emissions or which have been voluntarily removed from the market by its owners. At least one retirement account will be identified initially; additional accounts may be necessary to meet specific needs, if a detailed analysis of requirements indicates that separating retired allowances would be useful for analysis or other purposes.

A *government account* holds allowances which are still under the control of a State or Tribe (or, as their agent, the Tracking System Administrator). These accounts will contain serialized allowances to be allocated in the future. The new source set-aside, for example, is a government account.

2. Core Data Entities and Attributes

- Accounts. Identification number, type, restrictions, relationship to source (if any), State/Tribe, or owner/representatives, owner type.

- People. Type and direction of relationship to accounts, address, affiliation, security level, user ID, passwords (or equivalent), phone numbers, email or equivalent.

- Owners/operators. Address, relationship to accounts.

3. Core Functional Requirements

- Add/create general accounts.
- Change owner/operators for general accounts.
- Change representatives for general accounts.
- Add/create retirement, government, and compliance accounts (system admin only).
- Implement freeze on account or specific allowances within account.
- Archive or delete accounts.
- Notification of changes to user and other responsible persons.

D. Allowance Allocations (Initial and Ongoing)

1. Description

The system should support both initial and ongoing allocations of allowances from government accounts into compliance accounts. The initial allocation for the first five year period would be provided by States or Tribes in a format to be defined by the TSA and system designers. It is recommended that the allocation process replicate the transfer of allowances from account to account, thus creating an audit trail of the allowance back to its original issuing State or Tribe. It is recommended that the system design include a standard file format for submission of initial allowance allocations by the State or Tribe.

All allowances would be serialized according to a numbering system to be determined as part of the system design when they are initially populated in the application. This serial number would be a permanent attribute of each allowance and could not be changed.

Ongoing allocations, which occur every five years for all allowances, would be supported through a process similar to the initial allocation, depending primarily on a standard file format, containing allocations determined by the State or Tribe for the period.

The application should generate a draft and final Regional Allocation Report for each five year allocation period.

The application should support periodic allocations of allowances to compliance accounts for new sources from the new source set-aside. Specialized tracking and reporting would be needed to record the date of all requests and the status of the set-aside account. When this account is depleted, the tracking information would be used to prioritize allocation of future allowances to these sources.

The application must support allocations of allowances for opt-in sources on an annual basis. It is assumed that the State or Tribe would provide data to support opt-in source allocation (including source identification) either on-line or in an electronic format.

The application must support notification of all allocations to registered sources and to the appropriate State or Tribe.

If a source representative elects a monitoring option for a unit under 1.(b) of Section I (Monitoring, Recordkeeping and Reporting) of the model rule, the source representative would submit a request to the State or Tribe about this election, and must provide information about the portion of the facility's allowance allocation attributable to these units. Upon approval of the request by the State or Tribe, the TSA (or the State or Tribe directly) would mark the appropriate number of allowances as "non-tradeable" in the allowance account for the source for all years already allocated. A record of the request and approval would be stored, so that future allocations would also be marked as non-tradeable. If the special monitoring status under Section I1.(b) is revoked or no longer applicable, the "non-tradeable" status of the allowances would be changed by the TSA.

2. Core Data Entities and Attributes

- Accounts. Identification number, type, restrictions, relationship to source, State/Tribe, or owner/representatives, owner type.

- Allowances. Serial number, type, origin, year (if not indicated by serial number), non-tradeable indicator.

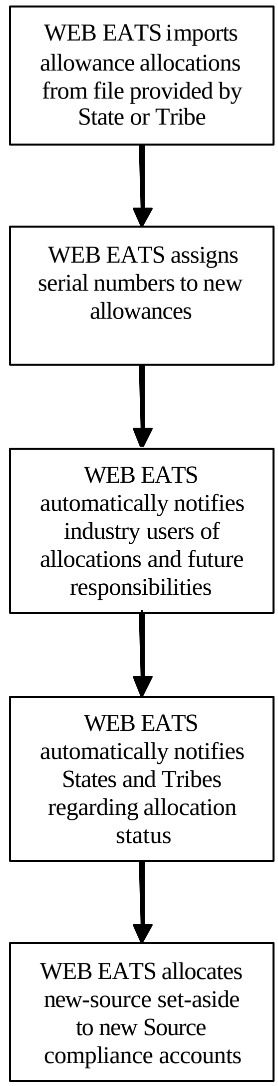
- Transactions. Transaction identifier, date, allowance range, transferor account, transferee account, type of transaction.

- Action Log. Type of submission or request, user, source, status, etc.

3. Core Functional Requirements

- Import of allowance allocations from file provide by State or Tribe.
- Assign serial numbers to new allowances.
- Notification system to automatically inform industry users of allocations and future responsibilities.
- Notification or report system to keep States and Tribes informed re allocation status.
- Tracking capability for new source set-aside requests.
- Allocations to compliance accounts from new-source set aside.

Figure 2
Flow Chart of Allowance Allocation Process



E. Allowance Trading

1. Description

The ability to trade allowances supports the underlying principle of an emissions trading program and the functionality to support allowance transfers is critical to the WEB EATS. Security of the data and transparency of the transfer record are critical to the overall program and should be carefully evaluated. The WEB EATS must provide the TSA the ability to maintain information on all current account holdings and an audit trail of all allowance transactions, including both market transactions and regulatory transactions. The current standard for emissions trading programs established by EPA is to allow industry users to record allowance transfers on-line in real-time. These applications support both interactive, on-line transfers and batch transfers using specified file formats to transfer larger numbers of allowances. For batch transfers, industry has developed software to monitor allowance ownership and submit large volumes of allowance transfers with a minimum of user intervention. It is assumed that the technical capability for secure system-to-system interactions will continue to improve and that this approach will be more widely used in the future. Current allowance trading systems also support transfers performed by the TSA based on the receipt of paper forms. It is assumed that the reliance on paper forms will continue to diminish. Whether this functionality should be supported in the WEB EATS should be evaluated.

During the true-up period, activity in compliance accounts is frozen to allow the TSA to conduct the necessary compliance evaluation and allowance retirement. The WEB EATS would allow users to submit allowance transfers for allowances involved in an ongoing compliance process, but these transfers would be held and recorded following the completed process. All affected parties would be informed of the status of these transfers both when submitted and when finally recorded or denied.

For on-line transfers performed interactively by the transferor, the WEB EATS should provide access only to those accounts over which the transferor currently exercises control. Account access would be determined by the WEB EATS based on the user's relationships to specific general or compliance accounts. From these accounts, the user would select the accounts and specific allowances for the transfer. The user would then identify the account into which the allowances should be transferred. It is assumed that eligible recipients include general accounts, compliance accounts or a voluntary retirement account. The user would be asked to review and verify the transfer prior to its taking affect.

The process for electronic transfers of batch transfers will be more technology dependent. It would undoubtedly require definition of file transfer formats and security standards to ensure authentication of the submitter and completeness and quality of the data. It is not feasible to predict standards or available technology for this process at this time.

The paper-based process used by the TSA would be similar to the interactive process. Depending on the volume of paper transfers, redundancy of data entry or additional verification should be considered to ensure data quality and accuracy.

For all transfers (interactive, batch or paper), the WEB EATS must support a process of communication to both the transferor and transferee so that transfers recorded are fully disclosed to all parties and errors or other disputes between parties can be quickly identified and resolved.

The WEB EATS must support a process of either transaction reversal or transaction error correction, or both. This functionality would be restricted to the TSA.

Reports would be available to the TSA and designated State/Tribe users to review specific transactions or overall transaction activity at any time.

2. Core Data Entities and Attributes

- Accounts. Identification number, type, relationship to source, State/Tribe, or owner/representatives.

- Allowances. Serial number, type, origin, year (if not indicated by serial number).

- Transactions. Transaction identifier, date, allowance range, transferor account, transferee account, type of transaction, status.

3. Core Functional Requirements

- Interactive transfer.
- Batch transfer.
- Capability to freeze compliance accounts with regard to allowances involved in ongoing compliance assessment.
- Notification to transferor and transferee.
- Reports and summaries.
- Allowance transaction audit trail.

F. Annual Compliance Assessment

1. Description

Following each control period, the TSA must perform an assessment of annual compliance with the basic program requirement that each affected source hold a number of allowances equal to or exceeding the tons of SO_2 emissions for the period. The compliance module of the WEB EATS would support receipt of annual compliance notifications and certifications by the source representative. It is expected that most representatives would provide the certifications and designate allowances to be deducted using an on-line access similar to the allowance transfer capability. Following receipt of the annual compliance forms, the WEB EATS would then compare the allowances held in the compliance account and the level of emissions for the source (taking into account the year of allowances, flow control limitations and prior exceedances) and deduct the appropriate allowances from compliance accounts into retirement accounts. Emissions reported at the unit level would be "rolled" up to the facility level. The process would result in a compliance report or compliance assessment notification to source representatives, States and Tribes.

In addition, the WEB EATS would assess the need to apply flow control in subsequent years and determine the appropriate flow control factor.

Finally, the WEB EATS would identify any failure to meet allowance limitations. Based on the level of excess emissions the WEB EATS would compute the appropriate penalties, both monetary penalties and deduction of subsequent year allowances.

2. Core Data Entities and Attributes

! Annual compliance certifications. Facilities, submitter name/ID, year, compliance certification statements.

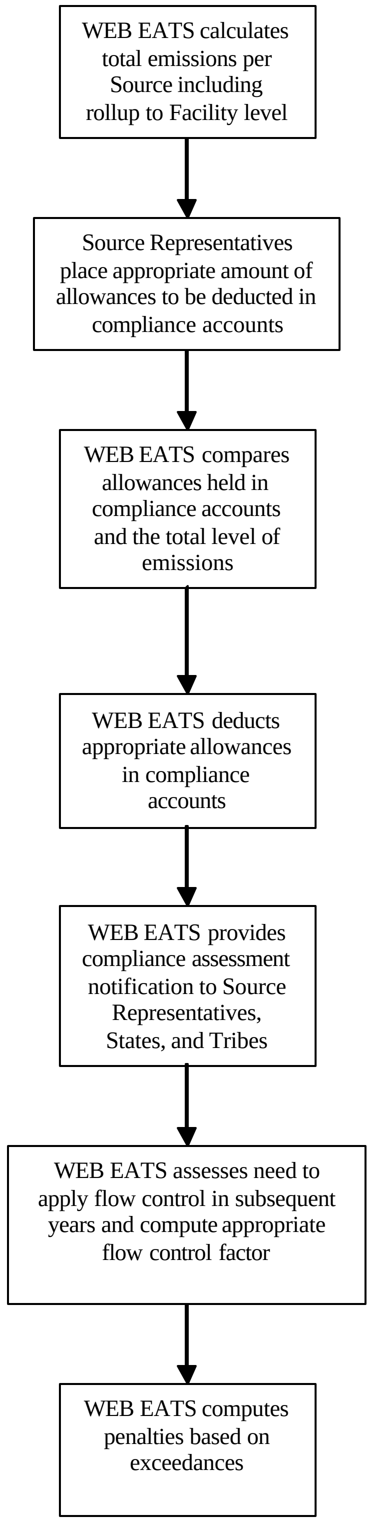
! Tracking. List of facilities for whom an annual compliance certification is required, received, etc.

! Compliance Results. Penalties, deductions, status, year.

3. Core Functional Requirements

! Receive and store annual compliance certifications.
! Perform compliance assessment.
! Calculate exceedances.
! Calculate flow control applicability and ratios.
! Communicate compliance results.

Figure 3
Flow Chart of Annual Compliance Assessment Process



G. Emissions Tracking and Emissions Reporting

1. Description

Emissions tracking and reporting for compliance purposes following the program trigger will require a wide range of functionality and data tables. There will be a need to evaluate carefully how and whether the functionality of the Emissions Tracking Database used for milestone tracking inventory purposes can be utilized to support the post-trigger emissions reporting. Also, it will be very useful to identify any potential overlap with existing emissions reporting systems used for other national or regional trading programs. For example, EPA plans to put into place the Emissions Collection System (ECS) and Monitoring Plan System (MPS) sometime after 2004. Although the software itself may not be adaptable for use as the emissions reporting module of WEB EATS, the system requirements and design should be consulted as an additional, more detailed, roadmap in the initial stage of system design.

The following general areas of functionality would be required:

Reporting Requirements and Tracking Information. To facilitate program implementation, the WEB EATS would identify monitoring and reporting obligations of each source participating in the program and track the receipt of required information. At least three types of reporters are envisioned:

- Part 75 reporters (submitting SO_2 emissions reports directly to EPA);
- Hourly non-Part 75 reporters; and
- Annual reporters (not participating in trading because of monitoring limitations).

For each of these type of reporting there are distinctly different reporting obligations and functionality to support submissions and reported information.

Monitoring and Emissions Information for Part 75 Units. For Part 75 affected sources who are reporting SO_2 monitoring and emissions data directly to EPA, the assumption is that redundant submission of these data would not be required. Instead, the WEB EATS would access or receive information from the EPA system about submissions and reported values under Part 75. Although EPA does not share these data directly with other data systems currently, it is anticipated that technological advances and the demand for shared data by other emissions trading programs would make this not only viable, but routine, by the time the program trigger occurs.

Monitoring Information for Non-Part 75 Units. For non-Part 75 units monitoring under Section I of the model rule, the submission requirements are not spelled out in the model rule. We recommend and assume that the program require and support the electronic submission of monitoring plans that are needed to establish an identification base for monitoring methodologies, monitoring locations and monitoring systems. These data are needed to support periodic reporting of hourly emissions data and to ensure that the data from monitoring systems are certified and quality assured. Tracking capability would be needed to assist in identifying whether required submissions (electronic and hardcopy) have been received, reviews conducted and approvals issued. This capability would assist States and Tribes, the TSA, and source representatives in the implementation phase of the monitoring program.

Because monitoring plans contain important components which are either graphics or documentation and are not easily stored as data elements, system designers should consider including document management capability to complement the tracking of information and sharing of data between all parties. A robust document manager could provide a submission process and eliminate or greatly reduce submission of hard copy material. This is an area in which technical options and standard practices may improve significantly prior to the program trigger year.

Emissions Data for Non-Part 75 Units. For non-Part 75 sources required to monitor SO_2 emissions, the WEB EATS would support submission, processing and storage of hourly emissions data. By current standards, the volume of and processing capability for hourly data could be large. However, it is expected that processing power and data storage capability will continue to expand and costs will decline. It is also expected that the submission process would utilize the next generation of broadband access and communication, in whatever direction technology dictates. Standardization of data reporting protocols would probably facilitate design and implementation of data submission requirements. The shape of the WEB EATS would be dictated to a large degree by available technology, supporting basic functionality of receipt, tracking, checking, analysis, and communication between the regulated sources and program management.

Quality Assurance of Emissions Data. Underlying successful cap and trade programs is the assumption that the emissions recorded and traded are comparable from State to State, Tribe to Tribe and industry to industry. Clear monitoring protocols and quality emissions data are needed to maintain the viability of the program. The monitoring and emissions data collection process should include the appropriate level of checking, analysis to ensure accurate and complete monitoring and reporting. Part 75 is a useful model of standards and checking which has provided the appropriate level of market assurances about the quality of emissions. The designers and developers of the WEB EATS should provide comparable capability, including calculation checks, assessment of monitoring system quality assurance compliance, and the accuracy of missing data routines. Emissions data should be evaluated to check routinely and periodically for anomalies and inconsistencies.

Petition Tracking. To meet SIP approval requirements, petitions for alternative monitoring would require joint approval of the State/Tribe and the U.S. EPA. The WEB EATS should provide a mechanism to track petitions and their approval and disapproval in a centrally accessible location for all State, Tribal and EPA program administrators. The WEB EATS should highlight and define electronically any aspect of the petition which results in allowable changes to reporting of monitoring or emissions data.

Annual Emission Statements for Reduced Monitoring Units. For units with reduced monitoring requirements under Model Rule Section I1.(b), the owner or operator would submit an annual emissions statement. The WEB EATS would track receipt of these submissions and record the emissions value reported. Annual production data or other information may also be required on a case-by-case basis as a condition of State or Tribe acceptance of the request under Paragraph b. These data should also be recorded in the data system.

2. Core Data Entities and Attributes

- Tracking. Including projected monitoring and reporting deadlines, submissions, and approvals or other status.

- Emissions Methodology/Reporter Type. Compliance period, Facility/Unit.

- Monitoring Locations. Units, stacks and pipes and attributes.

- Monitoring Systems Detail. Monitoring systems, formulas.

- Certification and Ongoing Quality Assurance Test Data. Test dates, overall results, test detail data.

- Cumulative Quarterly and Annual Emissions.

- Hourly Emissions Data.

3. Core Functional Requirements

- Track deadlines, requirements and submissions.
- Communicate with users about upcoming deadlines or deficiencies.
- Receive emissions report, quarterly and annual.
- Receive original and revised monitoring plans.
- Receive monitoring system certification and quality assurance data.
- Receive quality assurance test data and perform quality assurance checks.
- Address data quality problems.
- Provide final emissions data for annual compliance.

H. Program Assessment and Analysis

1. Description

Ongoing program assessment and evaluation is an explicit responsibility of the TSA and the system design and requirements should reflect the needs for various types of assessment including: environmental benefits, geographic impacts, market function, implementation successes and failures, co-benefits, and SO_2 control strategies. In each of these areas, the proposed database design should be evaluated to determine whether anticipated needs will be met. The analytical utility of the data in WEB EATS will be enhanced in some cases by ensuring that accurate and complete links to other databases are supported and maintained. Similarly, geographic analyses will be enhanced by having high quality and complete locational information. These data will facilitate the availability and use of deposition and other modeling data.

It is important to consider the needs of users who want access to basic and repeatable analyses and the needs of users who want access to the data to perform complex analysis or one-time analysis. The basic user may best be served by providing standard reports designed to provide a program overview, summary statistics or status reports on specific types of activity. Combined with basic filtering and sorting options, a well designed report will meet many of the ongoing needs. More flexibility in data analysis could be provided by developing a more robust query tool, perhaps with control over report formats and output file types. For the high end user with more complex analytical needs or requiring use of data volumes beyond the capability of the user interface platform, the ability to request and deliver data in standard formats should be considered. If it is determined that the basic user needs include access to large volumes of data in predictable summary formats or quick access to complex data, the design and development of a data warehouse to facilitate this access should be considered.

2. Core Data Entities and Attributes

- Data warehouse. To provide easier access to aggregated data for analysis purposes.

3. Core Functional Requirements

- Generate standard reports.
- Provide data query tool.
- Provide capability for data export and delivery.
- Provide links to other information systems.

I. Public Information Needs and Requirements

1. Description

To support market trading, information about market activity must be available to market participants and the general public. This includes, in particular, information about allowance trades and the identity of market participants, including representatives. The specific data content would be evaluated in detail at the time of design and development. It is expected that public access to some data, for example the tribal allocations for set-aside, would be limited.

It should be noted that the timeliness of the data is a critical aspect; but it may be appropriate to provide access to different types of information at different intervals. For example, a daily update cycle for allowance trading and representative changes has been adequate for the Federal trading programs; access to reported emissions data may be provided quarterly or even annually.

The ease of access for the public is also important. The current standard is to publish data though the Web, either in a readable format such as .pdf, in a standard spreadsheet format or through a query tool which retrieves and displays data in .html format through a browser. Although the technology available for public access to information in the next decade is not easily predicted, it would be expected that similar methods of providing access would be selected. The technical architecture and data formats should be selected based on security, speed or performance, overall accessibility to the technology, and flexibility offered in terms of both output and format.

2. Core Data Entities and Attributes

- Data warehouse. To provide easier access to aggregated data for analysis purposes.

3. Core Functional Requirements

- Timely public access to source inventory, account, allowance and representative information.
- Public access to periodic emissions data.
- Data downloading or extraction.

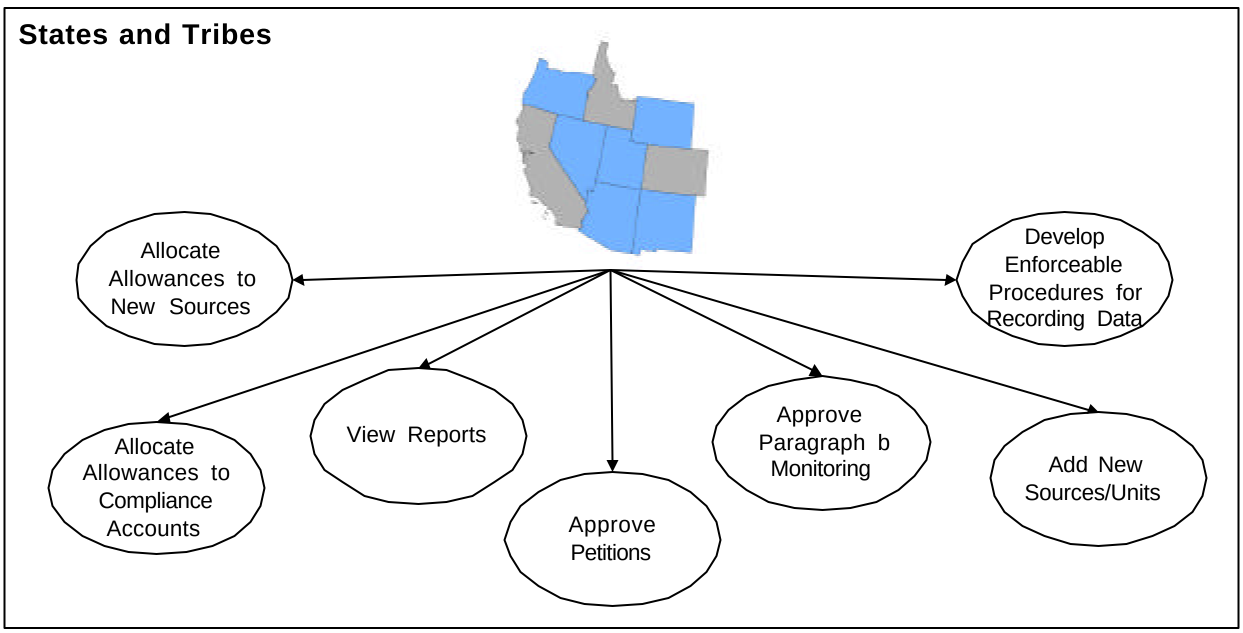
IV. Types of Users

As depicted in Figure 1, there are five basic categories of users for the application: State and Tribal users; industry users; general account holders; the Tracking System Administrator; and public users.

A. State and Tribal Users

Staff members of a State or Tribe participating in the Backstop Emissions Trading Program would be key stakeholders and users of the application. These users would have read-only access to almost all data in the application and a variety of reports. They would provide key data to the system using a combination of data upload or on-line capability. These would include facility and unit and program applicability data, general allowance allocations, allocations from new source set asides, and approvals of monitoring submissions. These users would have no day-to-day responsibilities for the operation, management or maintenance of the application or data.

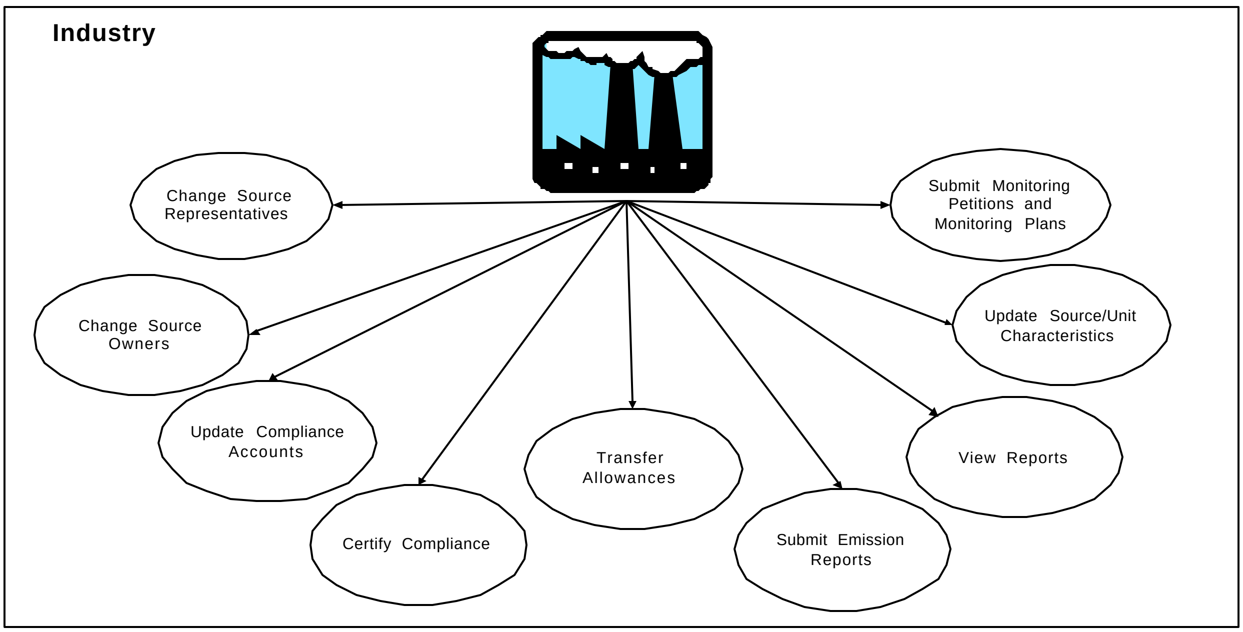
Figure 4
Use Case Diagram: State and Tribal Users



B. Industry Users

Representatives of the regulated community would also be key users of the application. These users would have access to data relating to sources under their control, as defined by their roles and responsibilities as source representatives. In this capacity, they would be able to maintain source and unit information, transfer allowances in compliance or general (that they set up) accounts to and from other accounts, and submit required emissions data and compliance certifications.

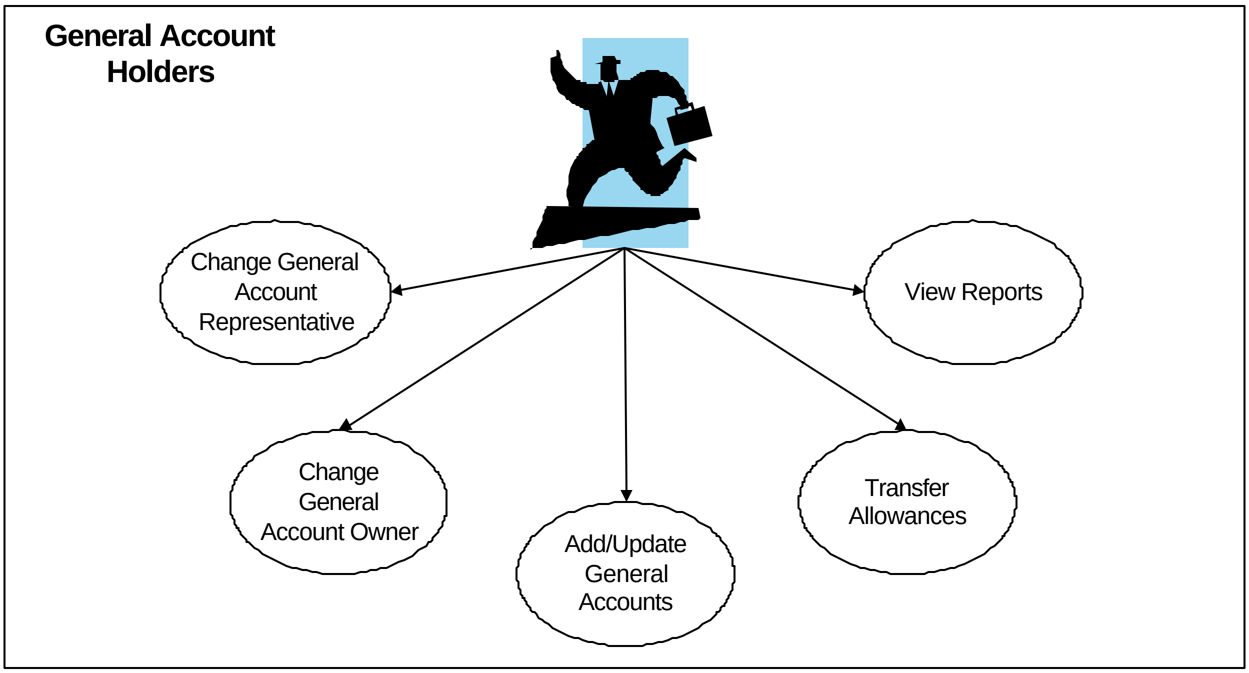
Figure 5
Use Case Diagram: Industry Users



C. General Account Holders

A representative for a general account would also have access to the application to update general account information, create new accounts, transfer allowances out of their general accounts to other accounts and to view reports. The general account holder would have limited (or no) access to source information, unless the holder is also a compliance account holder or until such information is determined to be public information.

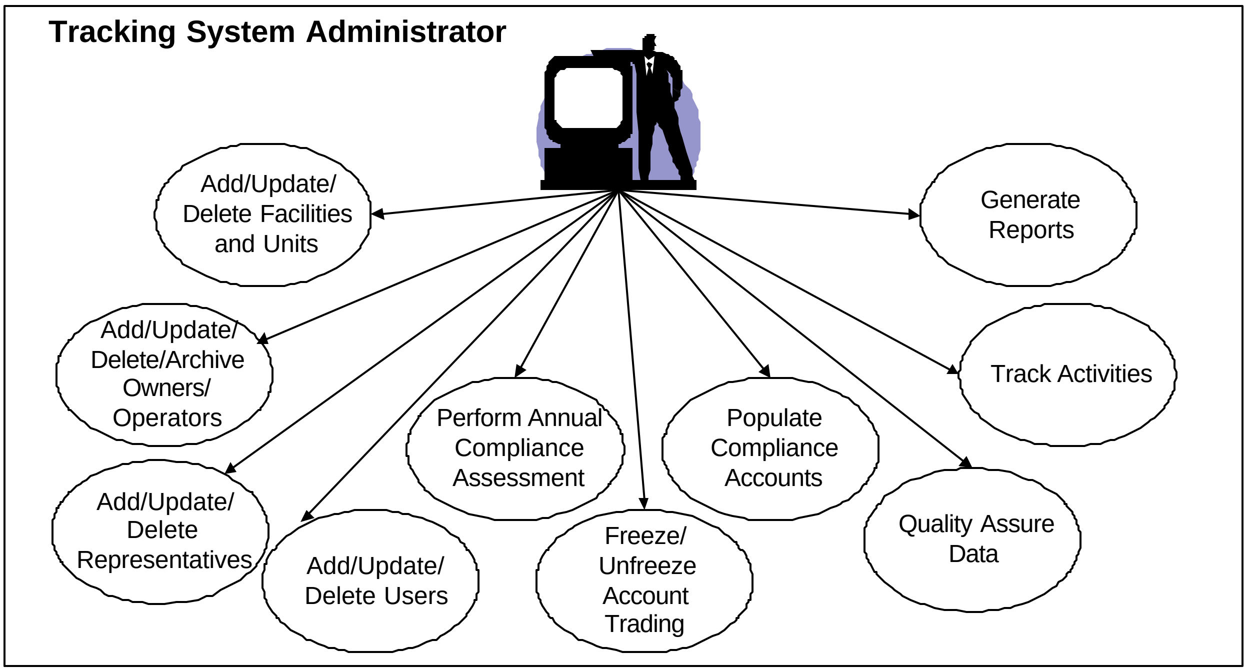
Figure 6
Use Case Diagram: General Account Holders



D. Tracking System Administrator

The Tracking System Administrator (TSA) would utilize virtually all functionality contained within the application. In appropriate circumstances the TSA would act on behalf of State/Tribal, industry and general account users. In addition, the TSA would perform all types of system management and maintenance activities to ensure effective operation of the application. The TSA would approve access for all users of the application.

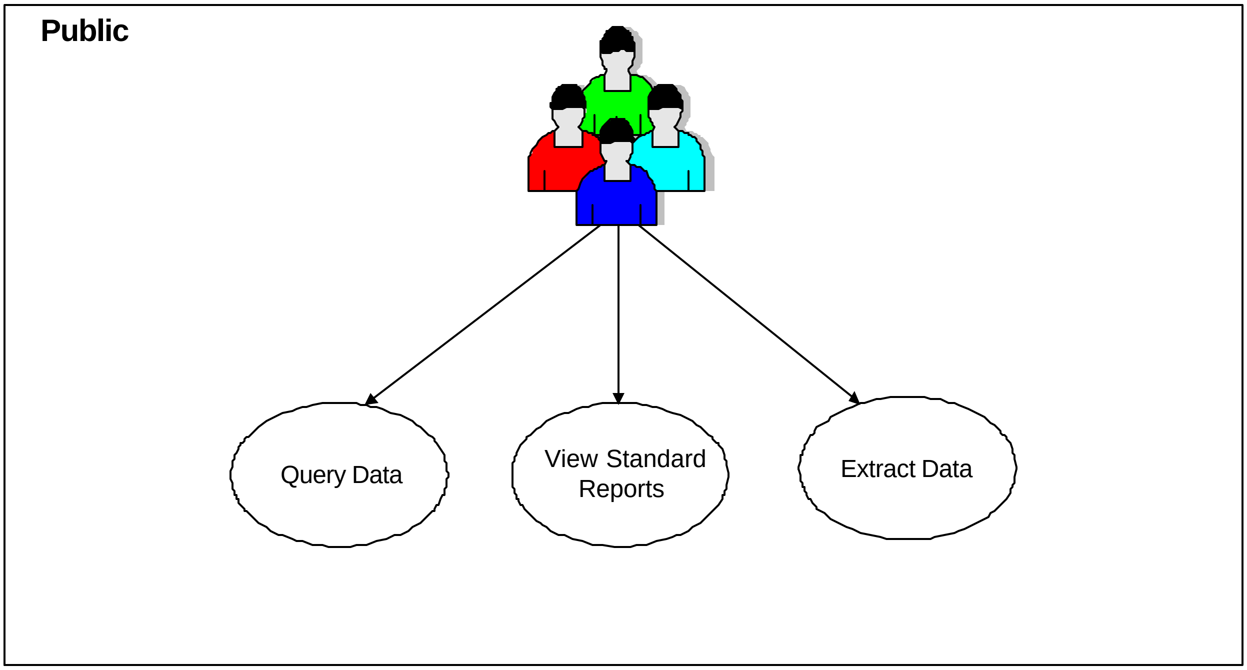
Figure 7
Use Case Diagram: Tracking System Administrator



E. Public Users

Public users have read-only access to selected data within the system. This access would be consistent with the security requirements of the application and data.

Figure 8
Use Case Diagram: Public Users



V. Technical Architecture

A key component of system design is the selection of a common architecture. One of the major components of system architecture is the number of levels or layers in a system. An application installed on a user's machine that does not communicate with any other applications or systems is a 1-tier system. A client-server system, where one application sits on a user's computer (client) and another, related application sits on the server is a 2-tier system. Most Web applications are 3-tier systems, where there is a browser and Web server (client), a business logic server and a database server. The system should be built with at least three layers to separate the display (client), business logic, and database, so that each layer could be modified without having to change other parts. The exact architecture would be determined at the time of system design.

The final decisions about system architecture should consider many factors, including security, performance, and maintainability.

A. Security

Due to the importance of data integrity and accuracy in the WEB EATS, security will be extremely important. The security measures should be based on current best practices and standards. The system's security can be divided into two areas: application and server level security.

1. Application Level Security

The system's application level security consists of the protective measures designed into the application's code. These include the logical measures to determine which users may access which areas of the system, the manner in which session management is handled and the protection of sensitive information, like passwords, at the application level.

- Password Encryption. The system must include a process to authenticate all authorized users to the system. Today's system utilizes encryption to protect the vulnerable data elements, such as user passwords. Implementation of an extremely robust encryption, routine or its equivalent should be incorporated into the system.

- Separate Logins. Each user should maintain a unique username and password, with the password encrypted and stored in a secure database. Each user should be assigned a unique ID.

- Separate User Types. The access rights and restrictions should be controlled at the user group level. Each user group would have a unique set of rights and restrictions within the WEB EATS. Upon user login to the system, the user's specific user group security should be verified and rights and restrictions set for the session. If the user belongs to multiple user groups, they should be assigned the highest rights for a given section or action among their user groups.

- Audit Trail. The system design should include specific requirements to maintain an audit trail of data adds, updates, and deletes for critical data elements. This audit trail should be designed to detect and resolve challenges to the data (for example, allowance ownerships), and as an additional means of restoring data should there be a breach of data integrity.

- Session Management. Strict session management control, in which session tokens are properly protected and validated, is essential. When two applications are run remotely from each other (like a browser and a server), they require session tokens to be able to communicate about the application state. To prevent attackers from hijacking active sessions and assuming the identity of a user, session tokens need to be regularly re-validated.

2. Server Security

The system's server level security consists of the protective measures designed to protect the server itself from inappropriate access. These include proper server maintenance and the modifying of default system passwords.

- Server-Side Data Validation and Business Logic. To the extent possible, all business logic and data validation should be checked and handled at the server level and not be coded at the client or browser level. Server-side validation improves performance and reduces the risk of a user bypassing business logic designed to prevent them from submitting invalid data. Server-side validation includes business logic as well as basic data type validation (i.e., length, range, data type, characters sets).

- Server Maintenance. The servers or host platform should be maintained according to security standards. For example, many of today's current servers are patched on a regular basis with the latest security releases as soon as they are available. Because flaws in server software are usually well known in the hacker community, it is important to protect the server from attackers.

- System Passwords. The system passwords to the servers or host platform should be modified from their defaults and changed on regular intervals. Because the default passwords for commercial servers are commonly known, they pose a security threat and should be changed. Also, standard security practices should be followed regarding the regular changing of passwords.

3. Physical Data Security

Physical data security should be provided by the measures to protect the data center, a specialized facility that hosts an application, from dangers. These dangers include theft, natural disasters, manmade catastrophes, and accidental damage (e.g., from electrical surges, extreme temperatures, spilled coffee, etc.). The data center that hosts the WEB EATS should maintain strong security practices and undergo periodic audits.

4. Backup and Recovery

The database should be backed up at least daily and the application files should be backed up regularly. It may be advisable to back-up the allowance transaction data at a more frequent interval, based on the frequency of use and level of recoverability deemed necessary. A copy of the backup files should be stored off-site from the data center to ensure minimum downtime should a catastrophe occur.

A Catastrophe Recovery Plan (CRP) should be created to enable the application to return to service as soon as possible following a catastrophe. Most CRPs contain the following:

- Threat analysis,
- Risk assessment,
- Mitigation steps,
- Response and recovery plans,
- Damage assessment process,
- Salvage procedures, and
- Rehabilitation plans.

B. System Performance

The system's performance can be greatly improved with the intelligent application of best practices and procedures for performance tuning and system design. These include the following:

1. Database Design and Query Optimization

The database should be designed with performance in mind. All database queries should be optimized to maximize performance. Use of views and indices or similar database functionality should be considered to maximize database performance. By limiting the results to only those that will be utilized immediately, the system will minimize the server and network resource load.

2. Session Variables

System design or programming technologies that overuse session variables can degrade the performance of the system. Therefore, only information that absolutely must be maintained to keep the session active should be stored in session variables. Following a user logout or the expiration of a short time limit, session variables should be explicitly purged from memory.

3. Archiving Data

Data should be archived regularly to conserve database space and enhance performance. A mechanism should be provided for retrieving the archived data for reporting purposes.

4. Data Volume

The data volume of the WEB EATS will be largely determined by the number of sources and the frequency of data collection. With a planned number of sources of less than a thousand, which may include the periodic submittal of hourly data collection, the database is projected to grow approximately 4GB per year. To ensure maximum performance, the database should be regularly re-indexed and monitored for performance. It is recommended that the emissions data collection component sit on a separate server from the business logic server for performance gains.

5. Frequency of Use

The system design should take into account the number of users, the level of access, and the volume of data provided by users for specific processes. The WEB EATS usage is expected to be well within the normal expectation of capability for a small to moderate size application. For emissions data submission, the volume of data may be relatively high (by current standards) and require special design consideration.

C. Maintainability

To achieve a flexible system that evolves with program needs, the system should be developed for maximum maintainability. If the application is based on vendor software, it should be built upon well-known technology and platforms. If it is custom developed, it should be well documented and based upon best programming practices and standards and developed in a common development language. These measures will minimize time and cost to maintain the application following implementation.

In addition, the programming team should be required to adhere to programming standards, including code organization and documentation, to facilitate support and enhancements after deployment.

Post-deployment modifications should be developed by a set protocol including input from users.

D. System Outputs

The system should support various types of outputs, including data transfers, electronic communications, like email, and connections to external systems. During the system design, the needs of the proposed users and the archiving of data should determine exactly which system outputs should be available.

1. Data Transfers

The periodic transfer of emissions and related data should be communicated to the application via a standard information exchange protocol. The exact protocol and procedure will need to be determined based on best practices and volume of data at the time of implementation. Each data record should be error checked to verify its integrity during the submission process.

2. Electronic Communications

The application should contain functionality that notifies parties via electronic communication upon the execution of certain actions. These actions would include, for example, allowance transfers, freezing/unfreezing accounts, and system maintenance notices. The exact list of actions, subsequent message media, recipients, and structures should be determined as part of system design.

3. External System Connections

The application would be expected to provide data to external data systems such as the Emissions Inventory System that the WRAP will be using to perform the program trigger evaluations tracking. The system should also support connectivity with the National Environmental Information Exchange Network and Tribal Emissions Implementation Software Solution (TEISS). The exact methods used to connect other systems will be determined at the time of system design.

The application should also be able to communicate and transfer data files to and from other EPA data and allowance tracking systems, such as the system supporting the federal SO_2 emissions trading programs.

E. Application of Platform Selection Criteria

During the preliminary phases of the system design, a significant decision will be the selection of the technology platforms or architecture for the system. These platforms include the Web server, business logic server, database server, and client interface. For each of these platforms, consider these issues with the following questions in mind:

! Data volume. Will the volume of data which must be maintained, transferred and analyzed be supported by the database and/or the application? Be sure to calculate the data volumes over the estimated life cycle of the project keeping in mind any applicable program specific or overarching regulatory requirements relating to government recordkeeping.

! Performance. What are the minimum performance requirements for basic application tasks, such as accessing the system, updating source information, transferring allowances? What are the minimum performance requirements for infrequent tasks, such as annual compliance assessments, data quality analyses, or submitting hourly emissions data? What are the performance requirements for reports?

! Relative Costs. What are the overall cost constraints? What is the acceptable ratio of design costs to development costs and initial deployment costs versus maintenance costs? Research these issues for comparable systems and platforms.

- <u>Maintainability</u>. What specific standards and assumptions should be imposed for maintainability?

- <u>Connectivity</u>. Which connectivity standards should the system support?

- <u>Efficiency</u>. Are there specific design choices which will impact the efficiency of program implementation? Examine design options and platform options to maximize efficiency benefits of the information system for the overall operation of the program. To what extent should the efficiency benefits to regulated industry, general account holders and the public be taken into account?

- <u>Availability</u>. What level of system availability is acceptable for each type of user?

VI. Design and Development Approach

The second objective of this document is to serve as a roadmap to help the States and Tribes implement the program once it has been triggered. Outlined below is an implementation methodology that the States and Tribes can follow to design, develop and deploy the system. In addition, this section provides an analysis of cost and scheduling factors that should be considered.

A. Recommended Implementation Methodology

Upon the trigger of the WEB Trading Program, detailed system requirements will need to be assessed. The following section recommends, steps to design, develop and implement an information system for the program. It is recommended that a workgroup be created and assigned responsibility for this task. The workgroup should be comprised of user group representation, program analyst(s), and technical specialist(s).

1. Requirements Verification

The first step following the need to implement the program will be to verify the requirements of the information system. Since many of the procedural elements of the SIP/TIP will be decided in the future, the exact functionality may have changed since the creation of this document. Therefore, detailed requirements should be verified and incorporated into a system analysis document. It is expected that this stage of the process will require significant participation of all stakeholders, particularly the States and Tribes participating in the program.

2. Assessment of Current Standards and Technology

Following the verification of requirements, the workgroup should research and assess the current standards and technologies applicable to this type of information system. Since this application would probably not be designed until many years after this document, it was determined that the current standards would have little value and these have not been evaluated or referenced.

3. Technical Architecture Option Evaluation

Just as the standards and technology should be evaluated, so should the possible technical architectures, as discussed above. Most systems at the time of the creation of this document are 3-tier, but that should certainly not limit the architecture of the WEB EATS. Also, the suggested measures for security and maintainability may no longer be applicable, and should thus be re-evaluated.

4. Closeness of Fit

Based upon the system analysis requirements, standards, and architecture assessments, the workgroup should perform a Closeness of Fit study to analyze the available products, technologies, and platforms available. By analyzing the field of products, technologies, and platforms available, the Closeness of Fit study should conclude with a recommended product or set of development technologies and standards.

5. Decision

Based upon the Closeness of Fit study, the workgroup should select a product from a vendor(s), develop a custom system, or a combination of the two.

6. Design/Customization/Development Strategy

Following the decision to either select a Commercial Off-the-Shelf (COS) product, develop a custom application, or customize an existing application, the workgroup should select a developer and/or TSA to design, develop and implement the system.

The development plan should include a careful review of the schedule of program implementation and requirements to ensure that the necessary elements of the application are in place at the appropriate time. A staged process, with design, development, and deployment of specific system modules, is recommended. For example, the initial phase of development would probably focus on the source registration capability and initial allowance allocations. Later development could include allowance transfers capability, annual compliance assessment or overall program assessments.

7. Development

Following agreement upon the system design, the developer or TSA should develop the system utilizing modern development best practices and procedures. It is recommended that the developer and/or TSA work with the members of the requirements gathering workgroup to re-affirm and adjust requirements as needed.

8. Quality Assurance/Testing

Following the successful development of the system, the developer/TSA should submit the system for rigorous testing. A test environment should be set up and a test database should be populated with data that closely match the quantity and type of data that will be utilized during live transactions. All phases of the system should be rigorously tested by the developer/TSA, States and Tribes, and a select group of end-users.

9. Deployment

Following successful quality assurance of the system, the workgroup and the developer/TSA should agree that the system is ready to be deployed or implemented in a production environment. Prior to production, the database will need to be populated with the necessary baseline information including source inventory data, emissions data, users, etc. The developer/TSA should provide training/instructions to users of the system along with appropriate documentation. It is assumed that participating States and Tribes will work closely with the TSA to define and implement a communication strategy to ensure compliance with all program requirements and full use of the information management system developed to ensure its success.

B. Timing/Schedule

If there is no significant delay after program trigger in the initiation of the information system design and development process and if a staged approach to deployment is adopted, then an implementation schedule in which the necessary system elements are in place is achievable. This objective should be stated at the outset of the project.

It should be noted that the use of COS or the customization of an existing system might reduce the initial development time for the system. To fully design, develop and deploy a custom application by today's standards might extend one to two years. Additional time might be necessary if there were significant issues relating to functionality or process about which State and Tribal participants could not agree. Technology trends indicate that forthcoming design and development methodologies will likely reduce this estimate.

C. Cost Factors

Factors driving the cost of the information system include technical platform, design complexity, data volume, security level, and the level of and approach to integration with other data systems. The availability of and use of COS or another application as the basis for the application would also affect costs.

1. Technical Platform

The technical platform includes the server software and business logic systems that are required. There are a wide range of options for the level of solution required and cost. A middle-ground solution is most likely the most suitable for the WEB EATS, one that maximizes flexibility and maintainability.

2. Design Complexity

The level of complexity incorporated into the system design will be a large cost factor. Generally, the more complex systems are, the more they cost. Based on the current system analysis, the system design appears to be moderately complex. As with any application, the requirements phase of the project may result in relatively more or less complex requirements, directly affecting costs.

3. Data Volume

The amount or volume of data will be a key cost driver in selecting the database server. If only one database is utilized for both the allowance and emissions data in WEB EATS , the database will grow quickly and will require a high-end solution to maintain performance levels. It is expected that the relatively high data volume will require database optimization and regular tuning, which will add to the maintenance costs.

4. Security Level

The level of security built into the system will certainly affect the cost. The more robust the security model is, the more time consuming and costly to implement. The security level detailed in Section III(A)(I) dictates a moderate level of security.

VII. TSA Responsibilities and Performance Criteria

A. TSA Responsibilities

The Tracking System Administrator (TSA) will have responsibility for the deployment of the site, ongoing maintenance and the day-to-day program implementation tasks associated with the program. It seems likely that the TSA would also design and develop the information system, but it is not necessary that both development and support should be provided by the same organization. Regardless, the ongoing responsibilities of the TSA would include two types of support: information system and program implementation.

1. Information System

This category of support is to ensure that the information system is properly administered, supported and performs all required functionality.

- Data security. The TSA would assume responsibility for ensuring that the security of the site and the data is monitored and protected on an ongoing basis. This would include monitoring access to the site and attempted but failed access (particularly if occurring in significant volume).

- Data integrity. The TSA would assume responsibility for ensuring that the integrity of the data is monitored and protected on an ongoing basis. This would include ensuring that the referential integrity of the data is maintained, a data backup plan is implemented, and any opportunities for data corruption are identified and addressed.

- Data quality assessment and corrective maintenance. The TSA would develop within the application and be responsible for performing data checks to identify duplicative information, data omissions or other data of poor quality that are not easily prevented by error checks or data standards. The TSA would make corrections to the data, as necessary, and maintain documentation of changes.

- WEB EATS enhancements. The TSA would document and evaluate any proposed enhancements, modifications or additions to the application. Working with the State/Tribe participants in the trading program and within established budget constraints, the TSA would perform, test and deploy the modifications (in coordination with the assigned programming team).

- WEB EATS documentation. The TSA would have responsibility for maintaining all technical documentation for the WEB EATS (including enhancements and for maintaining records relating to its ongoing operation).

- User technical support. The TSA would provide technical support to all users of the application. This would include telephone support and responses to requests or inquiries through other means of communications. The TSA would maintain records of all technical support and the TSA response. Technical support needs could also be addressed through the use of other support tools, comparable to the FAQs or online support systems currently in use.

- Performance monitoring. The TSA would be responsible for monitoring the overall performance and availability of the application for all types of users. This would include identifying the causes of any disruption of service or availability and identifying any persistent problems experienced by the user community.

- Database administration. The TSA would monitor data performance and perform all maintenance and optimization tasks affecting the performance of the database. The TSA would maintain records of all database administration activities.

2. Program Implementation

The TSA is also expected to implement the program for the consortium of States and Tribes participating in the program. This is necessary to ensure that the program will be implemented consistently and cost effectively.

- User access administration. This support would include evaluating and responding to user access requests, password changes, and related usage issues.

- Coordination with States and Tribes. The TSA will coordinate, as necessary, with each State or Tribe participating in the program to ensure that the State or Tribe fulfills their responsibilities and is aware of the need for their participation in decisions or issues. This includes aiding the States and Tribes in developing enforceable procedures for recording the necessary data. For example, the TSA would obtain allocation lists, petitions, retirement approvals, information about new sources, and reduced emissions monitoring under Section I1.(6) of the model rule from the State or Tribe.

- Perform allowance allocations. Using the information provided by the State or Tribe, the TSA would perform allowance transfers from government accounts to compliance accounts. The TSA would provide a report (or electronic file) to the State or Tribe of these actions.

- Periodic status reports on system activity and program implementation issues. On a regular basis (monthly, quarterly and annually), the TSA would provide to the participating State and Tribes a summary of program activity. This report would include, for example, a summary of allowance transfer activities, a status report on emissions reports, or the level of public access to the database.

- Annual compliance assessment. The TSA would perform the annual compliance assessment or true-up and would coordinate with industry, States and Tribes regarding the results of this process. Following review or approval by the participating States and Tribes, the TSA would finalize the compliance assessment by retiring the appropriate number of allowances from compliance accounts. An end-of-year compliance report would be made available.

- Communication strategy development/implementation/support. Throughout the life of the program, the TSA would work with the participating States and Tribes to maintain and implement a communication strategy and plan. The purpose of the plan would be to ensure full participation of affected sources in the emissions trading program and to maximize understanding of and knowledge about the program among all interested parties. The content of the plan would include a strategy for general guidance, day-to-day communications to sources about their actions (transfer confirmations, data receipts, etc.), State/Tribal reports, communications between States and Tribes about ongoing program issues such as monitoring approvals or petitions, participant or public meetings and publications containing program results or environmental assessments.

- Overall program assessment. The TSA would assist the States and Tribes in designing and conducting an assessment of the overall program operation, costs, and environmental benefits on a periodic basis.

- Error correction, followup and documentation. The TSA would be responsible for correcting any data entry errors reported by users that are not within the security limits for the user.

B. TSA Performance Criteria

To ensure adequate support for the program, it will be necessary to establish performance criteria for the TSA.

1. Technology Standards

For the WEB EATS and technology support, the key criteria should be based on technology standards prevalent at the time of deployment and they should be tailored to the technical architecture selected for the WEB EATS. The following criteria would fall into this category and should be defined at the appropriate time. The importance of each of these factors should also be considered during the WEB EATS system design phase and in the selection of a technical architecture.

- System performance (response time, number of concurrent users supported, frequency of WEB EATS or database errors, etc).

- System availability (average downtime).

- Timeliness of public access to data.

2. Contract Performance Standards

Other important criteria relating to TSA performance would be the traditional criteria relating to overall performance with respect to basic contract terms. These would include:

- Responsiveness to customer concerns,
- Timeliness and quality of status reports,
- Overall cost, and
- Budget accuracy.

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3. United States Environmental Protection Agency. Clean Air Market Programs. Emissions & Allowance Tracking System.

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Appendix A-8c. Recommendations for Making Additional Determinations in the Context of Reasonably Attributable BART

Recommendations for Making Attribution Determinations in the Context of Reasonably Attributable BART

Prepared by: The WESTAR Council

Prepared for: The Air Managers Committee, Western Regional Air Partnership

May 2003

Recommendations for Making Attribution Determinations in the Context of Reasonably Attributable BART

Prepared by:

The WESTAR Council RA BART Phase II Working Group: Alice Edwards, Alaska Department of Environmental Conservation; Mike Sundblom, Arizona Department of Environmental Quality; Deb Wolfe, Montana Department of Environmental Quality; Dana Mount, North Dakota Department of Health; Dave DuBois, New Mexico Environment Department; Colleen Delaney, Utah Department of Environment Quality; Alan Newman, Washington Department of Ecology; Lisa Reiner, Quinalt Indian Nation; Bruce Polkowsky and Kristi Gebhart, National Park Service; and Kristin Gaston and Bob Lebens, WESTAR.

Prepared for:

The Air Managers Committee of the Western Regional Air Partnership
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Authors of the Attribution Techniques (Section VI) are Mike Sundblom (Monitoring); Kristi Gebhart (Receptor Modeling); and Dave DuBois (Source Modeling), with assistance from Ajith Kaduwela, California Air Resources Board. Bruce Polkowsky and Colleen Delaney drafted the certification section and provided liaison between the Western Regional Air Partnership Market Trading Forum and the Working Group. Alan Newman, Washington Department of Ecology drafted the portion of the report outlining the example process to which Dana Mount also contributed. Kristin Gaston drafted the regulatory context section and along with Bob Lebens, edited the report.

EXECUTIVE SUMMARY

This report recommends a general procedure and applicable technical approaches that may be used by states and tribes to assess reasonable attribution in response to a Federal land manager (FLM) certification of visibility impairment in a Class I area (Certification).

WESTAR formed the Reasonably Attributable Best Available Retrofit Technology (RA BART) Phase II Working Group with Federal land management agency staff and members of state and tribal air quality agencies knowledgeable about RA BART and associated monitoring and modeling techniques. To provide the necessary framework, the report provides background information about both the certification process and the attribution determination process. However, the recommendations focus on the general principles of the attribution assessment process and the technical criteria used in the assessment.

The recommendations are summarized below:

General Principles:

The attribution assessment should be:

- A collaborative process that relies on existing data with minimal additional analyses.
- Technically and legally defensible.
- Accomplished at a reasonable cost and within a reasonable time frame.
- No more complex than necessary.
- Performed by state or tribal agency staff.
- Adequate to determine whether or not visibility impairment is attributable to an existing stationary source potentially subject to BART.

Technical Criteria:

- Emissions from BART-eligible sources must "cause or contribute to" visibility impairment. Visibility-impairing pollutants of concern must be identified.
- Factors to consider in assessing impairment include: duration, frequency, geographic extent, magnitude, and time of occurrence.
- Identify distance from source to Class I area to determine appropriate tools for characterization of the impairment.
- Quantitative results are preferable, although qualitative results such as photographs may be adequate.
- Use as many different indicators of impairment as practicable rather than relying on a single indicator.
- Consider level of uncertainty in the assessment.
- Use EPA guideline models whenever practicable.

Table of Contents

I. BACKGROUND

A. Introduction and Purpose

Reasonably Attributable Best Available Retrofit Technology (RA BART) is the portion of EPA's visibility rule published in 1980 and codified in 40 CFR 51.302–51.306 that deals with visibility impacts from one source or a small groups of sources. RA BART refers to reasonably attributable visibility impairment and best available retrofit technology for eligible sources and emission limits, and emissions controls as defined by the statute and the rules. Some confusion exists regarding the application of RA BART, the process of assessing sources of visibility impairment, and the technical tools available for an RA BART attribution determination. RA BART is a statutory requirement, although certain of the requirements may no longer be applicable when a source complies with BART or installs BART-like controls or after a state implements a trading program under 51.308(e)(2) or any trading program under 51.309, and if no remaining visibility impacts continue from one source or a small group of sources.

This report, therefore, addresses the RA BART attribution process and builds upon case studies WESTAR developed in 2001 to examine and document how Reasonably Attributable Visibility Impairment (RAVI) had been addressed in previous assessments.[1]

The Federal land managers (FLMs) advocate maintaining RA BART as a tool because RA BART is effective when new monitoring indicates that a previously un-monitored area has visibility problems differing from the regional visibility impairment conditions at other areas. In addition, RA BART is effective when BART-eligible sources in the vicinity of the protected area are causing or contributing to identified visibility impairment.[2]

First, this report recommends attribution process principles and assessment techniques a state or tribe may consider in an attribution assessment to identify if, and to what degree, an existing source or small group of sources causes or contributes to visibility impairment. The report focuses on RAVI and does not specifically address impairment due to regional haze. Although this report includes references to regional haze, such references serve only to place the attribution process in the larger context of the broad regulatory framework that addresses visibility impairment, including the regional haze regulations.

Second, this report includes no recommendations with regard to establishing a threshold level at which reasonably attributable impairment exists. Instead, the working group outlined a recommended general process and recommended technical procedures that may be used as guidelines if an attribution assessment is necessary. Due to the circumstances unique to each attribution assessment and the requirement that the assessment be conducted on a case-by-case basis, recommending one specific analysis for every situation was not possible. A state or tribe should select from the techniques summarized in Section IV. Section IV(C) includes five examples of the attribution assessment process, each providing a range of techniques to be used

[1] WESTAR Council, *RA BART and RA BART-like Case Studies*, June 2001.

[2] This document specifically relates to RA BART and does not address broader issues relating to long-term visibility strategies. FLMs generally do not intend to issue Certifications citing specific sources except for situations involving BART sources.

based on available data. The examples also recommend more refined analyses that may require additional data.

Third, this report includes specific information about the current policy of FLM agencies regarding certifications of impairment (Certification), but makes no recommendations regarding the certification process. This report makes no recommendations regarding state process following an attribution determination nor examines options for performing the Best Available Retrofit Technology (BART) analysis or the incorporation of BART requirements into State Implementation Plans (SIPs).

Tribal Implementation

The recommendations in this document are intended to help states assess reasonable attribution following Certification by an FLM. Subject to the requirements of the Clean Air Act, 42 USC 7601(d) and the Tribal Authority Rule, 40 CFR 49.1– 49.11, a tribe may accept responsibility for making reasonably attributable determinations in response to a Certification by an FLM when a BART-eligible source identified by the FLM in the Certification is on the tribe's land. The regional haze rule also explicitly recognizes the authority of tribes to implement the provisions of that rule on tribal lands. Those provisions create the following framework:

1. Absent special circumstances, reservation lands are not subject to state jurisdiction.
2. Federally recognized tribes may apply for and receive delegation of federal authority to implement CAA programs (including visibility regulation), or "reasonably severable" elements of such programs. The mechanism for this delegation is a Tribal Implementation Plan (TIP). A reasonably severable element is one that is not integrally related to program elements that are not included in the plan submittal, and is consistent with applicable statutory and regulatory requirements.
3. Where a tribe does not seek delegation through a TIP, the Environmental Protection Agency (EPA), as necessary and appropriate, will promulgate a Federal Implementation Plan (FIP) within a reasonable timeframe to protect air quality on tribal lands.

Accordingly, these recommendations also may assist a federally recognized tribe that chooses to adopt a TIP to implement the RA BART provisions. In some cases, a tribe may be able to utilize the recommendations in much the same way as states. In many other cases, however, the recommendations may be modified to meet the unique situation of the tribe and the nature of its air program, including its manner of defining "reasonably severable elements" and its method of dividing responsibilities between the tribe and EPA. Because of these differences, the recommendations that follow do not refer to tribes every time states are referenced.

B. Regulatory Context

The national goal for visibility is set forth in the Clean Air Act (CAA) at 42 USC 7491: "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from manmade air pollution." The requirements apply to 156 designated Class I areas.

As stated previously, Congress required that states provide a remedy for visibility impairment that was "reasonably attributable" to one source or a small group of sources. (42 USC 7491). Congress directed EPA to ensure that all SIPs contained measures necessary to make reasonable progress toward meeting the national goal, including requirements for identifying major sources of emissions causing or contributing to visibility impairment, and requirements for the application of BART on such sources. EPA promulgated rules pursuant to Congress's directive to provide guidelines to the states on appropriate techniques and methods for implementing the SIP requirements. (40 CFR 51.302(c)). (Note: when this report refers to a "source" within the meaning of this regulation, the phrase "or a small group of sources" is implied.)

The requirement to install Best Available Retrofit Technology controls on existing sources is a key element of the visibility protection provisions in the CAA demonstrating the need to focus on pollution emitted from a specific set of existing sources. Sources are potentially subject to BART controls if they meet the following criteria:

1. A major stationary source from 1 of 26 source categories identified in the CAA and regulations (see Appendix A);
2. Potential to Emit (PTE) 250 tons per year of any air pollutant; and,
3. Not in operation prior to August 7, 1962 and "in existence" on August 7, 1977.

In the 1980 visibility rule, EPA used the term "existing stationary facility" to define a facility that met the above criteria. However, to avoid any confusion about whether that term encompassed a larger group of sources, EPA now uses the term "BART-eligible source." The term "BART-eligible source" is used throughout this report for similar reasons, but the reader should be aware that some sections of the visibility rule still refer to "existing stationary facilities." For purposes of the attribution discussion in this paper, these terms are interchangeable.

In 1999, EPA added two new sections to the visibility rule to address regional haze (40 CFR 51.308 and 51.309). Pollutants causing regional haze may be transported hundreds of miles, and therefore, regional haze must be addressed as a broader regional issue. The 1980 visibility rule focused on direct visibility impacts of an individual source or small group of sources. The 1999 revisions are commonly referred to as the regional haze rule, although the 1999 rule incorporates the earlier requirements for BART as well as the new regional haze provisions.

To remedy RAVI, the regulations outline a process to identify and control emissions from sources that are directly impacting visibility at specific Class I areas (40 CFR 51.302). Three primary steps in this process are:

1. The Federal land manager certifies impairment;
2. The state identifies existing sources that cause or contribute to the visibility impairment; and

3. The state performs a BART analysis to determine what controls, if any, are required on any existing source that meets the BART criteria and has been identified as contributing to the impairment.

Attribution Process

The language of 40 CFR 51.302(c)(4)(i) provides the basic principle upon which the state will rely during the attribution process. That section states that the attribution must indicate each [BART-eligible source] "*which may reasonably be anticipated to cause or contribute to impairment of visibility*." Whether or not the impairment is "reasonably attributable" is determined by "visual observation or other technique the state deems appropriate." (40 CFR 51.301(s)). Because the state is responsible for identifying sources, this report provides recommendations for the state to consider when it undertakes an attribution determination.

Once visibility impairment is identified, RAVI is addressed on a case-by-case basis. Under the 1980 regulation, a state evaluates BART-eligible sources only after an FLM certifies the existence of visibility impairment. However, in the context of the current regional haze rule, states must also address BART requirements for regional haze (RH BART).[3] Several options exist for addressing RH BART. For example, rather than require a source-specific BART emission limit, a state may choose to develop a trading program, either regionally or within its own jurisdiction, that achieves greater reasonable progress than case-by-case RH BART.

If a state develops a trading program, the time period to achieve the emissions reductions may be extended. As a result, visibility conditions at a specific Class I area initially may remain static or even deteriorate during the early implementation period. During this time, FLMs have indicated that the RAVI process may be utilized to provide steady and continuing improvement in visibility. Within the context of the regional haze rule, this may be an example of a "geographic enhancement." As noted above, the recommendations in this report apply only to case-by-case applications of BART and are not intended to apply to the broader regional haze rule such as a market-based trading program implemented as part of the 1999 rule.

A state may find it difficult to determine a source/receptor link for RAVI difficult when there are other sources located in the area, including international sources. However, the regional haze rule provisions do not alter the requirement to undertake the attribution assessment.

State determines what controls, if any, are required

After the attribution determination, the state is required to perform a BART analysis to determine what types of controls, if any, should be placed on the source(s) found to be contributing to the impairment. The following factors affect the BART determination:

1. Available technology;
2. Costs of compliance;
3. Energy and non air quality environmental impacts of compliance;

[3] The RH BART provision was remanded to EPA by the U.S. Court of Appeals as a result of the ruling in *American Corn Growers Association v. EPA*, No. 9901348 (DC Cir. May 24, 2002)

4. Remaining useful life of the source; and,
5. Degree of improvement that can be anticipated to result from the use of the controls.

As noted above, this report does not provide guidance regarding state process following an attribution determination nor does it examine options for implementing the BART requirement.

II. FEDERAL LAND MANAGER CERTIFICATION OF IMPAIRMENT

The Federal land managers monitor visibility through a nationwide monitoring network, known as Interagency Monitoring of PROtected Visual Environments (IMPROVE). The IMPROVE network has recently been expanded and the FLMs anticipate reliable trend data for the new IMPROVE sites between the years 2006 and 2008. The FLMs plan to evaluate the current visibility conditions in Class I areas as well as trends occurring over time to identify areas where visibility is not improving.

The FLMs generally will use a screening process to identify Class I areas that may be affected by RAVI. This screening process will be influenced by the approach the state relies upon to address RH BART in its SIP. There are three approaches that may be used.

1. Case-by-Case Review of RH BART under 51.308

No distinction exists between emission reductions needed to address RH BART and reductions to address RAVI, therefore, the BART process will address both types of visibility impairment.

2. Trading Program under 51.308

The FLMs anticipate that the following screening criteria may be appropriate, but will not make a final decision until a 308 trading program has been developed. The screening criteria associated with this approach may be similar to the screening criteria associated with the trading program option under 51.309. However, the FLMs have indicated that the screening criteria ultimately selected for 51.308 will depend on how the trading program is structured, the selected emissions cap, and other aspects of the trading program.

Potential Screening Process Criteria:

(i) Sulfate, nitrate, organic carbon, other fine particulate, etc., levels in the Class I area are not decreasing.[4]
(ii) One or more BART-eligible sources of SO_2, NO_x, VOC, PM_{10}, etc., are located within 100 miles of the mandatory federal Class I area.
(iii) The BART-eligible sources identified in (ii) are not already well-controlled for pollutants that contribute to visibility impairment.

3. Milestones and Backstop Trading Program under 51.309

The FLMs plan to sign a Memorandum of Understanding (MOU) with the participating states to define the screening criteria the FLMs will use to certify impairment.

[4] The decrease of a pollutant (or secondary species of that pollutant) would be measured from the beginning of the market or emissions trading program, and such a trading program would take a long time (10 to 15 years) to reach the level of reduction that "meets" BART. The decrease would be tested over the first 5 to 10 years. A very quick time frame for reductions would negate the need for RA BART criteria.

Screening Process criteria:[5]

(i) Sulfate levels in the Class I area are not decreasing.
(ii) One or more BART-eligible sources of SO_2 are located within 100 miles of the mandatory federal Class I area.
(iii) The BART-eligible sources identified in (ii) are not already well-controlled for SO_2 (85% or better SO_2 control for coal-fired utility boilers).

Goal: For FLMs to complete the certification process between 2006 and 2008.[6]

These criteria were influenced by the design of the 309 trading program including emission reduction estimates, shape of the declining emission cap, inclusion of sources that were not BART-eligible, and inclusion of new source growth under the cap.

Although geographic enhancements do not need to be addressed under the first approach, they must be addressed in the two trading programs described above because emission reductions may occur more gradually in the context of a trading program. The FLMs do not anticipate certifying impairment under these circumstances but do intend to notify the state as part of the SIP development process if concerns arise regarding "hot spot" impacts from sources that may directly affect specific Class I areas.

Note: BART for regional haze has been addressed for SO_2 under this option. Regional haze BART for NO_x and PM will be addressed in SIP revisions that are due in 2008.

In all three cases discussed above, if the FLM determines that a certification of visibility impairment is necessary, the FLM will send an official Certification to the state. The Certification will generally include the following information:

1. Class I area(s) impacted;
2. Basis of certification (photographic documentation, monitoring, modeling, etc.);
3. Type of impairment certified: plume impact, or layered or uniform haze;
4. Pollutant(s) of interest; and,
5. Preliminary identification of source(s) believed responsible for impact.

FLM, State, and EPA roles in RA BART

FLMs are responsible for certifying impairment. The Certification demonstrates the FLM's determination that there is evidence of visibility impairment from one source or a small group of sources.

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[5] Within the context of established regional milestones for SO_2 and a backstop trading program, the FLMs have said it is appropriate to use the following screening process in making these recommendations as part of the Certification. Voluntary Emissions Reduction Program for Major Industrial Sources of Sulfur Dioxide in Nine Western States and A Backstop Trading Program. An Annex to the Report of the Grand Canyon Visibility Transport Commission. Submitted by the Western Regional Air Partnership to the U.S. Environmental Protection Agency, p. 61, September 29, 2000.
[6] This goal will not in any way restrict the ability of the FLMs to certify impairment at a later date if it is necessary to fulfill their statutory obligations. *ibid*.

Following the Certification, states have the following regulatory obligations: (1) identify facilities that "emit an air pollutant which may be reasonably anticipated to cause or contribute to any visibility impairment" in that Class I area, and (2) for sources subject to BART, the state must identify the BART level of control technology. If the source does not have adequate control in place, the state must establish a BART limit in the SIP.

EPA has two major responsibilities for the RA BART requirement. First, in the states that do not have a SIP in place to address the RA BART requirements, but where the program is implemented through a FIP, EPA will conduct the BART analysis and establish any BART emission limits. Second, for the states with SIPs that include RA BART regulations, EPA will provide federal enforcement of state-established BART emission limits.

III. THE ATTRIBUTION DETERMINATION PROCESS

This section recommends a process for the state to follow in order to complete an attribution determination after receipt of a Certification from an FLM under 40 CFR 51.302(c)(1).

The Certification focuses on the existence of visibility impairment. While the FLM may identify sources or even sources areas that contribute to the Certification, the formal identification of sources is a state responsibility.

The state should make a detailed review of the data supporting the Certification to determine which sources or source areas require further evaluation. If the data are insufficient to identify specific sources or source areas, the state may request that the FLM perform more detailed analyses to further substantiate the impairment set forth in the Certification.

If the state determines sufficient information exists to proceed, the state should begin the process by: (1) evaluating which sources are BART-eligible, and (2) reviewing the impairment information provided by the FLM in support of the Certification.

1. Evaluate which sources are BART-eligible

Congress and EPA established criteria to determine which sources are subject to BART. The categories of sources subject to BART are listed in 40 CFR 51.301, the definition of "existing stationary facility," and also are included in Appendix A of this report.

The state must confirm that the potential source or group of sources is subject to the RA BART process by examining the potential source emissions and the dates of operation.

The criteria for determining if a source is BART-eligible may be complicated if a source has multiple units that were constructed at different times and a state may be unable to determine if a specific source would qualify as BART-eligible. EPA published guidelines in 1980 to aid states in implementing the 1980 rule.[7] In addition to the 1980 guidelines for determining BART-eligibility, EPA also has proposed guidelines that include criteria for determining if a source is BART-eligible.[8] These guidelines are expected to be re-proposed in 2004, promulgated in 2005 and codified at 40 CFR Part 51 as Appendix Y. The state should refer to both sets of guidelines to determine if a source is BART-eligible, although the proposed guidelines are not binding until final promulgation occurs.

When using the applicability criteria in Appendix Y, the state should look for information readily available from existing state data such as permitting history, emission inventory, or other similar databases.

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[7] U.S. Environmental Protection Agency, *Guidelines for Determining Best Available Retrofit Technology for Coal-fired Power plans and Other Existing Stationary Facilities,* EPA-450/3-80-009(b), Office of Air Quality Planning and Standards, Research Triangle Park, N.D., November 1980 (1980 BART Guidelines).

[8] 66 FR 38108 *Proposed Guidelines for Best Available Retrofit Technology (BART)* (July 20, 2001). EPA will re-propose these guidelines as a result of the remand in *American Corn Growers v. EPA*.

1. If a database of Potential To Emit (PTE) is not available, state emission inventories can be a useful screening tool to determine whether a source meets the size criteria (for example, identify all sources with emissions greater than 100 tons/year of visibility impairing pollutants). Operating permit applications may also contain information about the PTE of a source, or individual units within a source.
2. State business records may be useful to determine when the facility was constructed or when it commenced operation. Newspaper article searches or a detailed historical review of each source may also provide useful information.
3. The state should require the source to provide information regarding the construction dates of individual emission units.
4. Institutional memory within the air agency can be invaluable if records of construction dates of major emission units are not available, although memories will not withstand legal challenges like hard documentary data.
5. New Source Review permitting records may be useful to identify new units that were constructed after 1977, determine the PTE of the source, or determine if reconstruction has occurred. (Note: the draft guidelines in Appendix Y state that modifications at a source do not affect applicability unless the change qualifies as reconstruction of the source).

If the source or group of sources identified in the Certification is not BART-eligible, the state should inform the FLM of its finding. The state should look in the vicinity of all the sources suspected of causing or contributing to the impairment identified in the Certification. If no BART-eligible sources exist, an attribution assessment is unnecessary.

2. Review Support Information in the FLM Certification

Initially, the state should acquire all the supporting information the FLM used in the Certification and independently evaluate the data. This initial review will help the state determine if the information is sufficient to support a reasonable attribution determination.

The state should consider the type of impairment in the Certification: (a) plume impact visibility impairment, (b) uniform haze visibility impairment, or (c) layered haze visibility impairment:

(a) Plume impact is the impairment addressed by the original visibility protection program under which the state must make a reasonable attribution determination before proceeding to the BART analysis (40 CFR 51.301-51.307).

(b) In some instances, uniform haze may be thought to be source-specific haze from a BART-eligible source. If a state can successfully demonstrate there is a source emitting any air pollutant that may reasonably be anticipated to cause or contribute to any impairment of visibility, the state should consider that portion of the uniform haze to be impact from the identified source(s) and, therefore, consider the source to be subject to BART.

(c) The visibility impairment may also be defined as layered haze, a condition that results when aerosols are “trapped” under stagnant air mass conditions.

Once the FLM has issued a Certification, the responsibility for the attribution assessment shifts to the state. If a state does attribute impairment to a source, the state must be able to defend its finding that one or more BART-eligible sources did cause or contribute to visibility impairment in the Class I area. However, the Ninth Circuit Court of Appeals established a low threshold for unacceptable visibility impairment.[9]

3. Evaluate Existing Data not included in the Certification

When analyzing supporting data, the state should determine if additional information exists that was not available to the FLM. Examples include special project camera studies or ambient monitoring data collected by the state or local air pollution control agency, the potential or actual PSD permit applicant,[10] or the university. In certain situations, another agency may have previously collected information that could be used in an attribution determination.[11] These data should be reviewed to determine whether they support the FLM Certification.

To conclude this portion of the attribution process, the state may wish to prepare a report that summarizes its initial evaluation of the Certification. The purpose of the report is to carefully document the state's findings and conclusions about its decisions. The report would address two questions:

First, the report would assess whether any BART-eligible source(s) exist that potentially contributed to visibility impairment as described in the Certification. The report would contain a preliminary determination of whether the sources are BART-eligible and, if possible, analyze each source's relative contribution to the impairment (based on available source/receptor information).

Second, the report would assess the impairment data. This assessment would include the state's evaluation of the supporting data in the Certification and an analysis of any additional data used in the attribution assessment. The data gaps found in this review would be identified along with any recommendations for strategies to obtain the missing information. The state may use these recommendations to determine the next steps in the attribution process.

If the state believes the Certification is supported by sufficient data, proceeds with an attribution assessment and makes a determination that the data does or does not indicate a source subject to BART, the attribution process is complete. However, if the state determines the data is insufficient to complete an attribution assessment, the evaluation process ends, and the state may proceed to the next step—identification of data gaps and the studies necessary to obtain this information.

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[9] See *Central Ariz. Water Conservation Dist v. EPA*, 990 F.2d 1531 (9th Cir. 1993); See also discussion in *RA BART and RA BART-like Case Studies*.

[10] For example, a PSD permit applicant may be required to obtain pre-application ambient air quality information, and that information may not have been available to or known to the FLM.

[11] In Washington state, the plume of a defunct copper smelter has been traced by its arsenic deposition. If this were an active facility, this ground tracing of the plume could be used to support a source/receptor connection in an attribution determination.

4. Identify data gaps and necessary studies to fill the gaps

As part of the data review, the state should note gaps or inconsistencies in the available data. Examples of data gaps and inconsistencies may include:

1. Missing photos in a sequence of photos,
2. Poor resolution of the plume or its source in the photos,
3. Back trajectory analyses done with a very large grid resolution or poor techniques,
4. IMPROVE monitor data missing at critical periods,
5. Lack of association between the source's emissions and monitored data at the receptor,
6. Special studies performed during a time when a source that potentially contributed to the impairment was not operating,
7. Contemporaneous studies with contradictory results that cannot be explained,
8. Ambient studies that use naturally occurring tracers and, when the suspected source(s) are tested, the tracers do not exist or exist at levels far below (or above) the level indicated by the ambient study results,
9. Tracer studies where the tracer was not found at the anticipated receptors,
10. No explicit exploration of whether wildfire or other natural events significantly caused or contributed to one or more of the impairment episodes,
11. Other differences or inconsistencies in the available data.

Once any data gaps have been identified, the state should decide which studies are necessary to obtain the missing information sufficient to complete an attribution assessment. The state should design potential studies and determine the resource needs of those studies. The amount of work necessary will depend on the availability of the information and how critical the information is to the attribution assessment. Section IV provides technical criteria and examples of the technical process the state may consider at this point in the process.

5. Consultation Process

The WESTAR review of previous RAVI assessments demonstrated the importance of including all stakeholders in the design of any data collection plans or modeling protocols. Competing studies can be very inefficient, expensive, and time-consuming, and ultimately may not help the state make a final decision.

If stakeholders are involved in the design of any data collection efforts or modeling protocols, disagreements may be resolved before the state or source continues with any additional studies. The state should consider involving the following stakeholders in the consultation process:

1. Affected sources
2. Neighboring states and tribes
3. Environmental Protection Agency
4. Federal land managers
5. Local environmental groups
6. Local permitting agencies

7. Local government representatives

6. Completion and Review of Additional Visibility Studies

When the additional visibility studies, if any, are complete, the state should evaluate the resulting data. The technical staff may wish to finalize the report and make recommendations based on the scientific aspects of the data.

7. Final Determination of Reasonably Attributable Visibility Impairment

The state may reach any one of the following conclusions:

1. The impairment certified by the FLM is reasonably attributable to the identified BART-eligible source(s) for specific pollutants;
2. The impairment certified by the FLM is reasonably attributable to the source(s) identified by the FLM and additional sources not identified by the FLM for specific pollutants;
3. There is inadequate data to support a determination that the impairment is due to the source(s) identified by the FLM;
4. The impairment is reasonably attributable to other adjacent BART-eligible sources for specific pollutants; or
5. The impairment certified by the FLM is not reasonably attributable to a BART-eligible source.

IV. GENERAL PRINCIPLES AND CRITERIA

This section provides general principles and technical criteria for the state to consider after receipt of an FLM Certification. After receipt of such a Certification, the state must determine whether BART-eligible sources "emit any air pollutant which may reasonably be anticipated to cause or contribute to any visibility impairment in any" Class I area. While these principles and technical criteria should generally be useful and applicable, each state must decide what is required to support its individual determination.

Part A contains general principles to guide the development of a conceptual framework for the attribution assessment process. Part B contains evaluation criteria to guide the decisions regarding a technical framework for the attribution assessment process.

Conceptually, the statutory framework for an attribution determination ("may reasonably be anticipated to cause or contribute to visibility impairment") should be the general principle guiding the attribution process. EPA maintains, and the Ninth Circuit agreed, that an affirmative attribution decision is possible even with considerable uncertainty and a low triggering threshold. However, each state should decide individually what is required to support its determination.

A. General Principles of the Attribution Process

Attribution process criteria address factors likely to influence the performance of the state attribution assessment. These criteria provide parameters to define and implement the attribution assessment process given resource constraints, legal considerations, administrative decisionmaking requirements, and other relevant factors. The general principles include the following:

1. Whenever possible, an attribution assessment should be a collaborative process that relies on existing data with a minimum of additional analysis (*see* section III). If supplemental data are needed, field studies should be designed in a collaborative process between affected states and tribes, identified sources, Federal land managers, EPA, and the general public. Past experience has shown that competing technical studies often result in an unnecessarily expensive and unduly complicated process.

2. Attribution assessments should be technically and legally defensible.

3. Attribution assessments should be accomplished at a reasonable cost and within a reasonable time frame.

4. Attribution assessments should be no more complex than necessary, recognizing that the circumstances surrounding a Certification may vary greatly. State or tribal agency staff should be capable of performing the attribution assessment and making the final determination, although contractors may be used for certain types of modeling or monitoring.

5. Reasonably attributable visibility impairment can only be identified if a source/receptor

links a potentially BART-eligible source or small group of sources to a Class I area.

B. Technical Criteria

The technical criteria address the appropriateness of available analytical techniques from a scientific perspective. The rule defines visibility impairment to mean "any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions."

The technical criteria include the following:

1. The BART source must emit an air pollutant that may reasonably be anticipated to cause or contribute to any of the impairment. The visibility-impairing pollutants of concern must be identified.

2. The attribution assessment should address the unique visibility impairment in the FLM Certification for the Class I area. Some factors to consider include:

    a. Duration: source's length of effect on visibility per episode;[12]

    b. Frequency: how often episodes of impairment occur;

    c. Geographic extent: how much of the Class I area is affected by the impairment;

    d. Magnitude: how much visibility impairment is due to the source's emissions; and

    e. Time of occurrence: including time of day and time of year.

    These factors need to be considered together, because they affect each other. An infrequent occurrence of a large magnitude episode may meet the criteria. A frequent occurrence of a small magnitude episode may also meet the criteria. The FLM may provide information about these criteria in the Certification, and the state should review this information as a starting point for its assessment. The state may consider other factors and data, as appropriate.

3. The attribution assessment should identify the distance from the source to the Class I area. This distance will affect the choice of tools appropriate for characterizing the specific source's impact on visibility impairment.

4. To the extent possible, the attribution assessment should be quantitative. Under certain circumstances, qualitative information, such as photographs or time-lapse video of distinct plumes or source-specific haze events, may be adequate.

5. The state should use as many approaches or indicators of impairment as practicable

[12] Based on previous cases, most impairment episodes are relatively short—lasting one to several hours—which may affect monitoring and other assessment techniques.

rather than relying on a single method. The assessment may rely on air monitoring and modeling techniques and other supporting scientific data. Consistency between source and observational techniques strengthens the analysis.[13]

6. The state should consider the level of uncertainty in the assessment.

7. EPA guideline models should be used whenever practicable. When other models are used, additional technical discussions with EPA may be necessary.

C. Examples of the Attribution Process

The state should consult this section after evaluation of the FLM Certification. At this point, the state will already have decided what gaps need to be filled to complete the attribution assessment.

The recommendations in this report recognize that each attribution determination will be unique. Because an attribution determination is a fact-specific and individual determination, it is not possible to recommended a single technical approach for a state to follow. A combination of monitoring and modeling techniques is usually appropriate, but instead of attempting to cover all possible combinations of techniques, this report provides five selected scenarios. The general principles and technical criteria identified in sections A and B are incorporated into these scenarios. The goal is to provide the state with references for use when it is creating its own individualized technical procedure.

In addition to the scenarios, this report provides detailed tables and narrative descriptions of techniques that may be considered and/or substituted for the techniques in the scenarios (see Section V).

<u>Scenario 1</u>: Limited data/one source

Data input: Small amount of existing data (i.e., one IMPROVE site with data for 2-3 years)
Evidence of "local" impact.
Limited meteorological data.

Where it is likely that one major source contributes to impairment, a combination of the following techniques is suggested:

1. Examine IMPROVE data, including quality assurance
2. Look at extinction budget to identify visibility-impairing pollutants
3. Perform some analysis of when the episodes are occurring
4. Perform a simple back trajectory analysis using a method such as HYSPLIT
5. Look at relationships between particulate species
6. Examine source emissions data for correlations with ambient monitoring
7. Perform dispersion model based on data and capabilities such as VISCREEN or CALPUFF Lite

[13] WESTAR Council, *RA BART and RA BART-like Case Studies*, June 2001.

8. Examine other data such as source owner data, deposition data, or photographic evidence

The results of this initial analysis may not always be conclusive. This level of review may be adequate if a source/receptor relationship can be identified. However, if the results are inconclusive, more data and/or more refined analyses may be necessary and may help the state reach an attribution determination. The state should consider how the available data and choice of techniques might affect its ability to assess the effectiveness of the controls in remedying the impairment.

It may be efficient to look ahead to the data and analytical needs of a potential BART analysis. For example, the state may wish to use a more refined model that would be useful for both attribution and remedy assessment.

Assuming there is a two-year time period[14] to collect data and analyze additional information, the following techniques also can be considered:

1. Better source characterization, including measurement of emissions of trace elements (source profiles) for use in CMB modeling
2. Met monitoring or modeling
3. Camera site, possibly with time-lapse video
4. Additional aerosol monitoring, episodic or saturation
5. In plume trajectory by aircraft, if available
6. Fine time-resolved optical monitoring, such as nephelometer, transmissometer, aethelometer combined with pollutant monitoring (e.g., SO_2, NOx, real time PM) for monitoring of episodes
7. More refined chemical visibility model, such as CALPUFF
8. Repeat initial techniques with new data

The technical criteria are listed below, followed by techniques that may be used to obtain results about the criteria.

1. The impairment must be related to emissions from specific sources. The visibility-impairing pollutants of concern should be identified.

   Techniques: Back trajectory, species relationships, relationship between source emissions and ambient monitoring, dispersion model refined by camera, aerosol, in plume, optical monitoring, and refined dispersion models.

2. The attribution assessment must address the unique visibility impairment certified by

[14] The 1999 regional haze rule revised the requirements for general plan requirements for visibility protection. As a result, plan revisions are required once every five years, rather than the Long Term Strategy review requirement of every three years. If an FLM certifies RAVI at least 6 months prior to a plan revision, section 51.302 requires that the State Plan revision address such Certifications. Given this 5-year cycle, we have presumed for this report that an attribution analysis should take about two years to complete in order to allow time for the BART engineering analysis, if needed.

the FLM for the Class I area. Some factors to consider include:

a. Duration: source's length of effect per episode
Techniques: Monitoring, dispersion model, back trajectory, camera

b. Frequency: how often the impairment occurs
Techniques: Monitoring, dispersion model, back trajectory, camera

c. Geographic extent: how much of the Class I area is impaired
Techniques: Monitoring, dispersion model, additional data on deposition and other studies

d. Magnitude: how much impairment is due to the source
Techniques: Dispersion model, receptor model

e. Time of occurrence
Techniques: Monitoring, dispersion model, back trajectory, camera

3. Uncertainty of results: Each analytical method will have its own level of uncertainty. These individual uncertainties should be kept in mind as outputs are compared within the overall assessment. If the results of different techniques are the same or similar (within the uncertainties of the techniques), then the overall level of uncertainty is likely to decrease.

Scenario 2: Moderate data/multiple sources

Data input: Moderate amount of existing data (i.e., one IMPROVE site with data for six or more years)
Evidence of an increasing trend in sulfate
Meteorological data likely from several stations

Assuming the Certification identifies multiple BART sources of different types within a 100-mile radius, a combination of the following techniques is suggested:

1. Examine IMPROVE data, including quality assurance
2. Look at extinction budget to identify visibility-impairing pollutants
3. Perform some analysis of when the episodes are occurring
4. Perform multiple back trajectory analyses using a method such as HYSPLIT
5. Look at relationships between particulate species
6. Examine source emissions data for correlations with ambient monitoring
7. Perform dispersion model based on data and capabilities such as CALMET/CALPUFF
8. Examine other data such as source owner data, deposition data, or photographic evidence
9. Wind fields/Synoptic analyses
10. Comparison of different episodes
11. UNMIX, PMF and/or CMB

12. Analysis of any regional modeling already conducted, such as CMAQ
13. Long term visual monitoring, such as camera data or transmissometer data, compared to met data to identify quadrants of concern

The results of this initial analysis may not be conclusive. This level of review may be adequate if a source/receptor relationship can be identified.

However, if the results are inconclusive, more data and/or more refined analyses may be necessary and may help the state reach an attribution determination. The state should consider how the available data might affect the ability to assess the effectiveness of the controls in remedying the impairment. It may be efficient to look ahead to the data and analytical needs of a potential BART analysis. For example, the state may wish to use a more refined model that would be useful for both attribution and remedy assessment.

Assuming there is a two-year time period to collect data and analyze additional information, the following techniques also can be considered:

1. Emissions inventory
2. Analysis of a nested domain within the regional model
3. Source profiles (natural tracers)
4. Additional source measurements, such as stack testing
5. Met monitoring or modeling
6. Camera
7. Additional aerosol monitoring, episodic or saturation
8. Monitoring to measure additional parameters, such as precursors, ammonia and oxidants
9. In plume trajectory by aircraft, if available, to characterize plume chemistry
10. Fine time-resolved optical monitoring, such as nephelometer, transmissometer, aethelometer combined with pollutant monitoring (e.g., SO_2, NOx, real time PM) for monitoring episodes.
11. Repeat initial techniques with new data

The technical criteria are listed below, followed by techniques that may be used to obtain results about the criteria.

1. The impairment must be related to emissions from specific sources. The visibility-impairing pollutants of concern should be identified.

   Techniques: Back trajectory, species relationships, relationship between source emissions and ambient monitoring, dispersion model refined by camera, aerosol, in plume, optical monitoring, and refined dispersion models.

2. The attribution assessment must address the unique visibility impairment certified by the FLM for the Class I area. Some factors to consider include:

   a. Duration: each source's length of effect per episode

Techniques: Monitoring, dispersion model, back trajectory, camera

b. Frequency: how often the impairment occurs by source
   Techniques: Monitoring, dispersion model, back trajectory, receptor model, camera

c. Geographic extent: how much of the Class I area is impaired
   Techniques: Monitoring, dispersion model, additional data on deposition and other studies

d. Magnitude: how much impairment is due to each individual source
   Techniques: Dispersion model, receptor model

e. Time of occurrence
   Techniques: Monitoring, dispersion model, back trajectory, camera

Scenario 3: No IMPROVE data, Certification by modeling evidence

Data input: Detailed modeling of a source and specific visibility impairment using a CALPUFF run, or detailed (nested) run of regional model.
Detailed emissions data and meteorological data were input to the model.
No IMPROVE data available for this specific Class I area (monitoring may be at a "representative site")
Some optical data, photographic data, and limited aerosol data from other networks

Assuming the Certification points to a specific source, a combination of the following techniques is suggested:

1. Examine IMPROVE data for any nearby Class I areas (especially those included in the modeling domain) to better understand the regional conditions and compare with model outputs of the unique effect
2. Review the model's outputs on "high impact" days and compare with actual meteorological data of the area (to confirm transport, inversions, or other aspects of the model which may create the unique impact)
3. Review source emissions data used in the model
4. Review other monitoring data (optical measurements, deposition data, ozone data, etc.) to collaborate model predictions
5. Examine any photographic evidence

The results of this initial analysis may not always be conclusive. This level of review may be adequate if a source/receptor relationship can be identified. Because no visibility-specific particle monitoring is available in this case, the key to attribution is to determine that the source emissions are indeed reaching the Class I area on days when impairment exists. If the results are inconclusive, more data and/or more refined analyses may be necessary and may help the state reach an attribution determination. The state should consider if the available data and modeling information supplied with this Certification could be used to determine the effectiveness of the controls in remedying the impairment. It may be efficient to look ahead to the data and analytical needs of a potential BART analysis if additional or different modeling will be necessary.

Additional data collection and analyses that might be considered:

1. Better source profiles or newer emissions information
2. Met monitoring or modeling
3. Camera
4. New aerosol monitoring (episodic or saturation)
5. In plume trajectory by aircraft, if available
6. Repeat initial analytical techniques with new data

The technical criteria are listed below, followed by techniques that may be used to obtain results about the criteria.

1. The impairment must be related to emissions from specific sources. The visibility-impairing pollutants of concern should be identified.

   Techniques: Confirm model inputs, compare with any new particle monitoring at Class I area. Examine performance of the model, and perform uncertainty analyses.

2. The attribution assessment must address the unique visibility impairment certified by the FLM for the Class I area. Some factors to consider include:

   a. Duration: source's length of effect per episode
      Techniques: Monitoring, dispersion model, back trajectory, camera

   b. Frequency: how often the impairment occurs
      Techniques: Monitoring, dispersion model, back trajectory, camera

   c. Geographic extent: how much of the Class I area is impaired
      Techniques: New monitoring and examination of dispersion model outputs, additional data on deposition and other studies

   d. Magnitude: how much impairment is due to the source
      Techniques: Dispersion model

   e. Time of occurrence
      Techniques: Monitoring, dispersion model, back trajectory, camera

Scenario 4: Direct Photographic Evidence

Data input: The FLM certified impairment in a wilderness area based on photographic evidence. Photographs taken over a period of two years showed a distinct haze in a valley located in the wilderness area when the wind is from the east. A series of photographs during two episodes showed a distinct plume that

originates at an existing stationary source constructed in 1965 and located ten miles east of the wilderness area. The photographic series showed that the plume traveled into the wilderness area.
Aerial photos during one episode also show a distinct plume that travels into the wilderness area. The wilderness area does not have an IMPROVE site. A Class I area located 50 miles to the north has an IMPROVE site that was representative for the area. This monitoring site does not show decreased visibility on the days when haze was photographed in the wilderness valley.

Assuming the Certification identifies one BART source, the following steps are suggested:

1. Review the photographic evidence and determine whether the photographs show a clear connection between the source and the haze documented in the wilderness area.

   In this example, the photographic evidence showed a clear connection between the source and the haze in the wilderness area. Qualitative information, such as photographic evidence that establishes a source/receptor link, is allowed under EPA regulations that define reasonable attribution as determined by "visual observation or other technique the State deems appropriate." (40 CFR 51.301(s)).

The results of this initial analysis may not always be conclusive. If the photographic evidence is not compelling, the state may reach a different conclusion. The state may determine that the impairment, as documented by the FLM, was not reasonably attributable to the source identified in the Certification. The FLM would then need to gather additional information to support a Certification. Alternatively, if the state determines that the source may be causing the haze but the qualitative evidence is not quite sufficient to determine attribution, the state could initiate a data collection effort to provide better information regarding visibility impairment at the Class I area. Such techniques may include:

1. Better source characterization, including measurement of emissions of trace elements (source profiles) for use in CMB modeling
2. Met monitoring or modeling
3. Additional aerosol monitoring (episodic or saturation)
4. In plume trajectory by aircraft, if available
5. Fine time-resolved optical monitoring, such as nephelometer, transmissometer, or aethelometer combined with pollutant monitoring (e.g., SO_2, NOx, real time PM) for monitoring of episodes.
6. More refined chemical visibility model, such as CALPUFF

The technical criteria are listed below, followed by techniques that may be used to obtain results about the criteria.

1. The impairment must be related to emissions from specific sources. The visibility-impairing pollutants of concern should be identified.
   Techniques: Back trajectory, species relationships, relationship between source emissions and ambient monitoring, dispersion model refined by camera, aerosol, in

plume, optical monitoring, and refined dispersion models.

2. The attribution assessment must address the unique visibility impairment certified by the FLM for the Class I area. Some factors to consider include:

   a. Duration: source's length of effect per episode
   Techniques: Monitoring, dispersion model, back trajectory, camera

   b. Frequency: how often the impairment occurs
   Techniques: Monitoring, dispersion model, back trajectory, camera

   c. Geographic extent: how much of the Class I area is impaired
   Techniques: Monitoring, dispersion model, additional data on deposition and other studies

   d. Magnitude: how much impairment is due to the source
   Techniques: Dispersion model, receptor model

   e. Time of occurrence
   Techniques: Monitoring, dispersion model, back trajectory, camera

3. Uncertainty of results: Each analytical method will have its own level of uncertainty. These individual uncertainties should be kept in mind as outputs are compared within the overall assessment. If the results of different techniques are the same or similar (within the uncertainties of the techniques), then the overall level of uncertainty is likely to decrease.

The final step in the attribution process scenario would be to verify that the source was operating on the days when the haze was observed in the area. The state should also determine if the source was experiencing unusual upset conditions during the times identified. In this example, the source was determined to have been operating normally. The state would then issue a determination that the visibility impairment at the Class I area was reasonably attributable to the existing stationary facility.

Scenario 5: Data Rich

Data input: A large special visibility study recently was conducted.
Four months of data spanning two seasons was collected including:

1. At one "receptor" site in a Class I area there were multiple meteorological, optical, and particulate samplers including extensive measurements of particle compositions, size distributions, scattering, absorption, light extinction, ions, oxidants, relative humidity, temperature, vertical wind profiles, SO_2, photographs, and concentrations of four unique tracers released from four different sources of interest. There were co-located samplers measuring several parameters in more than one way. There are at least some one, six, and twelve-hour particle measurements in addition to twenty-four hour samples.

2. This receptor site has been an IMPROVE site for several years and these data are also available.
3. At thirty-five other sites in the region, called “satellite” sites there was an IMPROVE Module-A sampler taking daily twenty-four hour samples which were analyzed for fine mass, S, soil elements, trace metals, and elemental H from which organics can be estimated. The unique tracers were also measured at many of these sites.
4. Aircraft sampling of plumes from source(s) of interest was conducted.
5. An extensive current emissions inventory was created.
6. Wind profilers were deployed at two to three sites in addition to the receptor site.
7. Measurements of the chemical composition of resuspended local dust, smoke from burning local fuels, and emissions from local point and area sources of interest were collected in order to create “source profiles” to be used in receptor modeling.

Assuming the certification identifies a BART source within 100 miles of the Class I area from which a unique tracer was released, a combination of the following techniques is suggested:

1. Examine fine particle data, including quality assurance. Use the collocated data to assess accuracy and precision. The one, six, and twelve-hour data should average up to match the twenty-four hour data and if reasonable, be used to examine the diurnal cycles in the fine particle concentrations.
2. Look at the extinction budget to identify visibility-impairing pollutants. Because size distributions were measured, the extinction budget can be estimated from Mie scattering calculations as well as by using simple techniques that assume bulk scattering and absorption efficiencies. Check to see if measured scattering plus absorption add up to the measured and reconstructed extinction.
3. Compare the special study data to historical IMPROVE and archived meteorological data to determine the representativeness of the study period.
4. Perform some analysis of when the episodes are occurring. EOF analysis can be helpful to summarize the massive data set. Use the photographs to create a time-lapse visualization of the scene at the receptor site.
5. Perform back trajectory analyses using HYSPLIT, CAPITA Monte Carlo or ATAD. Examine whether the trajectories change substantially when the study’s wind-profiler data are included. Determine whether trajectories are consistent with tracer concentrations.
6. Look at relationships between particulate species (factor analysis) to see if they identify source types.
7. Look at the spatial and temporal patterns of trace elements and the major constituents of the fine mass. This may suggest dominant source areas and transport patterns for different source types. Use EOF analysis to determine the patterns that explain most of the covariance in the data. Check to see how well these are reconciled with the back trajectory modeling and the deterministic modeling. Check to see if the same dominant sources were indicated.
8. Examine source emissions data for correlations with ambient monitoring.
9. Perform dispersion model such as CALMET/CALPUFF.

10. Analyze wind fields, synoptic conditions, and satellite photos. Check to see if they were consistent with more sophisticated meteorological modeling. Look for unusual conditions such as wild fires, hurricanes, stagnation episodes, etc. Look to see if modeled and observed cloud patterns were comparable.
11. Compare the meteorological and chemical characteristics of different episodes
12. UNMIX, PMF and CMB can help determine major source types and when they were important.

If, at this point, similar source/receptor relationships have been identified using several different techniques, this level of review is adequate. If the results are inconclusive, and there are differing points of view about the frequency, duration, or significance of the attribution to the BART-eligible source, more analyses may be necessary. Often in a large study, measurements are made, but not immediately analyzed in the lab due to cost. If this is the case, more samples could be analyzed. It is unlikely that any additional field monitoring would be required.

The technical criteria are listed below, followed by techniques that may be used to obtain results about the criteria.

1. The impairment must be related to emissions from specific sources. The visibility-impairing pollutants of concern should be identified.

   Techniques: Reconstructed particle mass and light extinction including examination of the reconstructions in different size ranges and at different sites in the region, analysis of responses of light scattering to relative humidity, back trajectory analyses, examination of inter-species relationships compared to measured source profiles, dispersion modeling with sophisticated models such as REMSAD and CMAQ, analysis of wind fields and dispersion by comparison to measured tracer concentrations, computer animation of spatial patterns of species of interest, use of receptor models such as TMBR, DMB, and TAGIT that utilize unique tracer information, or other receptor models such as CMB, UNMIX, and PMF that do not require tracer information, but can use it. When so many different models can be used, model reconciliation is usually a part of a data-rich scenario.

2. The attribution assessment must address the unique visibility impairment certified by the FLM for the Class I area. Some factors to consider include:

   a. Duration: each source's length of effect per episode
      Techniques: Monitoring, dispersion model, back trajectory, camera

   b. Frequency: how often the impairment occurs by source
      Techniques: Monitoring, dispersion model, back trajectory, receptor model, camera

   c. Geographic extent: how much of the Class I area is impaired
      Techniques: Monitoring, dispersion model, analysis of spatial patterns using data from the satellite sites.

d. Magnitude: how much impairment is due to each individual source
Techniques: Dispersion model, receptor model

e. Time of occurrence
Techniques: Monitoring, dispersion model, back trajectory, camera

3. Uncertainty of results: In this case, the ability of a model to predict the observed tracer concentrations is an indicator of the model's uncertainty.

V. TECHNIQUES

A. Monitoring

Introduction

This section describes a variety of ambient air monitoring methods that, if appropriate, might be used to support an attribution analysis. The methods described include those most commonly used in pollution studies or ambient monitoring programs and should not be considered an exhaustive list of potential methods. Methods include, IMPROVE, filter based aerosol, continuous aerosol (includes optical methods such as the nephelometer), continuous gas and canister sampling, transmissometer, scene (includes film, video, digital), and tracer or aircraft methods.

Several of the methods described are currently in use as a part of national, state, local, tribal, or private ambient monitoring networks. These sites are generally located in urban areas, but those near the area of study could be used in the attribution analysis thereby reducing the cost of monitoring.

The IMPROVE network is designed to assess visibility in Class I areas and routinely measure visibility impairing pollutants. These sites offer value to the attribution analysis if they are located in the area of study.

The RA BART case studies show additional examples of the methods used during source attribution studies. The case studies also show that methods, other than ambient monitoring, may be used to support the analysis. Existing programs such as CASTNET (dry deposition network), surface water deposition studies, or snow deposition studies may provide additional data for the attribution analysis.

Although not specifically listed as a monitoring technique, meteorological monitoring is an important element the attribution analysis. Collection of meteorological data can range from simple wind, temperature, and relative humidity measurement to an array of acoustic wind profilers. The complexity of the meteorological monitoring program depends on data needs and the availability of existing data. As with ambient monitoring, meteorological data may be available at sites located near the study area and offers reduced monitoring cost.

1. IMPROVE

Overview: The Interagency Monitoring of PROtected Visual Environments (IMPROVE) program is a cooperative measurement effort governed by a steering committee composed of representatives from Federal and regional-state organizations. The IMPROVE monitoring program was established in 1985 to aid the creation of Federal and State implementation plans for the protection of visibility in Class I areas (156 national parks and wilderness areas) as stipulated in the 1977 amendments to the Clean Air Act. The objectives of IMPROVE are to: (1) establish current visibility and aerosol conditions in mandatory class I areas; (2) identify chemical species and emission sources responsible for existing man-made visibility impairment;

(3) document long-term trends for assessing progress towards the national visibility goal; and (4) with the enactment of the regional haze rule, provide regional haze monitoring representing all visibility-protected federal class I areas where practical.

Magnitude: Possible when used in conjunction with appropriate analytical techniques.

Frequency: Possible when used in conjunction with appropriate analytical techniques; Limited by twenty-four hour sample integration, and one-in-three day sampling frequency.

Duration: Possible when used in conjunction with appropriate analytical techniques; Limited by 24 hour sample integration, and one-in-three day sampling frequency.

Principle: Twenty-four hour integrated filter-based ambient monitor; Gravimetric analysis for $PM_{2.5}$ (Module D) and PM_{10}); S from Particle Induced X-ray Emission (PIXE); NO_3 from ion chromatography (denuded nylon filter from Module C); Organic and elemental carbon from Thermal Optical Reflectance (TOR); H from Proton Elastic Scattering (PESA).

Uncertainty: All elemental S if from sulfate; All sulfate is ammonium sulfate; NO_3 (Denuder efficiency is close to 100%. All nitrate is from ammonium nitrate);
Average organic molecule is 70% carbon; Carbon (organic and elemental) is defined by the analytical method; Fine soil based on elemental composition; Course mass (PM_{10} – $PM_{2.5}$) consists only of insoluble soil particles.

Strengths: Regulatory indicator for regional haze rule; Long term data record in or near many federal Class I areas; Extensive network currently in place.

Limitations: Integrated twenty-four hour sample; one-in-three day sampling interval; Nitrate losses due to volatilization from filter; Not capable of distinguishing between primary particulate and atmospherically transformed particulate.

Level of Expertise Required: Standard operating procedures available for routine operation and maintenance; Chemical analysis must be conducted by appropriate laboratory.

Regulatory Context: Regional Haze rule; Included in SIP Visibility Plan

2. FILTER-BASED AEROSOL

Overview: Filter-based aerosol monitoring is used to identify chemical species and obtain concentration measurements of atmospheric constituents that contribute to visibility impairment. Primary techniques include filter-based aerosol samplers that collect samples on various substrates in various size ranges such as $PM_{2.5}$ or PM_{10}. Aerosol monitoring can provide fine mass concentration, course mass concentration, optical absorption, major and trace elements, organic and elemental carbon, and sulfate, nitrate, and chloride ions. A variety of methods are available to conduct filter based aerosol monitoring. Many methods are approved as an EPA reference method, while some are not, but may offer variability that the reference method does not.

Magnitude: Possible when used in conjunction with appropriate analytical techniques.

Frequency: Possible when used in conjunction with appropriate analytical techniques; Limited by 24-hour sample integration and sampling frequency (daily sampling is possible depending on instrument selected).

Duration: Possible when used in conjunction with appropriate analytical techniques; Limited by 24-hour sample integration and sampling frequency (daily sampling is possible depending on instrument selected).

Principle: The methods used for analyses of these filter media include gravimetry (electro-microbalance) for mass; X-ray fluorescence (XRF) and particle induced X-ray emission (PIXE) for trace elements; Ion chromatography (IC) for anions and selected cations; Controlled-combustion for carbon; Gas chromatography/mass spectroscopy (GC/MS) for semi-volatile organic particles; Special measurement needs may include determining particle size and morphology through optical and/or electron microscopy.

Strengths: Large network of urban monitoring available; Filter based sampling allows for a variety of chemical/elemental analysis.

Limitations: Integrated twenty-four hour sample; Generally operated on one-in-three or one-in-six day sampling interval (daily sampling is possible depending on instrument selected); Not capable of distinguishing between primary particulate and atmospherically transformed particulate.

Level of Expertise Required: Standard operating procedures available for routine operation and maintenance; Chemical analysis must be conducted by appropriate laboratory.

Regulatory Context: Commonly used in NAAQS/SIP compliance monitoring networks.

3. CONTINUOUS AEROSOL

Overview: Aerosols can be measured continuously using several different methods. Optical measurement of aerosols can be measured using an instrument such as a nephelometer to measure light scattering (bscat) or a aethelometer to measure light absorption (babs) by aerosols (black carbon). Continuous instruments such as TEOM or BETA can provide PM_{10} or $PM_{2.5}$ aerosol concentration.

Magnitude: Possible when used in conjunction with appropriate analytical techniques.

Frequency: Possible when used in conjunction with appropriate analytical techniques; Limited by twenty-four hour sample integration and sampling frequency (daily sampling is possible depending on instrument selected).

Duration: Possible when used in conjunction with appropriate analytical techniques; Limited by twenty-four hour sample integration and sampling frequency (daily sampling is possible depending on instrument selected).

Strengths: Continuous measurement with at least hourly time resolution; Nephelometers and Aethelometers are commonly used to support Class I area monitoring programs and an existing data record may be available in some areas.

Limitations: Continuous aerosol measurement with methods such as TEOM and BETA are generally made in urban areas to support NAAQS compliance networks; Not capable of distinguishing between primary particulate and atmospherically transformed particulate.

Level of Expertise Required: Standard operating procedures available for routine operation and maintenance.

Regulatory Context: Commonly used in Class I area monitoring networks or urban NAAQS compliance networks.

4. CONTINUOUS GASEOUS

Overview: A variety of gaseous pollutants, such as Ozone (O_3), Carbon Monoxide (CO), Nitrogen Dioxide (NOx), nitric oxide (NO), ammonia (NH_3), hydrogen peroxide (H_2O_2), sulfur dioxide (SO_2), Organics, and HAPS/TOXICS, can be measured continuously. Gaseous monitoring is generally conducted with instruments that continuously draw sample air and periodically (as frequently as once per second) analyze the sample. Canister systems collect an ambient air sample over a specific period of time in clean evacuated canisters. The canisters are then subject to subsequent analysis at a laboratory using a method such as GC/FID. This method is able to provide time-integrated samples from several hours to twenty-four hours or more. Regular checks of the flow rate, stability, reproducibility, precision, and accuracy of these instruments must be conducted on a regular schedule in order to ensure data quality.

Magnitude: Possible when used in conjunction with appropriate analytical techniques.

Frequency: Possible when used in conjunction with appropriate analytical techniques.

Duration: Possible when used in conjunction with appropriate analytical techniques.

Strengths: Continuous measurement with hourly time resolution; Monitors available to identify variety of pollutants.

Weaknesses/Limitations: Generally require conditioned environment and frequent performance checks.

Practical Considerations: Data may be available from established urban area monitoring networks and some Class I area monitoring networks; Additional cost ($/year) for new sites.

Level of Expertise Required: Standard operating procedures available for routine operation and maintenance.

Regulatory Context: Commonly used in urban NAAQS compliance and HAPS/TOXICS networks.

5. TRANSMISSOMETER

Overview: Transmissometers measure the amount of light transmitted through the atmosphere over a known distance (generally between 0.5 km and 10.0 km) between a light source of known intensity and a receiver. The transmission measurements are electronically converted to hourly averaged light extinction (b_{ext}).

Magnitude: Possible when used in conjunction with appropriate analytical techniques.

Frequency: Possible when used in conjunction with appropriate analytical techniques.

Duration: Possible when used in conjunction with appropriate analytical techniques.

Uncertainties: A transmissometer must be installed in stable locations with a clear and unobstructed path to avoid interference with the signal.

Strengths: Continuous measurement of b_{ext} in many Class I areas and some urban areas.

Limitations: Not capable of identifying pollutants contributing to visibility impairment.

Level of Expertise Required: Standard operating procedures available for routine operation and maintenance; Data processing/quality assurance requires high level of expertise.

Regulatory Context: Commonly used in Class I area monitoring networks and in some urban areas.

6. SCENE

Overview: Scene monitoring refers to the use of still and/or time-lapse photography (including digital imagery) to provide a qualitative representation of visual air quality. Scene monitoring data quality objective recommendations are to document the appearance of scenes of interest under a variety of air quality and illumination conditions at different times of day and different seasons. Scene monitoring documents the visual condition observed at a monitoring site. The data collection schedule can be tailored to capture the periods when visibility impairment is most likely to occur at specific sites. Time-lapse movies (generally time-lapse video or super 8 mm film) can be used at monitoring sites and during special studies to document the visual dynamics of a scene or source.

Magnitude: Cannot provide a quantitative measurement of visibility impairment but can qualitatively illustrate various levels of visibility impairment.

Frequency: Possible depending on the method used. Time-lapse video may be able to demonstrate the frequency of the impairment. The use of still photography to document impairment frequency depends upon the number of images acquired over time.

Duration: Possible depending on the method used. Time-lapse video may be able to demonstrate the impairment frequency. The use of still photography to document impairment frequency depends upon the number of images acquired over time.

Uncertainties: n/a

Strengths: Provides image/video record

Limitations: Not capable of identifying pollutants contributing to visibility impairment.

Level of Expertise Required: Standard operating procedures available for routine operation and maintenance.

Regulatory Context: Commonly used in Class I area monitoring networks and in some urban areas.

7. TRACER METHODS, LIDAR SYSTEMS, AIRCRAFT BASED MEASUREMENTS

Overview: The methods described in this section are more specialized methods generally reserved for special studies as opposed to the previously described methods that are used more routinely. Tracer methods, lidar systems and aircraft based measurements will be described individually.

Tracer Methods:
A tracer element or compound is a substance with unique characteristics that allows positive identification at very low concentrations. The tracer compound of choice will vary by source type and composition of the plume being tracked. In general, the tracer must have very low natural background concentrations and ideally would have the same chemical form and properties as the compound being tracked. In ambient applications where use of the ideal tracer is not possible due to potential environmental risk, a near-substitute compound may be used. When used to determine potential source impacts, the chosen compound is released from a source stack and downwind monitors are used to detect the presence of the compound.

Lidar Methods:
A lidar transmits short pulses of laser light into the atmosphere. The laser beam loses light to scattering as it travels. At each range, some of the light is backscattered into a detector. Because the light takes longer to return from the more distant ranges, the time delay of the return pulses can be converted to the corresponding distance between the atmospheric scatterer and the lidar. The end result is a profile of atmospheric scattering versus distance. Analysis of this signal can yield information about the distribution of aerosols in the atmosphere. The amount of backscatter indicates the density of the scatters. This can be used to measure cloud base height or track

plumes of pollution. Other properties of the atmosphere can also be deduced from the lidar return signals. A frequency shift in the light because of the Doppler effect permits measurement of wind speeds. By detecting the amount of depolarization, one can discriminate between liquid droplets and nonspherical ice particles. Differential Absorption Lidar (DIAL) uses absorption, as evidenced by reduced backscatter from greater distances, to measure the concentration of atmospheric gases. A Raman lidar detects particular atmospheric components (such as water vapor) by measuring the wavelength-shifted return from selected molecules (NOAA).

Aircraft Based Measurements:
Aircraft based measurement systems utilize specially equipped aircraft to make pollutant and meteorological measurements at various elevations throughout the study domain. The aircraft can be equipped with a multitude of gaseous, aerosol, optical and meteorological equipment. This measurement method provides the advantage of vertical profiles of various parameters, the ability to track point source plumes, and the ability to establish boundary conditions for future analytical and modeling exercises.

References:

NOAA, Atmospheric Light Division, Environmental Technology Laboratory, http://www2.etl.noaa.gov/DIAL_lidar.html

U.S. Environmental Protection Agency, Visibility Monitoring Guidance (EPA-454/R-99-003), June 1999.

National Research Council, Protecting Visibility in National Parks and Wilderness Areas, National Academy Press, Washington D.C., 1993, pp. 315-357.

Table 1. Monitoring Techniques

Criteria	Monitoring Method						
	IMPROVE	Filter Based Aerosol	Continuous Aerosol	Gaseous; Continuous methods, canister sampling, etc.	Transmissometer	Scene 35mmfilm/8mm video, digital	Tracer Methods, Lidar systems, Aircraft based measurements
Pollutant							
PM_{10}	Yes	Yes	Yes	No	No	No	All Possible
$PM_{2.5}$	Yes	Yes	Yes	Yes	No	No	
NOx	(Site specific)	No	No	Yes	No	No	
SO_2	(Site specific)	No	No	Yes	No	No	
Sulfate	Yes	Yes	No	No	No	No	
Nitrate	Yes	Yes	No	No	No	No	
Carbon	Yes	Yes	No	No	No	No	
Organics	Yes	Yes	No	Yes	No	No	
Other	Reconstructed extinction		Nephelometer - Bscat Aethelometer - Babs	HAPS, TOXICS	Total Extinction	Visual Parameters	
Visibility/Concentration Changes							
Magnitude	Yes	Yes	All Possible	All Possible	All Possible	No	All Possible
Frequency	Yes	Yes	All Possible	All Possible	All Possible	Yes	All Possible
Duration	Yes	Yes				Yes	
Time of Day	No	No				Yes	
Likely Part of FLM Certification?	Possible						No

Monitoring Techniques (continued)

Principal							
Qualitative/ Quantitative	Quantitative					Qualitative	Qualitative/Quantitative
Strengths	Reconstructed extinction calculation, historical record	various chemical analysis, large network nationwide	Continuous measurement, nephelometer commonly located in or near Class I areas	Continuous measurement, variety of possible pollutants	Continuous measurement, provides light extinction value, historical record	Relatively inexpensive, uncomplicated operational requirements	Lidar and airplane based systems can provided temporal and spatial results, tracer methods can provide source-receptor data
Weaknesses/ Limitations	Fixed location in or near Class I areas, also located in several urban areas	Integrated 24 hour sample generally collected on one-in-three schedule, commonly in urban areas	TEOM, BETA, etc, commonly located in urban areas	Generally require conditioned environment for proper operation, commonly located in urban areas	Fixed location in or near Class I areas	Number of still images limited, video requires storage and routine review	Complex and relatively expensive to operate, requires specialized training and knowledge to operate and analyze results
Distinguish BART Sources?	Possible with other analysis	Possible with other analysis	No	Possible with other analysis	No	Possible with other analysis	Possible with other analysis
Practical Considerations							
Cost	Moderate; varies depending on the number of instruments					Low	High

B. Source Modeling

Introduction

Given the complex natural environment, the state must choose the configuration of modeling techniques that will provide the most information on the contributing source or sources of impairment within the limited resources of current technology, data, budgets, time and staff availability.

1. Physical Models

Physical models are those that simulate the meteorology and air quality over an area. Modeling relies on a numerical or analytical model to estimate particulate concentrations in space and time. Because of its nature and sources, particulate matter is difficult to model over all spatial scales. Many air quality models that are currently available were designed to be applied over the regional scale with grid sizes from four to forty kilometers. Modeling requires detailed meteorological fields and emissions inventory over the entire domain. The compilation of data required to run these models can require much effort and expertise. Efforts are underway by government agencies in the U.S. to generate and archive both emissions and estimated activity levels of many source types in geographical information systems.

Numerical source-oriented models are designed to simulate atmospheric diffusion or dispersion and estimate concentrations at defined receptors. Numerical source models can be grouped as kinematic, first-order closure, or second-order closure models (Bowne and Lundergan, 1983). Kinematic models are the simplest both mathematically and conceptually. These models simplify the non-linear equations of turbulent motion, thereby permitting a closed analytical approximation to describe pollutant concentration (Green *et al.*, 1980). First-order closure models are based on the assumption of an isotropic pollutant concentration field. Consequently, turbulent eddy fluxes are estimated as being proportional to the local spatial gradient of the transport quantities. The Eulerian grid models, Lagrangian particle models, and trajectory puff/plume models are included in this category. Second-order closure models involve a series of algorithm transformations of the equations of state, mass continuity, momentum, and energy by using the Boussinesque approximation and Reynold's decomposition theory (Holton, 1992; Stull, 1988).

2. Spatial Scales

The model's applicable spatial scales play a large role meeting the analysis' objectives and its ability to accurately assess spatial variability. PM_{10} and $PM_{2.5}$ concentrations modeled or measured at any receptor result from the complex interaction of meteorology, chemical transformations and emissions from nearby and distant sources. For example, a monitor located near an operating construction site will be impacted more by the daily construction activity than the surrounding area. That site may be classified as representing an area of a few tens of meters to no more than one kilometer depending on the size of the construction area and fugitive dust control measures.

The dimensions given below are nominal rather than exact and are presented as defined in 40 CFR part 58.

a. Micro-Scale (10 to 100 m): This scale does not apply to scenarios relevant to the attribution problem. Modeling at the microscale is usually done by simple Gaussian plume models such as ISCST3. Measurements in urban areas can show considerable variations at this scale while those in pristine areas would not. Variations often occur when monitors are located close to a low-level emissions source, such as a busy roadway, construction site, within a community that uses wood stoves, or a short industrial stack. Fortunately, compliance monitoring site exposure criteria avoids microscale influences even for source-oriented monitoring sites.

b. Middle Scale (100 to 500 m): Middle-scale monitors show significant differences between locations that are ~0.1 to 0.5 km apart. These differences may occur near large industrial areas with many different operations or near large construction sites. Monitors with middle-scale zones of representation are often source-oriented, used to determine the contributions from emitting activities with multiple, individual sources to nearby community exposure monitors.

c. Neighborhood Scale (500 m to 4 km): Neighborhood-scale monitors do not show significant differences in particulate concentrations with spacing of a few kilometers. This dimension is often the size of emissions and modeling grids used in large urban areas for PM source assessment, so this zone of representation of a monitor is the only one that should be used to evaluate such models. Sources affecting neighborhood-scale sites typically consist of small individual emitters, such as clean, paved, curbed roads, uncongested traffic flow without a significant fraction of heavy-duty vehicles, or neighborhood use of residential heating devices such as fireplaces and wood stoves.

d. Urban Scale (4 to 100 km): Urban-scale monitors show consistency among measurements with monitor separations of tens of kilometers. These monitors represent a mixture of particles from many sources within the urban complex, including those from the smaller scales. PM measurements at urban-scale locations are not dominated by any particular neighborhood, however. Urban-scale sites are often located at higher elevations and away from highly traveled roads, industries, and residential heating.

e. Regional-Scale Background (100 to 1,000 km): Regional-scale background monitors show consistency among measurements for monitor separations of a few hundred kilometers. Background concentrations are often more consistent for specific chemical compounds, such as sulfate or nitrate, than they are for PM mass concentrations. Regional-scale PM is a combination of naturally-occurring aerosol from windblown dust and marine aerosol as well as particles generated in urban and industrial areas that may be more than 1,000 km distant. Regional-scale sites are best located in rural areas away from local sources, and at higher elevations. National parks, national wilderness areas, and many state and county parks and reserves are appropriate areas for regional-scale sites. Many of the IMPROVE sites characterize PM regional scale background in different regions of the United States.

f. Continental-Scale Background (1,000 to 10,000 km): Continental-scale background monitors show little variation even when they are separated by more than 1,000 km. They are hundreds of kilometers from the nearest significant emitters. Though these sites measure a mixture of natural and diluted manmade source contributions, the manmade component is at its minimum expected concentration. The Jarbidge Wilderness IMPROVE site in northern Nevada is a good example of a continental-scale background site for particulate matter in North America.

e. Global-Scale Background (>10,000 km): Global-scale background monitors are intended to quantify concentrations transported between different continents as well as naturally-emitted particles and precursors from sea spray, volcanoes, and windblown dust. Yellow sand from China has been detected at the Mauna Loa, HI, laboratory (Darzi and Winchester, 1982; Braaten and Cahill, 1986), as well as on the North American continent. Red dust from Africa's Sahara desert has been detected at Mt. Yunque, Puerto Rico and over the southeastern United States. Other global-scale sites include McMurdo, Palmer, and Ahmundson-Scott stations in Antarctica (Lowenthal *et al.*, 1996), Pt. Barrow, Alaska, and Mace Head, Ireland.

3. Chemical Composition

This section illustrates how the chemical composition of aerosols is an important consideration in the choice of particulate matter models. The knowledge of how the aerosol's composition varies over an area will play a key role in the attribution study design.

The relative abundance of chemical components in the atmosphere closely reflect the characteristics of emission sources. Major chemical components of $PM_{2.5}$ and PM_{10} mass in urban and rural areas consist of nitrate, sulfate, ammonium, carbon, geological material, sodium chloride, and liquid water.

Chemical compositions can vary spatially in all scales of the atmosphere and depend on sources surrounding the monitoring site. For example, on the continental scale, the eastern U.S. fine particulate chemical compositions are different than those of the western states. In the eastern portion of the U.S., nonurban $PM_{2.5}$ is dominated by secondary sulfate, organics and elemental carbon (EPA, 1996). The data to support this conclusion are based on the IMPROVE and CASTNET networks. These networks provide a background fine-fraction aerosol database because the monitoring sites are primarily located in national parks and wilderness areas. Analysis of this network shows that the western U.S. nonurban $PM_{2.5}$ aerosol is predominantly carbon in nature. Nitrate also contributes significantly to the fine particle mass budget particularly in central and coastal California. Within these generalizations, obvious departures will be found especially near sources such as near the ocean and urban areas where the aerosol will be primarily influenced by sea salt and combustion particles, respectively.

The typical $PM_{2.5}$ chemical compositions vary by season (Chow et al., 1993a; 1996a, Watson et al., 1997), and consist of the following major components:

a. Organic Carbon: Organic carbon is composed of gases and particles containing combinations of carbon and hydrogen atoms. Organic compounds found in ambient air may also be associated with other elements and compounds, particularly oxygen, nitrogen, sulfur, halogens, and metals. Particulate organic carbon consists of hundreds, possibly thousands, of separate compounds (Rogge et al., 1993a). The mass concentration of organic carbon can be accurately measured, as can carbonate carbon (Chow et al., 1993b), but only about ten percent of the specific organic compounds that it contains have been measured. Vehicle exhaust (Rogge et al., 1993b), residential and agricultural burning (Rogge et al., 1998), meat cooking (Rogge et al., 1991), fuel combustion (Rogge et al., 1997), road dust (Rogge et al., 1993c), and particle formation from heavy hydrocarbon gases (Pandis et al., 1992), are the major sources of organic carbon in $PM_{2.5}$.

b. Elemental Carbon: Elemental carbon is black, often called "soot." Elemental carbon contains pure, graphitic carbon, but it also contains high molecular weight, dark-colored, nonvolatile organic materials such as tar, biological material (e.g., coffee), and coke. Elemental carbon usually accompanies organic carbon in combustion emissions, with diesel exhaust (Watson et al., 1994a, 1998) being the largest contributor.

c. Sulfate: Ammonium sulfate ((NH_4SO_4), ammonium bisulfate (NH_4HSO_4), and sulfuric acid (H_2SO_4), are the most common sulfate compounds in $PM_{2.5}$. These compounds are water-soluble and reside almost exclusively in the $PM_{2.5}$ size fraction. Sodium sulfate (Na_2SO_4) has been found in coastal areas where sulfuric acid has been neutralized by sodium chloride (NaCl) in sea salt. Although gypsum (Ca_2SO_4) and some other geological compounds contain sulfate, these are not easily dissolved in water for chemical analysis and are more abundant in the coarse fraction than in $PM_{2.5}$; they are usually classified in the geological fraction.

d. Nitrate: Ammonium nitrate (NH_4NO_3) is the most abundant nitrate compound, a large fraction of $PM_{2.5}$ occurs during winter, and a moderate fraction occurs during fall. Sodium nitrate ($NaNO_3$) is found in the $PM_{2.5}$ and coarse fractions near the oceans and salt playas. Small quantities of sodium nitrate have been found in summertime particulate matter inland owing to transport from the ocean (Chow et al., 1996b).

e. Ammonium: Ammonium sulfate (NH_4SO_4) and ammonium nitrate (NH_4NO_3) are the most common compounds containing ammonium from reactions between sulfuric acid, nitric acid, and ammonia gases. While most of the sulfur dioxide and oxides of nitrogen originate from fuel combustion in stationary and mobile sources, most of the ammonia derives from living things, especially animal husbandry practiced in dairies and feedlots.

f. Geological Material: Suspended dust consists mainly of oxides of aluminum, silicon, calcium, titanium, iron, and other metal oxides. In areas surrounded by substantial terrain (i.e., mountains), eons of runoff produce mineral compositions in soils that can be fairly homogeneous, with the exception of places where dry lake beds exist that have accumulated salt deposits. Industrial processes such as steel making, smelting, and mining have distinct geological compositions. For instance, cement production and distribution facilities may use alcareous, siliceous, argillaceous, and ferriferous minerals that may not be natural to the region, with limestone ($CaCO_3$) being the most abundant (Greer et al., 1992). Suspended geological material resides mostly in the coarse particle fraction (Houck et al, 1989,1990), and typically constitutes ~50% of PM_{10} while only contributing 5 to 15% of $PM_{2.5}$ (Watson et al., 1994b).

g. Sodium Chloride: Salt is found in suspended particles near oceans, open playas, and after de-icing materials are applied. Bulk sea water contains 57±7% chloride, 32±4% sodium, 8±1% sulfate, 1.1±0.1% soluble potassium, and 1.2±0.2% calcium (Pytkowicz and Kester, 1971). As noted above, sodium chloride is often neutralized by nitric or sulfuric acid in urban air where it is encountered as sodium nitrate or sodium sulfate.

h. Liquid Water: Soluble nitrates, sulfates, ammonium, sodium, other inorganic ions, and some organic material (Saxena and Hildemann, 1997) absorb water vapor from the atmosphere, especially when relative humidity exceeds 70% (Tang and Munkelwitz, 1993). Sulfuric acid absorbs some water or deliquesces at all humidities. Particles containing these compounds grow into the droplet mode as they take on liquid water. Some of this water is retained when particles are sampled and weighed for mass concentration. The precise amount of water quantified in a $PM_{2.5}$ depends on its ionic composition and the equilibration relative humidity applied prior to laboratory weighing.

Ambient mass concentrations contain both primary and secondary particles. Primary particles are directly emitted by sources and usually undergo few changes between source and receptor. Atmospheric concentrations of primary particles are, on average, proportional to the quantities that are emitted.

Secondary particles are those that form in the atmosphere from gases that are directly emitted by sources. Sulfur dioxide, ammonia, and oxides of nitrogen are the precursors for sulfuric acid, ammonium bisulfate, ammonium sulfate, and ammonium nitrate particles. "Heavy" volatile organic compounds or HVOC (those containing more than eight carbon atoms) may also change into particles. The majority of these transformations result from intense photochemical reactions that also create high ozone levels. Secondary particles usually form over several hours or days and attain aerodynamic diameters in the accumulation mode between 0.1 and 1 μm. Several of these particles, notably those containing ammonium nitrate, are volatile and transfer mass between the gas and particle phase to maintain a chemical equilibrium. This volatility has implications for ambient concentration measurements as well as for gas and particle concentrations in the atmosphere.

Ambient concentrations of secondary aerosols are not necessarily proportional to quantities of emissions since the rate at which they form may be limited by factors other than the concentration of the precursor gases. Secondary particulate ammonium nitrate concentrations depend on gaseous ammonia and nitric acid concentrations as well as temperature and relative humidity. A nearby source of ammonia may cause a localized increase in $PM_{2.5}$ concentrations by shifting the equilibrium from the gas to the particulate ammonium nitrate phase (Watson et al., 1994c). Ammonium sulfate may form rapidly from sulfur dioxide and ammonia gases in the presence of clouds and fogs, or slowly in dry air. Because fine particle deposition velocities are slower than those of the gaseous precursors, $PM_{2.5}$ may travel much farther than the precursors, and secondary particles precursors are often found far from their emissions sources and may extend over scales exceeding 1,000 km.

4. Particle Formation

Ammonium nitrate and ammonium sulfate aerosols are the most prevalent secondary particles found at urban and non-urban sites throughout the U.S. during the winter. These particles can form when gas molecules are attracted to and adhere to existing particles.

Sulfur dioxide gas changes to particulate sulfate through gas- and aqueous-phase transformation pathways. In the gas-phase pathway, ultraviolet sunlight induces photochemical reactions creating oxidizing species that react with a wide variety of atmospheric constituents. The gas-phase transformation rate appears to be controlled more by the presence or absence of the hydroxyl radical and its competing reactions of other gases than by the sulfur dioxide concentrations.

In the presence of fogs or clouds, sulfur dioxide dissolves in droplets where it experiences aqueous reactions that are much faster than gas-phase reactions. When ozone and hydrogen peroxide are dissolved in the droplet, the sulfur dioxide is quickly oxidized to sulfuric acid. When ammonia is dissolved in the droplet, the sulfuric acid is neutralized to ammonium sulfate. If the fog or cloud evaporates and relative humidity decreases below 100 percent, the sulfate particle exists as a small droplet that includes a portion of liquid water. As the relative humidity further decreases below 70 percent, the droplet evaporates and a small, solid sulfate particle remains. The reactions within the fog droplet are very fast, and the rate is controlled by the solubility of the precursor gases. Aqueous transformation rates of sulfur dioxide to sulfate are 10 to 100 times as fast as gas-phase rates. These chemical reactions are critical to understanding PM concentrations in areas and downwind of areas that emits large amounts of SO_2. The location and SO_2 emissions output of large point sources such as coal and oil fired power plants need to be mapped and compared with transport patterns in order to determine the impact of ammonium sulfate particles on ambient surface concentrations.

Fogs serve as an environment for creating particles and as vehicles for particle removal. During heavy fogs, particles and precursor gases are scavenged as fog droplets grow to sizes that settle rapidly to the surface. The extent and intensity of these fogs is so poorly characterized, however, that it is not yet possible to determine where and when particle formation overtakes particle deposition, thereby adding to the $PM_{2.5}$ concentration loading.

Nitrogen oxide converts to nitrogen dioxide, primarily by reaction with ozone. Nitrogen dioxide can: 1) change back to nitrogen oxide in the presence of ultraviolet radiation; 2) change to short-lived species which take place in other chemical reactions; 3) form organic nitrates; or 4) oxidize to form nitric acid. The major pathway to nitric acid is a reaction with hydroxyl radicals that transforms nitrogen dioxide to nitric acid. Nitric acid deposits from the atmosphere fairly rapidly but, in the presence of ammonia, it is neutralized to particulate ammonium nitrate. This is an important process in secondary particle production because many agricultural areas surrounding populated urban areas contain large ammonia sources. Chow and Egami (1997) show that San Joaquin Valley ammonia concentrations are large during winter. Conversion rates for nitrogen dioxide to nitric acid, ranging from less than one percent per hour to ninety percent per hour. These rates are typically five to ten times the conversion rates for sulfate formation. Though they vary throughout a twenty-four hour period, these rates are significant during both daytime and nighttime hours, in contrast to the gas-phase sulfate chemistry that is most active during daylight hours. The important nitric acid-ammonia reaction has implications to network design by the need to locate and map possible sources of ammonia. Significant sources of ammonia are associated with animal husbandry and fertilizer applications. Locating and estimating ammonia emissions will be a difficult task because it is not traditionally tabulated in emission inventories and requires further research to refine the methodology to measure the emissions.

While ammonium sulfate is a fairly stable compound, ammonium nitrate is not. Its equilibrium with gaseous ammonia and nitric acid is strongly influenced by temperature and relative humidity. Atmospheric particle nitrate can occur in atmospheric aerosol particles as solid ammonium nitrate or as ionized ammonium nitrate in aerosol particles containing water. In both the solid and ionized forms, ammonium nitrate is in equilibrium with gas-phase nitric acid and ammonia.

For fixed relative humidity, increasing temperature decreases the particle nitrate fraction. This is a consequence of the direct relation between the equilibrium constants and temperature. As temperature increases, the equilibrium constants increase, which means higher gas-phase pressures can be supported, thereby reducing the particle nitrate fraction. For fixed humidity, decreasing temperature increases the particle nitrate fraction. As temperatures approach 0°C, the curves approach limiting values. Particle fractions of one are used for ion ratios greater than or equal to one, and particle fractions are determined by the amount of available ammonia for ion ratios less than one. For the higher temperatures, increasing relative humidity increases the particle nitrate fraction. This is a consequence of liquid water present for the 60% and 80% relative humidity cases. When there is sufficient ammonia present with 30% relative humidity, more than 90% of the nitrate is in the particle phase for temperatures less than 20°C. More than half of the particle nitrate is gone at temperatures above 30°C, and all of it disappears at temperatures above 40°C.

Atmospheric water is another important component of suspended particulate matter. The sharp rise in liquid water content at relative humidities between 55% and 75% is known as deliquescence. A precise humidity at which soluble particles take on liquid water depends on the chemical mixture and temperature. Particles containing these compounds grow into the droplet mode as they take on liquid water, so the same concentration of sulfate or nitrate makes a much larger contribution to light extinction when humidities are high (>70 percent) than when they are low (<30 percent). Excess liquid water is also measured as part of the $PM_{2.5}$ mass when sampled by light scattering continuous monitors or when filters have not been equilibrated at relative humidities less than 30% prior to weighing.

Some of the organic carbon in suspended particles is also of secondary origin. Secondary organic compounds in particulate matter include aliphatic acids, alcohols, aromatic acids, nitro-aromatics, carbonyls, esters, phenols, and aliphatic nitrates (Grosjean and Seinfeld, 1989; Grosjean, 1992, Pandis et al., 1992, 1993; Seinfeld and Pandis, 1998). Normally, primary organic carbon particles are more prevalent than secondary organics with exceptions such as those found in Los Angeles where conditions of clear skies and high photochemical smog are frequent. Although secondary organic aerosol was thought to be minimal during winter in central California, recent analyses (Strader et al., 1998) demonstrate that it could be as much as 20% of twenty-four hour organic carbon in some samples. This occurs because low wintertime temperatures lower the saturation vapor pressure for semi-volatile organic compounds. This is probably minor during winter and fall when photochemical reactions are not dominant.

The exact precursors of secondary organics are not well understood, but they are believed to consist of heavy hydrocarbons with more than seven carbon atoms. Odum (1997) identifies aromatics as the major group of commonly measured reactive organic gases that affect both ozone and secondary aerosol formation.

5. Source Modeling Techniques

Before selecting a modeling technique, it is wise to establish a conceptual model. A conceptual model describes the relevant physical and chemical processes that affect emissions, transport, and transformation specific to the region of interest. It is the starting point for any source apportionment process. Conceptual models take advantage of the large body of scientific knowledge already acquired. They identify the sources that are likely to be present and eliminate those that are not. They examine meteorological conditions that affect concentrations and focus further modeling on the conditions conducive to the high concentrations.

Modeling techniques relevant to attribution are split into several categories depending complexity, physical attributes, purpose and cost to execute. The following tables on pages 55 to 62 provide a matrix of detailed information on specific models grouped in these categories.

a. Puff Modeling Techniques

These models are based on a Lagrangian framework where air parcels are tracked spatially and temporally. They can include chemical mechanisms as well as deposition effects. The most commonly used puff model is the CALMET/CALPUFF (Scire et al., 2000).

b. Grid Modeling Techniques

For estimating $PM_{2.5}$ levels, Eulerian models that include aerosol modules simulating the physical and chemical processes governing particulate concentrations in the atmosphere are more suitable than Lagrangian models such as plume trajectory models. Eulerian three-dimensional models may use either a simplified treatment of atmospheric chemistry (usually used to address long-term particulate concentrations at urban sites) or include a more detailed atmospheric chemistry treatment (usually used to simulate only a few days of episodes due to their compositional cost).

Commonly used long-term Eulerian models with simplified atmospheric processes include (Seigneur et al., 1997):

- Urban Airshed Model Version V (UAM-V).
- Urban Airshed Model with version V with Linear Chemistry (UAM-LC)
- Regulatory Modeling System for Aerosol and Deposition (REMSAD).

Short-term Eulerian models with complex atmospheric processes include:

- Urban Airshed Model Version V with Aerosols (UAM-AERO),
- Urban Airshed Model with Aerosol Inorganic Module (UAM-AIM).
- SARMAP Air Quality Model with Aerosols (SAQM-AERO).
- Community Multi-scale Air Quality Model (CMAQ)

- Comprehensive Air Quality Model with extensions (CAMx)

All of the above mentioned Eulerian models have been developed by various scientists from universities, federal and state agencies, and the private sector. These particulate air quality models provide a three-dimensional treatment to simulate the fate and transport of atmospheric contaminants. All of these Eulerian models include gas phase chemistry and aerosol dynamics and simulate atmospheric inorganics (such as sulfate, nitrate, and ammonium), but some of these models do not include the treatment of organics (i.e., REMSAD and UAM-LC).

c. Lagrangian Trajectory Model Techniques

The advantages of using Lagrangian models are the ease of use, the ability to perform many trajectories and perform back trajectories. Commonly used Lagrangian models include HYSPLIT (Draxler and Hess, 1997) and FLEXPART (Stohl and Siebert, 2001).

d. Meteorological Modeling Techniques

Meteorological models describe transport, dispersion, vertical mixing, and moisture in time and space. Meteorological models consist of straight line, interpolation (termed diagnostic), and first principle (termed prognostic) formulations, with increasing levels of complexity and requirements for computational and data resources.

The straight line model is applied to hourly wind directions from a single monitor, assuming an air mass travels a distance equal to the wind velocity in the measured direction, regardless of the distance from the monitoring site. This model is applicable for a few hours of transport in flat terrain, typically for evaluating a single emissions source.

Interpolation models integrate wind speed and directions from multiple measurement locations, including upper air measurements provide by remote sensors or balloon launches. The more advanced of these models allow barriers, such as mountains, to be placed between monitors. Wind fields, therefore, show different directions and velocities at different horizontal and vertical positions. Interpolation wind models are applicable to domains with a large number of well-placed monitors and for estimating the movement of air masses from many sources over transport times of more than half a day. The number and placement of monitors, especially upper air monitors, is especially important in mountainous terrain and in coastal areas where winds are unusual.

First principle models (Stauffer and Seaman, 1994; Seaman et al., 1995; Koracin and Enger, 1994) embody scientists' best knowledge of atmospheric physics and thermodynamics, employing basic equations for conservation and transfer of energy and momentum. Also known as "prognostic models," first principle models purport to need no data other than values from a sparse upper air network for interpolation. They are computationally intensive, often requiring supercomputers but have become more practical and cost-effective as workstation and desktop computers become more powerful. Modern versions use "four-dimensional data assimilation" or FDDA that compare model-calculated wind, humidity, and temperature fields with measurements and "nudge" model outputs toward observations.

A more complex meteorological model is not necessarily a better model for a specific application. One of the most widely used first principle model is the Fifth-Generation NCAR/Penn State Mesoscale Model or MM5 model (Grell et al., 1995). The MM5 meteorological model has been adopted as the platform for central California air quality studies (Seaman et. al., 1995). MM5 input data consist of wind speed, wind direction, temperature, atmospheric pressure, and relative humidity at ground level, within the boundary layer, and above the boundary layer. In many cases in valley situations ten-meter vertical resolution is needed within the surface layer, 30-50 m resolution is needed in the valley wide layer, and 100 m resolution is needed above the valleywide layer up to ~2000 m agl (Watson et al., 1998). Time resolution is at least hourly for these measurements. Measurements are needed where large differences are expected, although this is largely unknown for winter.

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Source Modeling and Back Trajectory Attribution Techniques

Table 2. Puff, Visibility and Trajectory Modeling Attribution Techniques

	Air Quality Models					
Evaluation Criteria		**Visibility Models**		**Lagrangian Trajectory Models**		
	CALPUFF	VISCREEN	PLUVUEII	HYSPLIT	RAPTAD	FLEXPART
Chemical Mechanisms						
Does the model simulate aqueous phase chemistry? (If it does what chemistry mechanism is used and does it include fog/cloud chemistry)	Yes; reactions for SO_4 and NO_3	NO	NO	NO	NO	NO
Does the model simulate gas phase chemistry? (if it does, what chemical mechanism is implemented)	Yes	NO	NO	NO	NO	NO
Simulate secondary organic aerosols	4 species model	NO	NO	NO	NO	NO
Inorganic PM (i.e. ions, SO_4, NO_3, etc)	SO_4, NO_3	NO	NO	NO	NO	NO
Size distributions (sectional or modal)	Coarse and fine modes	NO	NO	Only for deposition	NO	
Applicable spatial scales	Micro- to regional scale	Neighbor-hood to urban scale		Neighborhood to global scale	Neighborhood to global scale	Neighborhood to global scale
Applicable temporal scales (episodic or long term applications)	Episodic or Long term	N/A	N/A	Episodic or Long term	Episodic or Long term	Episodic or Long term
Does the model have the capability to distinguish BART sources?	YES	YES	YES	YES	YES	YES
Does the model have the capability to ingest field measurements (PM, HNO_3, H_2O_2, NH3, etc)	NO; only as background values	NO	NO	NO	NO	NO

Air Quality Models (continued)

Evaluation Criteria	CALPUFF	**Visibility Models** VISCREEN	PLUVUEII	**Lagrangian Trajectory Models** HYSPLIT	RAPTAD	FLEXPART
Visibility Modeling						
Does the model simulate background regional haze	NO	NO	NO	NO	NO	NO
Point source treatment (plume rise, plume in grid)	YES	YES	YES	YES	YES	YES
Does the model have the capability to calculate wet and dry deposition?	YES	NO	NO	YES	NO	YES
Visibility treatment: (extinction, deciview, visual range)	Extinction (total and for SO_4, NO_3, EC, OC, fine, coarse), Deciviews	*	*	NO	NO	NO
Input Requirements						
Meteorological data required (single site, gridded, number of levels, etc)	Gridded; able to run with single site	*	*	Gridded (FNL, EDAS, MM5)	Gridded (Use HOTMAC's prediction)	Gridded (ECMWF, MM5)
Emission data required (single stack, multiple point sources, gridded, etc)	Multiple point, area, volume	*	*	Multiple point sources, gridded inventory	Single stack or multiple point sources	*
Allow for initial and boundary conditions (is it required or not applicable)	YES	NO	NO	NO	NO	NO
Has the model been compared against field program data? Has the model been peer reviewed?	YES	YES	YES	YES	YES	NO
Does enough data exist now to run the model (Does data exist in a format ready for the model? Are current databases adequate for the model?)	Use CALMET with existing stations or MM data	YES	YES	Gridded met data available on NOAA ARL ftp site (FNL, EDAS); adaptable to read in MM5	Use HOTMAC to obtain wind and turbulence data	*

Air Quality Models (continued)

Evaluation Criteria	CALPUFF	**Visibility Models** VISCREEN	PLUVUEII	**Lagrangian Trajectory Models** HYSPLIT	RAPTAD	FLEXPART
Practical Considerations						
Costs to run (hardware platforms, file storage, operating system)	Inexpensive; PC, Windows, up to 20GB (with CALMET)	Inexpensive; PC, DOS, 1MB	Inexpensive; PC, DOS, 1MB	Inexpensive; PC, Windows, 20MB	Inexpensive: Linux PC, Redhat	Inexpensive; Linux PC, Redhat; can be compiled on PC
Have protocols or procedures been developed to run and interpret the model?	FLAG for Class I AQRVs	FLAG for Class I AQRVs	FLAG for Class I AQRVs	NO	NO	NO
Is the source code available?	YES	YES	YES	NO	YES	YES
Are beginning user training classes available?	YES; by EarthTech, BEE-Line	EPA; APTI	EPA; APTI	NO	YES	NO
Are user support groups available?	YES; one list-serve	YES; through EPA SCRAM	YES; through EPA SCRAM	NO	YES	NO
Level of expertise required to run and interpret results (Level of Linux, UNIX, PC skills required)	Moderate; able to run PC DOS programs; knowledge of atmospheric chemistry & physics	Simple; able to run on PC DOS and windows	Simple; able to run on PC DOS and Windows	Simple; able to run on PC running Windows	Simple to run: GUI allows the user to easily run the program Knowledge is needed to interpret results	Moderate; must compile source code for PC, Linux or UNIX; knowledge of met input formats
Output visualization required to interpret output numbers	YES	NO	NO	YES; has built in visualization	YES; has built in visualization	YES
Other strengths	*	*	*	*	Applicable from building scale to terrain scale.	*
Availability	EarthTech www.src.com	EPA	EPA	NOAA Air Resource Laboratory; www.arl.noaa.gov/ss/models/hysplit.html	Yamada Science & Art; http://www.ysasoft.com	http://www.forst.uni-muenchen.de/EXT/LST/METEO/stohl/flexpart.html

* No information available at this time

Table 3. Eulerian Grid Based Modeling Attribution Techniques

Evaluation Criteria	Air Quality Models / Grid Models: CMAQ	REMSAD	CAMx	UAM-AERO	UAM-VPM	URM	CalGrid
Chemical Mechanisms							
Does the model simulate aqueous phase chemistry? (If it does, what chemistry mechanism is used and does it include fog/cloud chemistry)	35 equilibria and 99 reactions for SO_4 and NO_3	1 reaction for SO_4	1 reaction for SO_4	35 equilibria and 99 reactions for SO_4 and NO_3	*	2 reactions for sulfate	NO
Does the model simulate gas phase chemistry? (if it does, what chemical mechanism is implemented)	CBM-IV (93 reactions) or RADM2 (158 reactions)	CBM-IV (93 reactions) or RADM2 (158 reactions)	CB-IV with enhanced isoprene or SAPRC97	SAPRC97 (185 reactions)	CB	LCC (about 100 reactions)	YES (both CBM-IV and SAPRC)
Simulate secondary organic aerosols	Primary from emissions; secondary from organics	Primary from emissions	Primary from emissions; secondary from gas phase reactions of organic precursors using yields	Secondary from gas phase reactions of organic precursors using yields	Primary from emissions	Primary from emissions; secondary from gas phase reactions of organic precursors using production fractions	NO
Inorganic PM (i.e. ions, SO_4, NO_3, etc)	SO_4, NO_3 and other material	SO_4, NO_3, NH_4, and other material	SO_4, NO_3, NH_4, Cl, other ions and materials	SO_4, NO_3, NH_4, Cl, other ions and materials	SO_4, NO_3, NH_4, and other materials	SO_4, NO_3, NH_4, Cl, other ions and materials	NO
Size distributions (sectional or modal)	Lognormal; three modes: Aitken, Accumulation and coase	$PM_{2.5}$ fraction, coarse mode	Discrete bins, user specified up to 10	Discrete bins, user specified up to 10	Lognormal bins; user specified	Discrete bins; user specified	NO
Applicable spatial scales	Mesoscale	Mesoscale	Mesoscale	Urban scale	Urban scale	Mesoscale	Urban to Regional
Applicable temporal scales (episodic or long term applications)	Episodic	Long term	Episodic	Episodic	Episodic	Episodic	Episodic
Does the model have the capability to distinguish BART sources?	YES; using plume in grid	NO	YES	NO	NO	NO	NO

Evaluation Criteria	Grid Models CMAQ	REMSAD	CAMx	UAM-AERO	UAM-VPM	URM	CalGrid
Chemical Mechanisms (continued)							
Does the model have the capability to ingest field measurements (PM,HNO_3,H_2O_2,NH_3,etc)	YES; as initial and boundary conditions	Uses default profiles	YES; as initial and boundary conditions	YES; as initial and boundary conditions	YES; as initial and boundary conditions	YES; as initial and boundary conditions	YES; as initial and boundary conditions
Visibility Modeling							
Does the model simulate background regional haze	YES	YES	YES	YES (with processing)	YES	YES	NO
Point source treatment (plume rise, plume in grid)	Plume in grid	NO	Plume in grid	NO	NO	NO	NO
Does the model have the capability to calculate wet and dry deposition?	YES	YES	YES	YES	YES	YES	YES
Visibility treatment: (extinction, deciview, visual range)	Extinction (total and for SO_4, NO_3, EC, OC, fine, coarse), Deciviews	Extinction (total and for SO_4, NO_3, EC, OC, fine, coarse), Deciviews	NO	YES (with processing)	*	*	NO
Input Requirements							
Meteorological data required (single site, gridded, number of levels, etc)	Gridded	Gridded	Gridded	Gridded	Gridded	Gridded	Gridded CALMET date
Emission data required (single stack, multiple point sources, gridded, etc)	Gridded	Gridded	Gridded	Gridded	Gridded	Gridded	Gridded
Allow for initial and boundary conditions (is it required or not applicable)	YES	YES	YES	YES	YES	YES	YES
Has the model been compared against field program data? Has the model been peer reviewed?	YES	YES	YES	YES	YES	YES	YES
Does enough data exist now to run the model (Does data exist in a format ready for the model? Are current databases adequate for the model?)	Extensive need for detailed emissions and meteorological fields	Extensive need for detailed emissions and meteorological fields	Extensive need for detailed emissions and meteorological fields	Extensive need for detailed emissions and meteorological fields	Extensive need for detailed emissions and meteorological fields	*	Extensive need for detailed emissions and meteorological fields

Air Quality Models (continued)

Evaluation Criteria	Grid Models						
	CMAQ	REMSAD	CAMx	UAM-AERO	UAM-VPM	URM	CalGrid
Practical Considerations							
Costs to run (hardware platforms, file storage, operating system)	Can be run inexpensively; Linux PC, up to 1 TB (annual runs)	Can be run inexpensive; Linux PC	Can be run inexpensively; Linux PC	Can be run inexpensively; Linux PC	Can be run inexpensively; Linux PC	Can be run inexpensively; Linux PC	Can be run inexpensively; Linux PC
Has a protocol or procedures been developed to run the model?	NO; but RPOs have regional haze protocols	NO; but RPOs have regional haze protocols	NO	NO	NO	NO	NO
Is the source code available?	YES	*	YES	YES	YES	YES	YES
Are beginning user training classes available?	YES; through EPA and RPOs	NO	YES; through SAI and RPOs	NO	NO	NO	NO
Are user support groups available?	YES; through EPA and RPOs	NO	NO	NO	NO	NO	NO
Level of expertise required to run and interpret results (Level of Linux, UNIX, PC skills required)	Considerable expertise in UNIX or Linux; knowledge of atmospheric chemistry & physics	*	Moderate to extensive	Moderate to extensive	*	*	Moderate
Output visualization required to interpret output numbers	YES; use PAVE	YES; use PAVE	YES	YES	YES	YES	YES
Availability	EPA; Sharon LeDuc 919-541-1335	SAI; Sharon Douglas 415-507-7108	ENVIRON; Ralph Morris 415-899-0700	SAI; Sharon Douglas 415-507-7108	SAI; Sharon Douglas 415-507-7108	Georgia Tech; Ted Russel, Talat Odman	California Air Resources Board

* No information available at this time

Table 4. Meteorological Modeling Attribution Techniques

Evaluation Criteria	Diagnostic Models		Mesoscale Prognostic Models				
	CALMET	Diagnostic Wind Model	RAMS	MM5	Eta *	ARPS	HOTMAC
Applicable spatial scales	Urban to regional scale	Urban to regional scale	Urban to global scale	Urban to global scale	Urban to global scale	Urban to global scale	Urban to mesoscale
Applicable temporal scales	Hourly to annual	Hourly to annual	Hourly to annual	Hourly to annual	Hourly to annual	Hourly to annual	Hourly to annual
Does enough data exist in organization now to run the model? Are the existing monitoring networks adequate within the domain?	Depends on area	Depends on area	Depends on area	Depends on area	Depends on area	Depends on area	Depends on area
For the prognostic models: Capable of FDDA?	N/A	N/A	Yes	Yes	Yes	Yes	Yes
For the prognostic models: Are files available (archived) from real-time?	N/A	N/A	NOAA is running the model for the east coast	Several federal agencies and regional consortiums are running MM5	NOAA is running the Eta model and fields available through NCEP ftp site	It can be initialized using NCEP analyses files as well as individual observations	No
Data storage/archival requirements for simulation of episodic and annual events	Depends on modeling domain, grid size, number of species and length of simulation	Depends on modeling domain, grid size, number of species and length of simulation	Depends on modeling domain, grid size, number of species and length of simulation	Depends on modeling domain, grid size, number of species and length of simulation	Depends on modeling domain, grid size, number of species and length of simulation	Depends on modeling domain, grid size, number of species and length of simulation	Depends on modeling domain, grid size, number of species and length of simulation
Simulate clouds/precipitation fields? At what time intervals?	No	No	Yes – minutes to days	Yes – minutes to days	Yes – minutes to days	Yes – minutes to days	Yes – minutes to days
Has the model been compared against field program data? Has the model been peer reviewed?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Meteorological Modeling Attribution Techniques (continued)

Evaluation Criteria	Diagnostic Models		Mesoscale Prognostic Models				
	CALMET	Diagnostic Wind Model	RAMS	MM5	Eta *	ARPS	HOTMAC
Tools available to visualize output fields? What operating systems?	Yes – Unix, Linux, Windows	Yes – Unix, Linux, Windows	Yes – Unix, Linux	Yes – Unix, Linux	Yes – Unix, Linux	Yes – Unix, Linux	Yes – Built-in GUI; Unix, Linux, Windows
Are user groups, listservers available when problems arise?	Yes	Yes	Yes	Yes	No	Yes	Yes
Cost to run (hardware, software)	PC Windows, PC Linux; Free source code	PC Linux, UNIX; Free	PC Linux; licensed source code	PC Linux, UNIX; Free source code	PC Linux, UNIX; Free source code	PC Linux, UNIX; Free source code	PC Linux; licensed source code
Level of expertise required to run and interpret results (Level of Linux, UNIX, PC skills required)	Moderate	Moderate	High	High	High	High	High
Availability of user training	Yes	Yes	Yes	Yes	No	Yes	Yes
Is the source code available?	Yes	Yes	Yes	Yes	No	Yes	Yes
Has a protocol or procedures been developed to run the model?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Strengths	Relatively easy to use; little observed data needed	Relatively easy to use; little observed data needed	Detailed 3-D, complex flow in time	Detailed 3-D, complex flow in time	Detailed 3-D, complex flow in time	Detailed 3-D, complex flow in time	Detailed 3-D, complex flow in time
Weaknesses/ Limitations	Parameterization depended; may not capture various flows	Parameterization depended; may not capture various flows	Large computer time; time consuming to debug	Large computer time; time consuming to debug	Large computer time; time consuming to debug	Large computer time; time consuming to debug	No real time data initialization

* While the Eta is not considered a mesoscale model, it has been used to simulate meteorology down to 10 km grid scales. The workstation Eta is available from NOAA and used experimentally by some NWS offices.
* No information available at this time

C. Observational Modeling Techniques

Introduction

Observational or receptor modeling refers to a group of analysis techniques in which monitoring data collected at or in the region of a receptor are analyzed in various ways in order to infer information about the pollutants and the sources of the pollutants causing visibility impairment.

These types of models often are used as the first technique for source apportionment in order to get an initial understanding of the source-receptor relationships in a region. They are also used to verify or reconcile deterministic models, and to aid in planning intensive monitoring studies.

Results of observational models can either be quantitative or qualitative. Quantitative results are estimates of the fractions of a measured species that can be attributed to a single source or attributed among several sources or source areas. Qualitative results include such information as the wind directions and other meteorological conditions most associated with high concentrations, or inferences about probable source types based on the relationships between trace elements at a single site, or information about source areas based on the spatial and temporal patterns in the concentrations of a single species. Often several observational models are used together to form hypotheses about the important source areas and source types affecting the concentrations at a receptor.

Advantages of receptor models are that they are generally quick and inexpensive to run and require relatively little input data. Disadvantages include the necessity of employing simplifying assumptions such as linear relationships and often the results are limited to averages over long periods of time or large spatial areas. Subjective user judgment is required to choose appropriate input data and/or interpret the results of many receptor models. As an example, suppose the UNMIX model data located a source associated with high concentrations of Br, K, elemental carbon, and organic carbon, and another source associated with high Se and S. It is the judgment of the modeler regarding the relationship of the individual species to a specific source that determines that first source is “smoke” and the second is “coal-fired power plants.”

Receptor models could potentially be grouped in several different ways, based on their different attributes. Here they are somewhat arbitrarily put into four categories, with each category requiring incrementally more particulate data at the receptor: 1) back-trajectory analyses; 2) analyses of interspecies relationships; 3) analyses of spatial and temporal patterns; and 4) analyses that require a unique tracer. Some models that fall into each category are listed below:

Category 1. Back-Trajectory Analyses

a. Residence Time Analyses including residence time, source contribution function, conditional probability, and so forth. These give qualitative information about source areas and transport patterns.

b. Trajectory Mass Balance – Regression of residence time of back trajectories in selected source areas against concentrations yielding quantitative source attributions.

Category 2. Analyses of Interspecies Relationships

a. Chemical Mass Balance (CMB) - Quantitative source attributions are obtained by a weighted regression of known source profiles against measured concentrations of several species.
b. UNMIX – By looking for "edges" in the relationships between species, UNMIX estimates both the source profiles and the quantitative source contributions from each source.
c. Positive Matrix Factorization (PMF) – PMF, like UNMIX, uses the relationships between species to estimate the number and composition of the sources and the quantitative source contributions.
d. Enrichment Factors (EF) – The "enrichment" of certain ratios of trace elements is used to qualitatively infer source types impacting a receptor.

Category 3. Analyses of Spatial and Temporal Patterns

a. Empirical Orthogonal Function Analysis (EOF) – Analysis of spatial and temporal patterns leading to qualitative information about locations of dominant source areas, frequency and timing of source impacts and meteorological conditions associated with them.
b. Receptor Model Applied to Patterns in Space (RMAPS) – With additional assumptions applied to EOFs, quantitative source attributions are estimated.

Category 4. Tracer Analyses

a. Tracer Mass Balance Regression (TMBR) – Tracer concentrations, possibly weighted by other factors, are regressed against concentrations of the species of interest to give a quantitative estimate of the contribution from the source that emitted the tracer.
b. Differential Mass Balance (DMB) - The differential ratios of tracer to pollutant between source and receptor are adjusted based on simple chemistry and meteorology to give an estimate of the contribution of the tracer source to the receptor.
c. Tracer-Aerosol Gradient Interpretive Technique (TAGIT) – By comparing the ratios of tracer to concentration of interest at "background" sites to the ratios at tracer-affected sites, a quantitative attribution of the tracer source to the receptor is estimated.

Following are brief descriptions of each of these models and a few references giving further details and examples of their use.

1a. Qualitative Back Trajectory Residence Time Analyses

There are several methods of statistically analyzing the relationships between where air masses arrived from and the concentrations measured at a receptor. These include, but are not limited to: 1) where was air most likely to arrive from when concentrations are high; 2) if air arrived from a given area, what is the probability that the concentration at the receptor was high when the air mass arrived there; 3) what is the mean (or median or maximum or distribution) of concentrations at the receptor when air masses arrived from a given area. Selected References: Ashbaugh et al. (1985), Gebhart et al. (2001), Poirot and Wishinski (1986).

Data Needed: A time series of concentrations of the species of interest. One or more back trajectories of three to five days duration corresponding to each concentration. Back trajectories can be calculated by any of several methods including ATAD, Hysplit, the CAPITA Monte Carlo Model, as well as others. Standard National Weather Service upper air data can be used as input, though more detailed meteorological data can be input if available. Dispersion can be included in some of these models.

Model Assumptions: Errors in trajectory placement are random and uncorrelated. Variations in deposition, chemistry, emissions, and so forth, have less influence on measured concentrations on average than variations in transport directions.

Biggest Potential Problems: Results of these types of analyses are qualitative rather than quantitative. Results are more statistically robust when averaged over long time periods, usually a minimum of one season and preferably several years. Nearby sources cannot be resolved. User judgment is required to choose trajectories of an appropriate type, height, and length and also to choose appropriate definitions of “high” concentrations. Some concentrations that vary seasonally may have all “high” concentrations in a single season, necessitating some compensation in the analysis. Model results are probably more appropriate for species such as particulate sulfate that are relatively uniform over large spatial scales, rather than, for example, particulate nitrate, which is more volatile and seems to be more related to local sources than long-range transport.

1b. TrMB (Trajectory Mass Balance)

This is a multiple linear regression of the frequency of occurrence of trajectory endpoints in each of several source areas against the corresponding concentrations at the receptor. The result is the average attribution of a single species among up to about 25 source areas over a long time, for example, one season or year, or several years. Selected references: Gebhart and Malm (1989), Stohl (1998).

Data Needed: Time series of concentrations of the pollutant of interest at a single site. One or more back trajectories associated with each concentration. Input data for these are upper air winds, temperatures, and moisture over a large area. Often data are obtained from the standard National Weather Service observations, but other data such as higher resolution wind fields, wind profiler data specific to a given study, can also be used if available. Emission data can be used if available, but must vary in time to be useful. Simple chemistry and/or deposition can be used if data are available. The user defines the size and locations of the source areas to be considered.

Model Assumptions: Average contributions of each source area can be written as a linear combination of the contributions from several source areas. Average chemistry and deposition are adequate to explain average source contributions. Errors in back trajectories are random and normally distributed.

Biggest Potential Problems: No attribution to single sources—only to source areas. Attributions must be averaged over long time periods. Nearby sources cannot be modeled accurately. Subjectivity in choosing source areas. Violation of assumptions of linear chemistry.

2a. Chemical Mass Balance (CMB)

CMB is a multiple linear regression of measured concentrations against known source profiles. It is used for the attribution of all measured chemical species among several sources for each concentration measurement period for a single monitoring site. Regressions are weighted by the uncertainties in both the source profiles and the concentrations. Selected References: Watson et al. (1984 and 2001).

Data Needed: Concentrations and measurement uncertainties of both the chemical species of interest and of as many trace elements as possible are necessary for each time period and location for which attributions are desired. IMPROVE data can be used. A source profile is needed for each source. These are the relative amounts of each emitted chemical species and the uncertainties in these values.

Model Assumptions: Compositions of source emissions are constant over the period of ambient and source sampling. Chemical species do not react with each other, for example, they add linearly. All sources with a potential for significantly contributing to the receptor have been identified and have had their emissions characterized. The sources' compositions are linearly independent of each other. The number of sources or source categories is less than or equal to the number of chemical species. Measurement uncertainties are random, uncorrelated and normally distributed.

Biggest Potential Problems: The model cannot directly apportion secondary species such as sulfates, nitrates, and secondary organics. There are some workarounds for this. The usual tactic is to apportion these species between the known primary sources and a source designated as "secondary particles." It is also possible to use "fractionated" or "aged" source profiles where an attempt is made to pre-determine the chemical processes that occurred between source and receptor and then adjust the source profile accordingly. Obtaining all necessary source profiles can be difficult. In some studies, other receptor models have estimated source profiles.

2b. UNMIX

For a selection of measured species, UNMIX uses singular value decomposition with additional non-negativity constraints to estimate the number of sources, the source compositions, and the source contributions to each sample at a single monitoring site. UNMIX attempts to find the "edges" in the relationships between species and relates these to sources. Selected References: Henry (1997a, 1999), Lewis et al. (1998).

Data Needed: A time series of concentrations of several species measured at a single site. IMPROVE data can be used.

Model Assumptions: Concentrations are linear combinations of an unknown number of sources of unknown composition. Contributions from sources are positive. Source compositions are approximately constant in time. For each source there are some samples that contain little or no contribution from that source.

Biggest Potential Problems: A maximum of seven sources can be identified. There is some subjectivity in choosing fitting species, number of sources, how to deal with missing or below detection limit values, and which time periods and species should be analyzed together. Sources of secondary species will probably violate the assumption of constant source composition. This can cause multiple sources to be identified for a single physical source that impacts the receptor under differing conditions. Supplemental analysis may be required to deconvolute these.

2c. Positive Matrix Factorization (PMF)

PMF uses an iterative weighted least squares method to decompose a time-by-species matrix to estimate the number and composition of the sources and the contributions of each source to each measured species. It will also calculate error estimates for these values. Selected References: Paatero and Tapper (1994), Paatero (1997); Xie *et al.* (1999).

Data Needed: A time series of concentrations and their uncertainties for several species at a single monitoring location. IMPROVE data can be used.

Model Assumptions: Concentrations are linear combinations of an unknown number of sources of unknown composition. Contributions from sources are positive. Source compositions are approximately constant in time.

Biggest Potential Problems: Correlations in detection limits or uncertainties as well as in concentrations can influence the results. For example, PMF may detect positive correlations between species either due to source activity (desirable) or measurement protocol changes (undesirable).

2d. Enrichment Factors (EF)

The differences in ratios of elemental concentrations between a reference sample and a measured sample are used to determine how sources may have "enriched" the concentrations of certain species. Some examples include: high Al/Ca has been linked to Saharan dust, high Br/Pb may indicate lead is linked to autos rather than industry, high Se is linked to coal burning, heavy metals are linked to smelting, V and Ni are linked to residual oil combustion. Selected References: Lawson and Winchester (1979), Parekh et al. (1989), Perru (1997), Roshid and Griffiths (1993).

Data Needed: Time series of concentrations of trace elements and the species of interest. Some historical information about the "standard" crustal, sea salt, or other ratios for a region.

Model Assumptions: Elemental ratios depend mostly on enrichment of trace elements by a source and have less dependence on meteorology. The reference ratios are constant.

Biggest Potential Problems: Attributions are generally to source areas, not to single sources.

3a. Empirical Orthogonal Function Analysis (EOF)

A few (typically two to six) spatial patterns that explain most of the covariance in the spatial and temporal patterns of a measured species are obtained by singular value decomposition. Associations between the spatial patterns and source areas and/or transport of air pollutants into the study area can often be inferred, but are qualitative. The original data matrix can be approximately reconstructed by linearly recombining these few patterns. Selected References: Gebhart and Malm (1997), Henry et al. (1991), Malm et al. (1990), Malm and Gebhart (1997).

Data Needed: Measurements of a single air pollutant of interest at several sites for several time periods. Typically used are concentrations measured at fifteen to forty sites for thirty or more time periods. There must be more time periods than sites. Data from special studies are often analyzed in this way.

Model Assumptions: Only a few spatial patterns are required to explain a large majority of the covariance in the spatial and temporal patterns. These patterns have a physical meaning that can be inferred, such as transport of emissions from a source into the study area or local stagnation.

Biggest Potential Problems: Source attributions are qualitative, not quantitative and interpretation of the spatial patterns is subjective. The model requires a site by time matrix with no missing values, so some method of eliminating or filling in both missing and below detection limit values is necessary.

3b. Receptor Model Applied to Patterns in Space (RMAPS)

Determines the average attribution of a single species among a few source areas by decomposing the time by site matrix of concentrations into a source matrix and a time weighting matrix. Similar to UNMIX, the edges in the scatterplots between sources and non-negativity requirements are used to constrain the identification of sources. Selected References: Henry (1997 b, c, d), White (1999).

Data Needed: Time series of concentrations of the pollutant of interest at several sites within a region. The model previously has been used in special studies such as Project MOHAVE and PREVENT where there are fifteen to forty sites within a one or two state region collecting data daily for several weeks or months.

Model Assumptions: Average contributions of each source area can be written as a non-negative linear combination of the major principal components of the data. The spatial scale of the pollutant is large compared to the spacing of the sampling sites.

Biggest Potential Problems: If the second major assumption is violated, the concentrations of the pollutant at each site will have little correlation with the other sites; therefore the model would not apply because it relies on the common variations among sites.

4a. Tracer Mass Balance Regression (TMBR) also called Multiple Linear Regression (MLR) on Marker Species

Estimates the attribution of the aerosol species of interest by a source or source type, which emitted or emits a unique tracer. Uncertainty estimates are also generated if included in the regression. The model is a regression of the tracer, possibly weighted by other factors against the species of interest. Selected References: Malm et al. (1989 a, b, c).

Data Needed: Time series of ambient concentrations and their uncertainties for the aerosol species being apportioned and also the tracer species.

Model Assumptions: The tracer(s) are uniquely emitted by non-overlapping groups of sources. Source emissions are constant over the period of ambient sampling. Deposition and conversion are constant for all sampling periods and can be estimated by first-order approximations. In the WHITEX application, sulfate oxidation rates were assumed to be related to RH, where RH was a surrogate for time the air mass spent in clouds. Measurement errors are random, uncorrelated, and normally distributed.

Biggest Potential Problems: Tracer concentrations are not often available. Source profiles, deposition, and conversion all vary in time and space.

4b. Differential Mass Balance (DMB)

DMB estimates the fraction of a species of interest attributable to a single source that can be tagged with a unique tracer. The ratio of measured tracer to measured sulfate or nitrate is assumed to be related to the fractional contribution of the traced source. The ratio is adjusted based on the estimated difference between the ratio at the source to the ratio at the receptor. Travel times between the source and receptor are estimated based on winds, and then by using simple estimates of dispersion, deposition and oxidation, the tracer to secondary species ratio is adjusted. Selected References: Malm (1989b, c).

Data Needed: Time series of tracer concentrations and concentrations and emission rates of the species of interest and its precursors, for example, sulfur dioxide and sulfate. Estimates of wind speed and direction, mixing heights, deposition and oxidation rates.

Model Assumptions: Wind direction does not change during transport time. The rates for deposition and conversion are first-order and invariant in space and time along the transport path between the source and the receptor. The ratio of the emission rates for the species of interest or its parent species and the tracer is known.

Biggest Potential Problems: Simple chemistry and meteorology may not be adequate, especially for long transport times, complex terrain, and/or changing chemical regimes. Tracer concentrations unique to a single source are often not available. The fraction of attributable concentration may only be calculable to within a range based on the reasonable ranges of rate coefficients.

4c. Tracer-Aerosol Gradient Interpretive Technique (TAGIT)

Results are the attribution of primary or secondary species associated with the source "tagged" by a tracer release. TAGIT computes attributions on a sample period-by-sample period basis. For each sample period, background concentration of the species of interest is determined by averaging the concentrations of the species at nearby sites that do not have tracer concentrations and are significantly above background. These sites are presumed to be unaffected by the tracer-tagged source and thus represent the average background. This background for each sample period is then subtracted from the concentration of the species of interest at impacted receptor sites for corresponding sample periods. The difference is the concentration attributable to the tagged source. Green (2001), Kuhns et al. (1999), Pitchford et al. (2000).

Data Needed: Concentrations of a unique tracer from a source of interest and simultaneous concentrations of a pollutant of interest at several sites in a region.

Model Assumptions: There is no impact from the tagged source if the tracer concentration is less than the level considered to be "significantly" above its' background. Background concentrations of the species of interest do not vary systematically in space.

Biggest Potential Problems: Assuming no impact from the tagged source when tracer is not statistically above background can lead to an underestimation of attribution. Measured tracer concentrations often have large uncertainties. Some sampling periods will have a negative concentration attributed to the tagged source.

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Table 5. Observational Modeling Techniques

	Analyses of Back Trajectories					
Criteria	**Residence Time & Source Contribution Function**	**Conditional Probability**	**Concentration Statistics by Air Mass History (Mean, Max, Median)**	**Cluster Analysis**	**Hit – No Hit**	**Trajectory Mass Balance**
Quantitative Source Attribution?	No	No	No	No	No	Yes
Number of sources that can be distinguished?	Typically only about 10 or fewer transport patterns are distinguishable	Maximum of 10-15	1/grid cell, typically 50x50 (2500), though usually only about 5-20 transport patterns are distinguishable	2-15	1	20-30 max
Averaging Time of Result?	Weeks to years	Weeks to years	Weeks to years	Weeks to years	Daily, possibly hourly	Months to years
Previous use at Class I Areas? (See Text for References)	Yes	Yes	Yes	Yes	Yes	Yes
Magnitude of impacts?	No	No	Yes	No	No	Yes
Frequency of impacts?	Yes	No	No	Yes	Yes	Yes
Duration of impacts?	Yes	No	No	Yes	Yes	Yes
Time of Day of impacts?	Depends on particle data	Depends on particle data	Depends on particle data	Depends on particle data	Yes	Depends on particle data
Time of Year of impacts?	Yes	Yes	Yes	Yes	Yes	Yes
Appropriate for what source-receptor distances?	Regional Scale	Regional Scale	Regional Scale	Regional Scale	Regional Scale	Regional Scale
Attribution of Secondary Species?	Yes	Yes	Yes	Yes	Yes	Yes
Cost to run?	Minimal	Minimal	Minimal	Minimal	Minimal	Minimal
Code Available?	No	No	No	No	No	No
Equations and/or algorithms available?	Yes	Yes	Yes	Yes	None needed	Yes
Computer Hardware Needed	PC	PC	PC	PC	PC	PC
Additional software necessary?	Any programming language or statistical package and graphics and/or mapping software that allows overlay of data on a map	Any programming language or statistical package and graphics and/or mapping software that allows overlay of data on a map	Any programming language or statistical package and graphics and/or mapping software that allows overlay of data on a map	Any programming language or statistical package and graphics and/or mapping software that allows overlay of data on a map	Graphing or mapping software that allows overlay of data on a map	Any programming language or statistical package and graphics and/or mapping software that allows overlay of data on a map
EPA Approved Model?	No	No	No	No	No	No

Observational Modeling Techniques(continued)

	Analyses of inter-species relationships				Analyses of Spatial and Temporal Patterns	
Criteria	**CMB**	**PMF**	**UNMIX**	**Factor Analysis**	**EOF**	**RMAPS**
Quantitative Source Attribution?	Yes	Yes	Yes	No	No	Yes
Number of sources that can be distinguished?	Usually < 10	Usually < 10	7	< Number of species analyzed	Usually 4-8 transport patterns	Usually 4-8 transport patterns
Averaging Time of Result?	Same as monitoring data	Same as monitoring data	Same as monitoring data		Same as monitoring data	Same as monitoring data
Previous use at Class I Areas? (See Text for References)	Yes	No?	No?	Yes	Yes	Yes
Magnitude of impacts?	Yes	Yes	Yes	No	No	Yes
Frequency of impacts?	Yes	Yes	Yes	Yes	Yes	Yes
Duration of impacts?	Yes	Yes	Yes	No	Yes	Yes
Time of Day of impacts?	Depends on input data	Depends on input data	Depends on input data	Depends on input data	Depends on input data	Depends on input data
Time of Year of impacts?	Yes	Yes	Yes	Yes	Yes	Yes
Appropriate for what source-receptor distances?	Urban to regional scales	Urban to regional scales	Urban to regional scales	Urban to regional scales	Regional Scale	Regional Scale
Attribution of Secondary Species?	With additional information	With additional information	With additional information	Yes	Yes	Yes
Cost to run?	Free to purchase, minimal to run	$700 to purchase, minimal to run	Currently free to purchase, minimal to run, $100 (student)-1500 (full) for MATLAB	Minimal	Minimal	Minimal
Code Available?	Yes	Yes	Yes	No	No	No
Equations and/or algorithms available?	Yes	Yes	Yes	Yes	Yes	Yes
Computer Hardware Needed	PC	PC	PC	PC	PC	PC
Additional software necessary?	No	No	MATLAB with optimization toolbox	Any statistics package	Any statistics package with ability to do singular value decompositions	Any statistics package with ability to do singular value decompositions
EPA Model?	Yes	No?	Yes?	No	No	No

Observational Modeling Techniques (continued)

	Analyses of Unique Tracer Data		
Criteria	**TMBR**	**DMB**	**TAGIT**
Quantitative Source Attribution?	Yes	Yes	Yes
Number of sources that can be distinguished?	1-3	1-3	1/tracer
Averaging Time of Result?		Same as particulate data	Same as particulate data
Previous use at Class I Areas? (See Text for References)	Yes	Yes	Yes
Magnitude of impacts?	Yes	Yes	Yes
Frequency of impacts?	Yes	Yes	Yes
Duration of impacts?	Yes	Yes	Yes
Time of Day of impacts?	Depends on particulate data	Depends on particulate data	Depends on particulate data
Time of Year of impacts?	Yes	Yes	Yes
Appropriate for what source-receptor distances?	Urban to Regional Scale	Urban to Regional Scale	Regional Scale
Attribution of Secondary Species?	Yes	Yes	Yes
Cost to run?	Minimal	Minimal	Minimal
Code Available?	No	No	No
Equations and/or algorithms available?	Yes	Yes	Yes
Computer Hardware Needed	PC	PC	PC
Additional software necessary?	Any programming language, spreadsheet, or statistical package	Any programming language, spreadsheet, or statistical package	Any programming language, spreadsheet, or statistical package
EPA Model?	No	No	No

Appendix A: **RA BART Rule** (40 CFR 51.300-306)

Sec. 51.300 Purpose and applicability.

Authority: Secs. 110, 114, 121, 160-169, 169A, and 301 of the Clean Air Act, (42 U.S.C. 7410, 7414, 7421, 7470-7479, and 7601).

Source: 45 FR 80089, Dec. 2, 1980, unless otherwise noted.

(a) Purpose. The primary purposes of this subpart are to require States to develop programs to assure reasonable progress toward meeting the national goal of preventing any future, and remedying any existing, impairment of visibility in mandatory Class I Federal areas which impairment results from manmade air pollution; and to establish necessary additional procedures for new source permit applicants, States and Federal Land Managers to use in conducting the visibility impact analysis required for new sources under Sec. 51.166. This subpart sets forth requirements addressing visibility impairment in its two principal forms: ``reasonably attributable'' impairment (i.e., impairment attributable to a single source/small group of sources) and regional haze (i.e., widespread haze from a multitude of sources which impairs visibility in every direction over a large area).

(b) Applicability. (1) General Applicability. The provisions of this subpart pertaining to implementation plan requirements for assuring reasonable progress in preventing any future and remedying any existing visibility impairment are applicable to:

(i) Each State which has a mandatory Class I Federal area identified in part 81, subpart D, of this title, and Each State in which there is any source the emissions from which may reasonably be anticipated to cause or contribute to any impairment of visibility in any such area.

(ii)The provisions of this subpart pertaining to implementation plans to address reasonably attributable visibility impairment are applicable to the following States: Alabama, Alaska, Arizona, Arkansas, California, Colorado, Florida, Georgia, Hawaii, Idaho, Kentucky, Louisiana, Maine, Michigan, Minnesota, Missouri, Montana, Nevada, New Hampshire, New Jersey, New Mexico, North Carolina, North Dakota, Oklahoma, Oregon, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Virgin Islands, Washington, West Virginia, Wyoming.

(3) The provisions of this subpart pertaining to implementation plans to address regional haze visibility impairment are applicable to all States as defined in section 302(d) of the Clean Air Act (CAA) except Guam, Puerto Rico, American Samoa, and the Northern Mariana Islands.

[45 FR 80089, Dec. 2, 1980, as amended at 64 FR 35763, July 1, 1999]

Sec. 51.301 Definitions.

For purposes of this subpart:

Adverse impact on visibility means, for purposes of section 307, visibility impairment which interferes with the management, protection, preservation, or enjoyment of the visitor's visual experience of the Federal Class I area. This determination must be made on a case-by-case basis taking into account the geographic extent, intensity, duration, frequency and time of visibility impairments, and how these factors correlate with (1) times of visitor use of the Federal Class I area, and (2) the frequency and timing of natural conditions that reduce visibility. This term does not include effects on integral vistas.

Agency means the U.S. Environmental Protection Agency.

BART-eligible source means an existing stationary facility as defined in this section. Best Available Retrofit Technology (BART) means an emission limitation based on the degree of reduction achievable through the application of the best system of continuous emission reduction for each pollutant which is emitted by an existing stationary facility. The emission limitation must be established, on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and nonair quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

Building, structure, or facility means all of the pollutant-emitting activities which belong to the same industrial grouping, are located on one or more contiguous or adjacent properties, and are under the control of the same person (or persons under common control). Pollutant-emitting activities must be considered as part of the same industrial grouping if they belong to the same Major Group (i.e., which have the same two-digit code) as described in the Standard Industrial Classification Manual, 1972 as amended by the 1977 Supplement (U.S. Government Printing Office stock numbers 4101-0066 and 003-005-00176-0 respectively).

Deciview means a measurement of visibility impairment. A deciview is a haze index derived from calculated light extinction, such that uniform changes in haziness correspond to uniform incremental changes in perception across the entire range of conditions, from pristine to highly impaired. The deciview haze index is calculated based on the following equation (for the purposes of calculating deciview, the atmospheric light extinction coefficient must be calculated from aerosol measurements):

Deciview haze index = $10 \ln_e (b_{ext}/10Mm^{-1})$ Where b_{ext} = the atmospheric light extinction coefficient, expressed in inverse megameters (Mm^{-1}).

Existing stationary facility means any of the following stationary sources of air pollutants, including any reconstructed source, which was not in operation prior to August 7, 1962, and was in existence on August 7, 1977, and has the potential to emit 250 tons per year or more of any air pollutant. In determining potential to emit, fugitive emissions, to the extent quantifiable, must be counted.

Fossil-fuel fired steam electric plants of more than 250 million British thermal units per hour heat input,

Coal cleaning plants (thermal dryers),

Kraft pulp mills,

Portland cement plants,

Primary zinc smelters,

Iron and steel mill plants,

Primary aluminum ore reduction plants,

Primary copper smelters,

Municipal incinerators capable of charging more than 250 tons of refuse per day,

Hydrofluoric, sulfuric, and nitric acid plants,

Petroleum refineries,

Lime plants,

Phosphate rock processing plants,

Coke oven batteries,
Sulfur recovery plants,
Carbon black plants (furnace process),
Primary lead smelters,
Fuel conversion plants,
Sintering plants,
Secondary metal production facilities,
Chemical process plants,
Fossil-fuel boilers of more than 250 million British thermal units per hour heat input,
Petroleum storage and transfer facilities with a capacity exceeding 300,000 barrels,
Taconite ore processing facilities,
Glass fiber processing plants, and
Charcoal production facilities.

Federal Class I area means any Federal land that is classified or reclassified Class I.

Federal Land Manager means the Secretary of the department with authority over the Federal Class I area (or the Secretary's designee) or, with respect to Roosevelt-Campobello International Park, the Chairman of the Roosevelt-Campobello International Park Commission.

Federally enforceable means all limitations and conditions which are enforceable by the Administrator under the Clean Air Act including those requirements developed pursuant to parts 60 and 61 of this title, requirements within any applicable State Implementation Plan, and any permit requirements established pursuant to Sec. 52.21 of this chapter or under regulations approved pursuant to part 51, 52, or 60 of this title.

Fixed capital cost means the capital needed to provide all of the depreciable components.

Fugitive Emissions means those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening.

Geographic enhancement for the purpose of Sec. 51.308 means a method, procedure, or process to allow a broad regional strategy, such as an emissions trading program designed to achieve greater reasonable progress than BART for regional haze, to accommodate BART for reasonably attributable impairment.

Implementation plan means, for the purposes of this part, any State Implementation Plan, Federal Implementation Plan, or Tribal Implementation Plan.

Indian tribe or *tribe* means any Indian tribe, band, nation, or other organized group or community, including any Alaska Native village, which is federally recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians.

In existence means that the owner or operator has obtained all necessary preconstruction approvals or permits required by Federal, State, or local air pollution emissions and air quality laws or regulations and either has (1) begun, or caused to begin, a continuous program of physical on-site construction of the facility or (2) entered into binding agreements or contractual obligations, which cannot be cancelled or modified without substantial loss to the owner or operator, to undertake a program of construction of the facility to be completed in a reasonable time.

In operation means engaged in activity related to the primary design function of the source.

Installation means an identifiable piece of process equipment.

Integral vista means a view perceived from within the mandatory Class I Federal area of a specific landmark or panorama located outside the boundary of the mandatory Class I Federal area.

Least impaired days means the average visibility impairment (measured in deciviews) for the twenty percent of monitored days in a calendar year with the lowest amount of visibility impairment.

Major stationary source and major modification mean major stationary source and major modification, respectively, as defined in Sec. 51.166.

Mandatory Class I Federal Area means any area identified in part 81, subpart D of this title.

Most impaired days means the average visibility impairment (measured in deciviews) for the twenty percent of monitored days in a calendar year with the highest amount of visibility impairment.

Natural conditions includes naturally occurring phenomena that reduce visibility as measured in terms of light extinction, visual range, contrast, or coloration.

Potential to emit means the maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the source to emit a pollutant including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation or the effect it would have on emissions is federally enforceable.
Secondary emissions do not count in determining the potential to emit of a stationary source.

Reasonably attributable means attributable by visual observation or any other technique the State deems appropriate. Reasonably attributable visibility impairment means visibility impairment that is caused by the emission of air pollutants from one, or a small number of sources.

Reconstruction will be presumed to have taken place where the fixed capital cost of the new component exceeds 50 percent of the fixed capital cost of a comparable entirely new source. Any final decision as to whether reconstruction has occurred must be made in accordance with the provisions of Sec. 60.15 (f) (1) through (3) of this title.

Regional haze means visibility impairment that is caused by the emission of air pollutants from numerous sources located over a wide geographic area. Such sources include, but are not limited to, major and minor stationary sources, mobile sources, and area sources.

Secondary emissions means emissions which occur as a result of the construction or operation of an existing stationary facility but do not come from the existing stationary facility. Secondary emissions may include, but are not limited to, emissions from ships or trains coming to or from the existing stationary facility.

Significant impairment means, for purposes of Sec. 51.303, visibility impairment which, in the judgment of the Administrator, interferes with the management, protection, preservation, or enjoyment of the visitor's visual experience of the mandatory Class I Federal area. This determination must be made on a case-by-case basis taking into account the geographic extent, intensity, duration, frequency and time of the visibility impairment, and how these factors correlate with (1) times of visitor use of the mandatory Class I Federal area, and (2) the frequency and timing of natural conditions that reduce visibility.

State means ``State'' as defined in section 302(d) of the CAA.

Stationary Source means any building, structure, facility, or installation which emits or may emit any air pollutant.

Visibility impairment means any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions.

Visibility in any mandatory Class I Federal area includes any integral vista associated with that area.

[45 FR 80089, Dec. 2, 1980, as amended at 64 FR 35763, 35774, July 1, 1999]

Sec. 51.302 Implementation control strategies for reasonably attributable visibility impairment.

(a) Plan Revision Procedures. (1) Each State identified in Sec. 51.300(b)(2) must have submitted, not later than September 2, 1981, an implementation plan meeting the requirements of this subpart pertaining to reasonably attributable visibility impairment.

(2)(i) The State, prior to adoption of any implementation plan to address reasonably attributable visibility impairment required by this subpart, must conduct one or more public hearings on such plan in accordance with Sec. 51.102.

(ii) In addition to the requirements in Sec. 51.102, the State must provide written notification of such hearings to each affected Federal Land Manager, and other affected States, and must state where the public can inspect a summary prepared by the Federal Land Managers of their conclusions and recommendations, if any, on the proposed plan revision.

(3) Submission of plans as required by this subpart must be conducted in accordance with the procedures in Sec. 51.103.

(b) State and Federal Land Manager Coordination. (1) The State must identify to the Federal Land Managers, in writing and within 30 days of the date of promulgation of these regulations, the title of the official to which the Federal Land Manager of any mandatory Class I Federal area can submit a recommendation on the implementation of this subpart including, but not limited to:

(i) A list of integral vistas that are to be listed by the State for the purpose of implementing section 304,

(ii) Identification of impairment of visibility in any mandatory Class I Federal area(s), and

(iii) Identification of elements for inclusion in the visibility monitoring strategy required by section 305.

(2) The State must provide opportunity for consultation, in person and at least 60 days prior to holding any public hearing on the plan, with the Federal Land Manager on the proposed SIP revision required by this subpart. This consultation must include the opportunity for the affected Federal Land Managers to discuss their:

(i) Assessment of impairment of visibility in any mandatory Class I Federal area, and

(ii) Recommendations on the development of the long-term strategy.

(3) The plan must provide procedures for continuing consultation between the State and Federal Land Manager on the implementation of the visibility protection program required by this subpart.

(c) General plan requirements for reasonably attributable visibility impairment. (1) The affected Federal Land Manager may certify to the State, at any time, that there exists reasonably attributable impairment of visibility in any mandatory Class I Federal area.

(2) The plan must contain the following to address reasonably attributable impairment:

(i) A long-term (10-15 years) strategy, as specified in Sec. 51.305 and Sec. 51.306, including such emission limitations, schedules of compliance, and such other measures including schedules for the implementation of the elements of the long-term strategy as may be necessary to make reasonable progress toward the national goal specified in Sec. 51.300(a).

(ii) An assessment of visibility impairment and a discussion of how each element of the plan relates to the preventing of future or remedying of existing impairment of visibility in any mandatory Class I Federal area within the State.

(iii) Emission limitations representing BART and schedules for compliance with BART for each existing stationary facility identified according to paragraph (c)(4) of this section.

(3) The plan must require each source to maintain control equipment required by this subpart and establish procedures to ensure such control equipment is properly operated and maintained.

(4) For any existing reasonably attributable visibility impairment the Federal Land Manager certifies to the State under paragraph (c)(1) of this section, at least 6 months prior to plan submission or revision:

(i) The State must identify and analyze for BART each existing stationary facility which may reasonably be anticipated to cause or contribute to impairment of visibility in any mandatory Class I Federal area where the impairment in the mandatory Class I Federal area is reasonably attributable to that existing stationary facility. The State need not consider any integral vista the Federal Land Manager did not identify pursuant to Sec. 51.304(b) at least 6 months before plan submission.

(ii) If the State determines that technologicial or economic limitations on the applicability of measurement methodology to a particular existing stationary facility would make the imposition of an emission standard infeasible it may instead prescribe a design, equipment, work practice, or other operational standard, or combination thereof, to require the application of BART. Such standard, to the degree possible, is to set forth the emission reduction to be achieved by implementation of such design, equipment, work practice or operation, and must provide for compliance by means which achieve equivalent results.

(iii) BART must be determined for fossil-fuel fired generating plants having a total generating capacity in excess of 750 megawatts pursuant to ``Guidelines for Determining Best Available Retrofit Technology for Coal-fired Power Plants and Other Existing Stationary Facilities'' (1980), which is incorporated by reference, exclusive of appendix E, which was published in the Federal Register on February 6, 1980 (45 FR 8210). It is EPA publication No. 450/3-80-009b and is for sale from the U.S. Department of Commerce, National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161. It is also available for inspection at the Office of the Federal Register Information Center, 800 North Capitol NW., suite 700, Washington, DC.

(iv) The plan must require that each existing stationary facility required to install and operate BART do so as expeditiously as practicable but in no case later than five years after plan approval.

(v) The plan must provide for a BART analysis of any existing stationary facility that might cause or contribute to impairment of visibility in any mandatory Class I Federal area identified under this paragraph (c)(4) at such times, as determined by the Administrator, as new technology for control of the pollutant becomes reasonably available if:

(A) The pollutant is emitted by that existing stationary facility,

(B) Controls representing BART for the pollutant have not previously been required under this subpart, and

(C) The impairment of visibility in any mandatory Class I Federal area is reasonably attributable to the emissions of that pollutant.

[45 FR 80089, Dec. 2, 1980, as amended at 57 FR 40042, Sept. 1, 1992; 64 FR 35764, 35774, July 1, 1999]

Sec. 51.303 Exemptions from control.

(a)(1) Any existing stationary facility subject to the requirement under Sec. 51.302 to install, operate, and maintain BART may apply to the Administrator for an exemption from that requirement.

(2) An application under this section must include all available documentation relevant to the impact of the source's emissions on visibility in any mandatory Class I Federal area and a demonstration by the existing stationary facility that it does not or will not, by itself or in combination with other sources, emit any air pollutant which may be reasonably anticipated to cause or contribute to a significant impairment of visibility in any mandatory Class I Federal area.

(b) Any fossil-fuel fired power plant with a total generating capacity of 750 megawatts or more may receive an exemption from BART only if the owner or operator of such power plant demonstrates to the satisfaction of the Administrator that such power plant is located at such a distance from all mandatory Class I Federal areas that such power plant does not or will not, by itself or in combination with other sources, emit any air pollutant which may reasonably be anticipated to cause or contribute to significant impairment of visibility in any such mandatory Class I Federal area.

(c) Application under this Sec. 51.303 must be accompanied by a written concurrence from the State with regulatory authority over the source.

(d) The existing stationary facility must give prior written notice to all affected Federal Land Managers of any application for exemption under this Sec. 51.303.

(e) The Federal Land Manager may provide an initial recommendation or comment on the disposition of such application. Such recommendation, where provided, must be part of the exemption application. This recommendation is not to be construed as the concurrence required under paragraph (h) of this section.

(f) The Administrator, within 90 days of receipt of an application for exemption from control, will provide notice of receipt of an exemption application and notice of opportunity for public hearing on the application.

(g) After notice and opportunity for public hearing, the Administrator may grant or deny the exemption. For purposes of judicial review, final EPA action on an application for an exemption under this Sec. 51.303 will not occur until EPA approves or disapproves the State Implementation Plan revision.

(h) An exemption granted by the Administrator under this Sec. 51.303 will be effective only upon concurrence by all affected Federal Land Managers with the Administrator's determination.

[45 FR 80089, Dec. 2, 1980, as amended by 64 FR 35774, July 1, 1999]

Sec. 51.304 Identification of integral vistas.

(a) On or before December 31, 1985 the Federal Land Manager may identify any integral vista. The integral vista must be identified according to criteria the Federal Land Manager develops. These criteria must include, but are not limited to, whether the integral vista is important to the visitor's visual experience of the mandatory Class I Federal area. Adoption of criteria must be preceded by reasonable notice and opportunity for public comment on the proposed criteria.

(b) The Federal Land Manager must notify the State of any integral vistas identified under paragraph (a) of this section, and the reasons therefor.

(c) The State must list in its implementation plan any integral vista the Federal Land Manager identifies at least six months prior to plan submission, and must list in its implementation plan at its earliest opportunity, and in no case later than at the time of the periodic review of the SIP required by Sec. 51.306(c), any integral vista the Federal Land Manager identifies after that time.

(d) The State need not in its implementation plan list any integral vista the identification of which was not made in accordance with the criteria in paragraph (a) of this section. In making this finding, the State must carefully consider the expertise of the Federal Land Manager in making the judgments called for by the criteria for identification. Where the State and the Federal Land Manager disagree on the identification of any integral vista, the State must give the Federal Land Manager an opportunity to consult with the Governor of the State.

[45 FR 80089, Dec. 2, 1980, as amended by 64 FR 35774, July 1, 1999]

Sec. 51.305 Monitoring for reasonably attributable visibility impairment.

(a) For the purposes of addressing reasonably attributable visibility impairment, each State containing a mandatory Class I Federal area must include in the plan a strategy for evaluating reasonably attributable visibility impairment in any mandatory Class I Federal area by visual observation or other appropriate monitoring techniques. Such strategy must take into account current and anticipated visibility monitoring research, the availability of appropriate monitoring techniques, and such guidance as is provided by the Agency.

(b) The plan must provide for the consideration of available visibility data and must provide a mechanism for its use in decisions required by this subpart.

[45 FR 80089, Dec. 2, 1980, as amended at 64 FR 35764, July 1, 1999]

Sec. 51.306 Long-term strategy requirements for reasonably attributable visibility impairment.

(a)(1) For the purposes of addressing reasonably attributable visibility impairment, each plan must include a long-term (10-15 years) strategy for making reasonable progress toward the national goal specified in Sec. 51.300(a). This strategy must cover any existing impairment the Federal Land Manager certifies to the State at least 6 months prior to plan submission, and any integral vista of which the Federal Land Manager notifies the State at least 6 months prior to plan submission.

(2) A long-term strategy must be developed for each mandatory Class I Federal area located within the State and each mandatory Class I Federal area located outside the State which may be affected by sources within the State. This does not preclude the development of a single comprehensive plan for all such areas.

(3) The plan must set forth with reasonable specificity why the long-term strategy is adequate for making reasonable progress toward the national visibility goal, including remedying existing and preventing future impairment.

(b) The State must coordinate its long-term strategy for an area with existing plans and goals, including those provided by the affected Federal Land Managers, that may affect impairment of visibility in any mandatory Class I Federal area.

(c) The plan must provide for periodic review and revision, as appropriate, of the long-term strategy for addressing reasonably attributable visibility impairment. The plan must provide for such periodic review and revision not less frequently than every 3 years until the date of submission of the State's first plan addressing regional haze visibility impairment in accordance with Sec. 51.308(b) and (c). On or before this date, the State must revise its plan to provide for review and revision of a coordinated long-term strategy for addressing reasonably attributable and regional haze visibility impairment, and the State must submit the first such coordinated long-term strategy. Future coordinated long-term strategies must be submitted consistent with the schedule for periodic progress reports set forth in Sec. 51.308(g). Until the State revises its plan to meet this requirement, the State must continue to comply with existing requirements for plan review and revision, and with all emission management requirements in the plan to address reasonably attributable impairment. This requirement does not affect any preexisting deadlines for State submittal of a long-term strategy review (or element thereof) between August 30, 1999, and the date required for submission of the State's first regional haze plan. In addition, the plan must provide for review of the long-term strategy as it applies to reasonably attributable impairment, and revision as appropriate, within 3 years of State receipt of any certification of reasonably attributable impairment from a Federal Land Manager. The review process must include consultation with the appropriate Federal Land Managers, and the State must provide a report to the public and the Administrator on progress toward the national goal. This report must include an assessment of:

(1) The progress achieved in remedying existing impairment of visibility in any mandatory Class I Federal area;

(2) The ability of the long-term strategy to prevent future impairment of visibility in any mandatory Class I Federal area;

(3) Any change in visibility since the last such report, or, in the case of the first report, since plan approval;

(4) Additional measures, including the need for SIP revisions, that may be necessary to assure reasonable progress toward the national visibility goal;

(5) The progress achieved in implementing BART and meeting other schedules set forth in the long-term strategy;

(6) The impact of any exemption granted under Sec. 51.303;

(7) The need for BART to remedy existing visibility impairment of any integral vista listed in the plan since the last such report, or, in the case of the first report, since plan approval.

(d) The long-term strategy must provide for review of the impacts from any new major stationary source or major modifications on visibility in any mandatory Class I Federal area. This review of major stationary sources or major modifications must be in accordance with Sec. 51.307, Sec. 51.166, Sec. 51.160, and any other binding guidance provided by the Agency insofar as these provisions pertain to protection of visibility in any mandatory Class I Federal areas.

(e) The State must consider, at a minimum, the following factors during the development of its long-term strategy:

(1) Emission reductions due to ongoing air pollution control programs,

(2) Additional emission limitations and schedules for compliance,

(3) Measures to mitigate the impacts of construction activities,

(4) Source retirement and replacement schedules,

(5) Smoke management techniques for agricultural and forestry management purposes including such plans as currently exist within the State for these purposes, and

(6) Enforceability of emission limitations and control measures.

(f) The plan must discuss the reasons why the above and other reasonable measures considered in the development of the long-term strategy were or were not adopted as part of the long-term strategy.

(g) The State, in developing the long-term strategy, must take into account the effect of new sources, and the costs of compliance, the time necessary for compliance, the energy and nonair quality environmental impacts of compliance, and the remaining useful life of any affected existing source and equipment therein.

[45 FR 80089, Dec. 2, 1980, as amended at 64 FR 35764, 35774, July 1, 1999]

APPENDIX A-9. MOBILE SOURCES

This appendix contains work products and references relied upon by Arizona in the development of Chapter 9 of the Regional Haze SIP.

<u>Appendix A-9a. Arizona Mobile Source Work Group Findings and Recommendations Related to Mobile Source Emissions</u>

Arizona Regional Haze Mobile Source Working Group
Mobile Source Significance Determination

INTRODUCTION

Statement of Purpose

This report presents the findings of the Mobile Source Working Group (MSWG) regarding the significance of Arizona mobile source emissions on the visibility impairment for the 16 Class I areas on the Colorado Plateau. The other Class I areas within the State will not be addressed here but will be addressed under Section 309(g) of the Regional Haze Rule (RHR) later. The MSWG's analysis was based on the regulatory requirements in 40 CFR 51.309(d)(5)(i-iii), the Grand Canyon Visibility Transport Commission (GCVTC) report that formed the basis for those regulations, and information from the Western Regional Air Partnership (WRAP).

The MSWG provides this report to the Arizona Department of Environmental Quality (ADEQ) for their consideration in preparing the Arizona Regional Haze State Implementation Plan (SIP).

Summary of Findings

Based on the analysis of available data, the MSWG finds that mobile source emissions in Arizona do not significantly contribute to visibility impairment in any of the 16 GCVTC Class I areas on the Colorado Plateau.

In reaching that conclusion, the MSWG analyzed mobile source pollutant emissions data of volatile organic compounds (VOC), oxides of nitrogen (NO_X), sulfur dioxide (SO_2), elemental carbon (EC), organic carbon (OC), and fine particulates ($PM_{2.5}$) for the years 2003 to 2018; air quality modeling and other technical information available from the WRAP; their approach in making the significance determination for the region, and the Environmental Protection Agency (EPA) current and future programs and their potential benefits. This conclusion is based upon the findings listed below, and explained in this report.

1) Mobile source emissions of VOC, NOx, $PM_{2.5,}$ SO_2, EC, and OC will decline from 2003 to 2018.

2) Year to year mobile source emissions of VOC, NOx $PM_{2.5}$, EC, and OC are expected to decline from 2003 to 2018.

3) Annual mobile source emissions of SO_2 are expected to decline from 2003 to 2013 with a slight increase from 2013 to 2018 with proposed federal standards for non-road equipment and diesel fuel. The minor increase is uncertain and cannot be accurately quantified and will be further addressed in the Technical

Support Document (TSD). In the event that the EPA proposed non-road standards are not adopted, Arizona will be required to submit a SIP revision as proposed by the WRAP, in their letter dated May 6, 2003 to ensure reasonable progress prior to December 31, 2008.

4) Annual mobile source emissions of VOC, NOx $PM_{2.5}$, EC, and OC are expected to have a minimal impact on visibility.

5) Reasonable progress will be achieved over the planning period with the projected emission reductions.

6) The relative contribution of mobile source SO_2 emissions is insignificant compared to that of the emissions from stationary sources.

7) There is considerable uncertainty in regulations and projections of emissions. The projected increase in SO_2 for the later part of the planning period is not certain. By 2008, the emissions for 2013 can be better assessed with some certainty.

REGULATORY REQUIREMENT

Regional Haze Rule

The federal RHR relies upon the GCVTC report as the basis for states to submit a SIP under 40 CFR 51.309(d)(5).

Section 309 of the RHR requires states to evaluate mobile source emissions, and if they are determined to significantly contribute to regional haze in the 16 Class I areas, then additional provisions apply.

SIPs developed under Section 309 must include the following elements:

- A statewide inventory of current mobile source emissions and projected future emissions of VOC, NO_X, SO_2, $PM_{2.5}$, EC, and OC, for the years 2003 to 2018. The emissions inventory must also include projections for 2005, or an alternative year when the mobile source emissions are found to be at their lowest levels (40 CFR 51.309(d)(5)(i)).

- A determination of whether mobile source emissions from any areas in the state "contribute significantly" to visibility impairment at any of the 16 Class I areas (40 CFR 51.309(d)(5)(ii)).

- If any area of the state is found to contribute significantly to visibility impairment at any of those 16 Class I areas, the SIP must also include:

    - An emission budget (cap) and measures to ensure that emissions do not increase beyond their lowest projected levels for the planning period (40 CFR 51.309(d)(5)(iii)(A)).
    - An emission tracking system to ensure that mobile source emissions do not increase thereafter (40 CFR 51.309(d)(5)(iii)(B)).

- Progress reports to EPA on the implementation of mobile source recommendations of the GCVTC (40 CFR 51.309(d)(5)(iv).

In the event that EPA finalizes the rule change as proposed, 51.309(d)(5)(ii) and (iii) above will then be removed (see below).

WRAP APPROACH TO SIGNIFICANCE DETERMINATION

Recently, the WRAP concluded that the attempt to measure mobile source significance is no longer necessary because new federal programs will achieve continual emission reductions as required for significant areas in Section 309(d)(5)(iii). On May 6, 2003, the WRAP submitted a letter to EPA proposing amendments to the RHR to eliminate the requirement to conduct the mobile source significance determination, and to address non-road mobile sources of SO_2. The WRAP letter is provided in Attachment A. The EPA has published these changes to the rule (Federal Register Vol.68, No. 128, July 3, 2003), along with a 30-day comment period. EPA has proposed a direct final for the rule. Even if the rule is challenged it still could be finalized by the end of the year.

Proposed WRAP Amendments: Significance Requirements

The GCVTC and the final RHR assumed that mobile sources were expected to decline from 2003-2005 and increase annually through 2018. As noted above, the rule required emission budgets in "significant" areas to prevent the increase in emissions. That goal is being achieved without emission caps because of new federal programs: Tier 1 gasoline sulfur controls in January 2001, and Tier 2 motor vehicle controls in February 2000, and heavy-duty engine and vehicle standards and highway diesel sulfur controls in October 2000 and January 2001. New and updated emissions models predict dramatic emission reductions from these programs. Therefore, the WRAP recommended that EPA remove the requirements for the significance determination in Sections 40 CFR 51.309(d)(5)(ii) and (iii) and amend the rule to require states to demonstrate and monitor a continuous reduction of mobile source emissions of each of the pollutants.

Proposed WRAP Amendments: SO_2 Emission Reductions

The WRAP recommendation also specifically addresses the issue of the projected increase in SO_2 emissions from non-road mobile sources in the late years of the planning period (2013-2018). Earlier this year, EPA proposed new standards for non-road equipment and non-road diesel fuels that will dramatically reduce SO_2 emission and ensure continued emission reductions for this pollutant (Federal Register Vol.68, No. 100, May 23, 2003). Those rules will not be finalized before December 31, 2003, the deadline for states to submit their Regional Haze SIPs. Therefore, the WRAP proposed amendment would require states to submit SIP revisions by 2008 to assess whether reasonable progress is being made and if necessary take action to reduce non-road SO_2 emissions if the EPA does not adopt the proposed federal standard to ensure reasonable progress.

SIGNIFICANCE DETERMINATION AND FINDINGS

The MSWG has determined that mobile sources emissions within areas in Arizona do not contribute significantly to visibility degradation at the 16 Class I areas. This conclusion also supports the WRAP recommendation that determination of mobile source emissions impact should be removed from the RHR and replaced with a requirement for states to demonstrate continual mobile source emission reductions over the planning period, considering economic and technological reasonableness and applicable state authority of the strategy.

In making the significance determination, the MSWG analyzed the Arizona mobile source emissions and the impact of the new federal programs to determine if continuous reductions were achieved for each of the pollutants throughout the planning period. The MSWG evaluated the technical data and recent modeling results prepared by ENVIRON for the WRAP. The findings provided below are based upon that review.

Current and Projected Emissions from Mobile Sources

Inventory

The WRAP developed comprehensive emission inventories for mobile sources for the State of Arizona and other western states in 5-year increments. It is assumed that interim years follow the 5-year trends. This inventory included the two major urban areas in the state (Phoenix region represented as Maricopa County, and Tucson region represented as Pima County). The emissions from these two counties follow that of the State totals, with their emissions continuing to decline over the planning period. The current and projected statewide inventories of emissions from mobile sources are shown in Table 1.

Table 1: Arizona Projected Emissions for Mobile Sources 2003 through 2018 TPD

	AZ. Total
2003	989.1
2008	733.1
2013	582.2
2018	495.9
% Change	**-50%**

Finding 1. Mobile source emissions of all pollutants (VOC, NOx, $PM_{2.5}$, EC, OC, and SO_2) decline from 2003 to 2018.

The analysis of the Arizona data parallels that of the regional analysis conducted by the WRAP. The success of new mobile source control programs is demonstrated most clearly in the dramatic reductions of emissions from 2003 to 2018. During this period of continued growth in population and vehicle miles traveled (VMT), all mobile source emissions are reduced. The total of all mobile source emissions decline 50% for the planning period. An analysis of the data for each pollutant during that same period shows that emissions of VOC and NOx steadily decline (by 51% and 52% respectively), while $PM_{2.5}$ shows a decrease of 22%. Additionally, because both EC and OC are represented as a percentage of the $PM_{2.5}$ we can assume that both EC and OC will follow the reduction observed in $PM_{2.5}$; SO_2 also declines by 11% (Attachment B).

Finding 2. Year to year mobile source emissions of VOC, NOx, $PM_{2.5}$, EC, and OC are expected to decline from 2003 to 2018.

The GCVTC recommended that emissions show reasonable progress. The GCVTC defined reasonable progress as steady and continuing emission reductions that, in the long-term, lead to improvements in visibility. This is used as the measure of reasonable progress under Section 309. The WRAP and EPA interpretation of the rule requires that each pollutant must be measured separately in the demonstration of continual reductions.

Attachment B provides a demonstration that VOC, NOx, and $PM_{2.5}$, and hence EC and OC, each show annual reductions in the planning period and thus meet the reasonable progress goal in the RHR.

Finding 3. Annual mobile source emissions of SO_2 are expected to continually decline from 2003 to 2013 with a minor increase from 2013 to 2018 with proposed federal sulfur standards for non-road diesel.

Annual mobile source emissions of SO_2 show an overall decline of 11% over the planning period with existing federal programs (Attachment B). The proposed non-road federal standards are expected to ensure annual emission reductions (Attachment C).

As noted in the WRAP letter of May 6, 2003, the proposed federal non-road standards are critical to this progress. As long as EPA adopts the proposed federal non-road standards, reasonable progress is achieved. Without these standards, the annual emission reductions for mobile sources are achieved only until 2013 when SO_2 emissions increase from 9.5 tons/day to 18.6 tons/day (Attachment B). If the non-road standards are adopted, the overall SO_2 emissions will decline by 27% from 2003 to 2018. The slight increase from 2013 to 2018 is uncertain and cannot be accurately quantified and will be further addressed in the TSD. If EPA fails to adopt the proposed standards by 2008, Arizona will have adequate time to reassess the progress and adopt state standards if necessary to account for any emissions increases in mobile source emissions. Even though some uncertainty exists in these projections, the new standards would ensure that annual emissions would decline for SO_2 emissions and therefore all mobile sources emissions in the state.

The RHR clearly does not require a separate analysis of on-road and non-road emissions in making the significance determination. However, the evaluation of the SO_2 emissions data demonstrates the importance of the federal non-road rule (see Attachments B and C). A comparison of emissions in the years 2003 and 2018 from Attachment B shows that on-road SO_2 emissions decrease by 78%, while non-road SO_2 emissions decrease until 2013 and then increase late in the planning period, resulting in a 46% increase overall. That increase is without the proposed federal non-road standards. Assuming the proposed federal standards are adopted (see Attachment C), the non-road SO_2 emissions decline by 27%.

The point is made even more dramatically in a comparison of 2018 non-road SO_2 emissions in Attachments B and C, showing that 2018 SO_2 emissions will be 16.5 tons/day without controls and 8.2 tons/day if the proposed federal standards are adopted. This will result in a 50% reduction in non-road SO_2 emissions.

Finding 4. Annual mobile source emissions of VOC, NOx, $PM_{2.5}$, EC, and OC are expected to have a minimal impact on visibility.

The WRAP performed a modeling analysis to estimate the impact of mobile source emissions from Phoenix Metropolitan area at the GCVTC Class I in 2018. The forecast year 2018 was chosen since it represents the year with the lowest emissions, and is at the end of the planning period. Table 2 summarizes the relative impact of emissions from the Phoenix Metropolitan area at the 16 GCVTC Class I areas, expressed as a percentage of the projected WRAP 2018 Base Case light extinction. Based on WRAP modeling, by 2018 the impact of mobile sources from Arizona urban areas on the GCVTC class I areas will be between 0% and 4% of the projected light extinction.

Table 2. Contribution to Light Extinction from Phoenix Mobile Source Emissions (Expressed as a % of WRAP 2018 Base Case Light Extinction)

Class I Area on the Colorado Plateau	Phoenix
Arches NP	0%
Black Canyon NP	0%
Bryce Canyon NP	0%
Canyonlands NP	0%
Capitol Reef NP	0%
Flat Tops Wilderness	0%
Grand Canyon NP	1%
Maroon Bells Wilderness	0%
Mesa Verde NP	1%
Mount Baldy Wilderness	2%

Petrified Forest NP	4%
San Pedro Parks WA	1%
Sycamore Canyon WA	2%
West Elk Wilderness	0%
Weminuche Wilderness	0%
Zion NP	0%

Source: Table 3. Percent change in light extinction over 2018 WRAP Base Case Conditions at the 16 Class I areas on the Colorado Plateau due to Mobile Source Emissions from the 9 GCVTC States, California, Phoenix, and Las Vegas, *"WRAP Technical memorandum from the Air Quality Modeling Forum to the Mobile Source Forum", November 4, 2002.*

Finding 5. Reasonable progress will be achieved over the planning period with the projected emission reductions for all mobile source pollutants.

The GCVTC definition of reasonable progress is thus met in findings 2 and 3 above, assuming the adoption of the proposed federal non-road rules.

Finding 6. The relative contribution of mobile source SO_2 is insignificant compared to that of stationary sources.

Based upon data from the WRAP Annex, the category of stationary sources is the primary source of SO_2 contributing to regional haze in the GCVTC 16 class I areas. In Arizona, the mobile source contribution to the total concentration of SO_2 is relatively small. In 2003, it represents about 5.3% of the total; while in 2018, with EPA's proposed rule, it is about 3.9% of total emissions. These data also show that the potential relative contribution of mobile sources emissions to the total SO_2 would be decreasing at a greater rate than that of stationary sources with EPA's new proposed non-road rule. This continued improvement in mobile source emissions is the result of stringent federal programs created after the 1995 GCVTC report. Therefore, the WRAP concluded that the Commission's concern about the potential impact from mobile sources has been addressed. Additional federal control programs for mobile sources will provide an even greater improvement in emissions in upcoming years.

Finding 7. The uncertainty in regulations and projections in emissions adds to the determination.

It is important to note that uncertainty exists in several areas: 1) the adoption of the proposed federal non-road standards as proposed on May 23, 2003; 2) the projected benefits that might be achieved, and 3) the projections of emissions from the model for the later years. When looking at the data, the projections for the early years are likely to be more valid than those estimated for 2018. This uncertainty can be addressed through periodic reporting on the progress of the reduction in mobile source emissions and then making adjustments in the SIP.

MSWG RECOMMENDATION TO ADEQ FOR SIGNIFICANCE DETERMINATION:

Based on this analysis, the MSWG concludes that mobile source emissions do not significantly contribute to regional haze at any of the 16 GCVTC Class I areas. This finding does not attempt to address the other Class I areas in the State that will be addressed in the future under Section 309(g) of the RHR.

In evaluating the impact of mobile source emissions in the 16 Class I areas, the MSWG considered a wide range of information from the WRAP analysis as well as Arizona-specific data on total emissions as well as specific pollutants. The Working Group concludes that reductions in mobile source emissions will meet the GCVTC goal of continued reduction throughout the planning period based upon new and proposed federal programs with the EPA adoption of the proposed non-road rules. In the event that EPA's proposed non-road standards are not realized, the WRAP recommends that states be required to file a SIP revision to ensure reasonable progress prior to December 31, 2008.

Based upon the findings above, the MSWG recommends that ADEQ consider this report in preparing the significance determination for the Arizona Regional Haze SIP.

Should the proposed revisions to the RHR become effective prior to the submission of the Arizona SIP under Section 309, references to 40 CFR 51.309(d)(5)(ii-iii) will be eliminated.

List of Attachments:

Attachment A "WRAP Letter to EPA (Dated May 6, 2003)"

Attachment B "Total Arizona Mobile Source Emissions by Pollutant Projected for 2003 through 2018 Assuming No New Regulations"

Attachment C "Total Arizona Mobile Source Emissions by Pollutant Projected for 2003 through 2018, Assuming a 15 ppm Sulfur Non-road Diesel Standard"

Western Regional Air Partnership

May 6, 2003

The Honorable Christie Todd Whitman
Administrator
U.S. Environmental Protection Agency (1101A)
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Dear Administrator Whitman:

The Western Regional Air Partnership (WRAP) requests that EPA update Section 309 of the Regional Haze Regulations to reflect the current situation relative to mobile source emissions in the West. The approach to mobile sources currently included in Section 309 is based on recommendations of the Grand Canyon Visibility Transport Commission (GCVTC) that are now outdated because of new mobile source emissions models and new federal engine and fuel standards adopted by EPA since the Commission made its recommendations in 1996.

The WRAP's suggested revisions update section 309 requirements to conform with expected trends in mobile source emissions. They also eliminate certain mobile source requirements which are now unnecessary, and add a substitute requirement for sulfur dioxide emissions from non-road mobile sources that would take effect if EPA's recently proposed standards for sulfur in non-road diesel fuel are not adopted.

Specifically, the requested revision would eliminate §51.309(d)(5)(ii) and (iii) and modify the provisions of §51.309(d)(5)(i) to require a showing of continuous emission reduction of total mobile source emissions of VOC, NOx, PM2.5, organic carbon and elemental carbon (evaluated separately) over the period 2003-2018. For SO_2, the requested correction would require an implementation plan revision by no later than December 31, 2008 containing any necessary long-term strategies to reduce emissions of SO_2 from non-road sources in the event that EPA does not adopt a federal standard as recently proposed. Specific regulatory language to implement these suggested changes is included in Attachment 1.

Staffed by:
Western Governors' Association
1515 Cleveland Place, Suite 200
Denver, CO 80202
(303) 623-9378
Fax (303) 534-7309

www.wrapair.org

Staffed by:
National Tribal Environmental Council
2221 Rio Grande NW
Albuquerque, NM 87104
(505) 242-2175
Fax (505) 242-2654

EPA's Regional Haze Rule currently requires states that choose to submit plans under Section 309 to provide for: "A determination whether mobile source emissions in any areas of the state contribute significantly to visibility impairment in any of the 16 Class I Areas, based on the statewide inventory of current and projected mobile source emissions" (51.309(d)(5)(ii)).

If mobile source emissions in any area of the state are found to contribute significantly to visibility impairment in any of the 16 Class I areas, the rule requires: "The establishment and documentation of a mobile source emissions budget for any such area, including provisions requiring the state to restrict the annual VOC, NOx, SO2, elemental and organic carbon, and/or fine particle mobile source emissions to their projected lowest level, to implement measures to achieve the budget or cap, and to demonstrate compliance with the budget." (51.309(d)(5)(iii)(A)).

These provisions are based on the GCVTC's recommendations for mobile sources. The GCVTC was concerned because their modeling of mobile source emissions showed emissions reaching a low point in 2005 and then increasing.

Due to new mobile source emissions models and, more importantly, new federal engine and fuel standards adopted by EPA since the Commission made its recommendations in 1996, the WRAP's current emissions projections indicate a significant decline in mobile source emissions throughout the West during the 2003-2018 time period covered by the Section 309 plans. This trend is especially dramatic for on-road mobile source emissions.

While we also project emission reductions from non-road mobile sources (except SO2), the reductions are not as great. By 2018, in the absence of new standards for non-road diesel engines and fuel, such as those recently proposed by EPA, the contribution to visibility impairment in the West from non-road sources will be much greater than that from on-road sources. For this reason, the WRAP supports expeditious implementation of rigorous new engine and fuel standards for non-road diesel sources that are similar in stringency to those for on-road sources.

Regarding SO2, the WRAP has found that current federal regulations for on-road gasoline and diesel fuel provide the most effective level of control possible at this time. On the other hand, the WRAP has found that SO2 emissions from non-road mobile sources will continue to be of concern in the absence of a federal standard for non-road diesel fuel. Since EPA has proposed new federal standards to address this problem, the WRAP's suggested update to Section 309 postpones action as part of the plans due this year, but requires states to submit an implementation plan revision by no later than December 31, 2008 containing any necessary long-term strategies to reduce emissions of SO2 from non-road sources, consistent with the goal of reasonable progress. This requirement is intended to

ensure that states work to reduce current levels of SO2 from non-road sources as part of their regional haze plans if EPA does not adopt a federal standard as recently proposed.
In the event that EPA does pass a federal sulfur standard for non-road diesel fuel, the WRAP does not believe that the resulting emission reductions should be allowed to be used to offset emissions from other sources that are contributing to haze in the West.

Given that Section 309 plans are due at the end of this year, we are hopeful that EPA will be able to work with the Office of Management and Budget to make this revision to the rule on an expedited basis. We appreciate your assistance with this request and will certainly provide any additional information EPA may need.

Sincerely,

Michael O. Leavitt
Governor of Utah
WRAP Co-Chair

Fred S. Vallo, Sr.
Governor of Pueblo of Acoma
WRAP Co- Chair

cc: Mr. Jeffrey Holmstead, EPA
Ms. Lydia Wegman, EPA

Attachment 1:
Proposed Revised Rule Language

CFR 51.309(d)(5) Mobile sources. The plan submission must provide for:

(i) Statewide inventories of on-road and non-road mobile source emissions of VOC, NOx, SO2, fine particles (PM-2.5), elemental carbon, and organic carbon for the years 2003, 2008, 2013, and 2018.

The inventories must demonstrate a continuous decline in total mobile source emissions (on-road plus non-road; tailpipe and evaporative) of VOC, NOx, fine particles (PM-2.5), elemental carbon, and organic carbon, evaluated separately. If the inventories show that mobile source emissions of each of these pollutants will continuously decline over the period, no further action is required as part of this plan to address mobile source emissions of these pollutants. If the inventories show that mobile source emissions of one or more of these pollutants will not continuously decline over the period 2003-2018, the plan submission must provide for an implementation plan revision by no later than December 31, 2008 containing any necessary long-term strategies to achieve a continuous decline in mobile source emissions of the pollutant(s), to the extent practicable, considering economic and technological reasonableness and applicable state authority.

The plan submission must also provide for an implementation plan revision by no later than December 31, 2008 containing any long-term strategies necessary to reduce emissions of SO2 from non-road mobile sources, consistent with the goal of reasonable progress. In assessing the need for such long term strategies, the state may consider emissions reductions achieved or anticipated from any new federal standards for sulfur in non-road diesel fuel.

Delete 309(d)(5)(ii) and (iii) and the definition of mobile source emissions budget found at 309(b)(6).

Definition of continuous decline: The emission inventories submitted as part of this plan must show that statewide mobile source emission levels (on-road plus non-road) of each listed pollutant in 2008, 2013, and 2018 are less than the estimated level of that pollutant for the previous period (i.e., 2008 less than 2003; 2013 less than 2008; and 2018 less than 2013).

Attachment B
Total Arizona Emission by Pollutant
Projections for 2003 through 2018
Assume No New Regulations
(TPD)

	State Total				
	VOC	NOx	PM2.5	SO2	Total
2003	448.7	496.5	23.0	20.9	**989.1**
2008	319.9	381.2	22.0	14.6	**737.7**
2013	256.9	296.7	19.1	16.6	**589.3**
2018	222.0	237.3	18.0	18.6	**495.9**
% Change	**-51%**	**-52%**	**-22%**	**-11%**	**-50%**

	Non-road				
	VOC	NOx	PM2.5	SO2*	Total
2003	112.1	150.2	14.2	11.3	**287.8**
2008	77.7	124.4	13.8	13.0	**228.9**
2013	70.3	111.1	13.3	14.8	**209.5**
2018	69.7	107.8	13.4	16.5	**207.4**
% Change	**-38%**	**-28%**	**-6%**	**46%**	**-28%**

*2003 and 2018 are actual model outputs;
2008 and 2013 are extrapolated and assumed to be linear.

	On-road				
	VOC	NOx	PM2.5	SO2	Total
2003	336.6	346.3	8.8	9.6	**701.3**
2008	242.2	256.8	8.2	1.6	**508.8**
2013	186.6	185.6	5.8	1.8	**379.8**
2018	152.3	129.5	4.6	2.1	**288.5**
% Change	**-55%**	**-63%**	**-48%**	**-78%**	**-59%**

Note: Both EC and OC are represented as a percentage of the $PM_{2.5}$ and we can assume that both EC and OC will follow the changes observed in $PM_{2.5}$

Attachment C
Total Arizona Emission by Pollutant
Projections for 2003 through 2018
Assume a 15 ppm Sulfur Non-road Diesel Standard
(TPD)

	State Total				
	VOC	**NOx**	**PM2.5**	**SO2**	**Total**
2003	448.7	496.5	23.0	20.9	**989.1**
2008	319.9	381.2	22.0	10.0	**733.1**
2013	256.9	296.7	19.1	9.5	**582.2**
2018	222.0	237.3	18.0	10.3	**487.6**
% Change	**-51%**	**-52%**	**-22%**	**-51%**	**-51%**

Note: Assumes all the reductions associated with 15 ppm Standard come between 2013 and 2018

	Non-road				
	VOC	**NOx**	**PM2.5**	**SO2**	**Total**
2003	112.1	150.2	14.2	11.3	**287.8**
2008	77.7	124.4	13.8	8.4	**224.3**
2013	70.3	111.1	13.3	7.7	**202.4**
2018	69.7	107.8	13.4	8.2	**199.1**
% Change	**-38%**	**-28%**	**-6%**	**-27%**	**-31%**

	On-road				
	VOC	**NOx**	**PM2.5**	**SO2**	**Total**
2003	336.6	346.3	8.8	9.6	**701.3**
2008	242.2	256.8	8.2	1.6	**508.8**
2013	186.6	185.6	5.8	1.8	**379.8**
2018	152.3	129.5	4.6	2.1	**288.5**
% Change	**-55%**	**-63%**	**-48%**	**-78%**	**-59%**

Note: Both EC and OC are represented as a percentage of the $PM_{2.5}$ and we can assume that both EC and OC will follow the changes observed in $PM_{2.5}$

REGIONAL HAZE STATE IMPLEMENTATION PLAN FOR THE STATE OF ARIZONA

APPENDICES - VOLUME II

Appendix A-10

Air Quality Division
Arizona Department of Environmental Quality

LIST OF APPENDICES

APPENDIX VOLUME I

LIST OF APPENDICES (Cont.)

APPENDIX VOLUME II

LIST OF APPENDICES (Cont.)

APPENDIX VOLUME III

APPENDIX A-10. FIRE PROGRAMS

This appendix contains work products and references relied upon by Arizona in the development of Chapter 10 of the Regional Haze SIP.

<u>Appendix A-10a. WRAP report "Assessing Status of Incorporating Smoke Effects into Fire Planning and Operation"</u>

Assessing Status of Incorporating Smoke Effects into Fire Planning and Operations

Western Governors' Association
Western Regional Air Partnership



August 29, 2002

Prepared by:

ENTRANCO

345 East Mountain Avenue
Fort Collins, CO 80524

ASSESSING STATUS OF INCORPORATING
SMOKE EFFECTS INTO FIRE PLANNING AND OPERATIONS

Prepared by:

Entranco
345 E. Mountain Avenue
Fort Collins, CO 80524

In association with:

Core Environmental Consulting

Forest Stewardship Concepts, Ltd.

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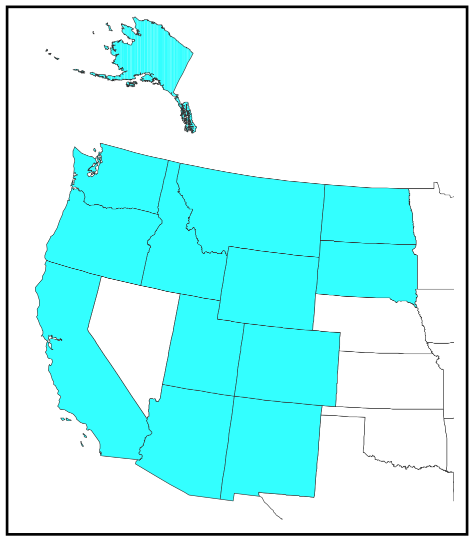
Appendices

1.0 Introduction

The Western Governor's Association (WGA), in conjunction with federal, state, tribal, and local entities throughout the west, formed the Western Regional Air Partnership (WRAP). The purpose of WRAP is to build on the work of the Grand Canyon Visibility Transport Commission (GCVTC) in developing and planning programs that can reduce visibility-impairing emissions and improve visibility throughout the West. WRAP can recommend regional approaches to improving air quality and reducing regional haze, but the authority and responsibility for implementing any or all WRAP recommendations lies with individual states, tribal entities, and local governments.

WRAP has a principal planning group, the Initiatives Oversight Committee (IOC), and a principal technical group, the Technical Oversight Committee (TOC). Under the IOC and TOC are several forums that develop technical and policy options for specific areas of interest to WRAP. One such forum is the Fire Emissions Joint Forum (FEJF), which reports to both the IOC and TOC. The FEJF is tasked with making recommendations on strategies and methods to manage emissions from prescribed fire. The Smoke Effects Task Team is part of the FEJF and is the sponsoring agent for the project described in this report.

Smoke from fires produces a variety of air pollutants. The predominant sources of smoke in the region typically are from fires for prescribed burns, natural wildland fires and agricultural burns. GCVTC recognized the need to address air quality effects from prescribed fire and managed natural fire (or wildland fire use [WFU]) because of increased use of prescribed fire throughout the West. GCVTC concluded that fire planning efforts should consider more thoroughly the effects of smoke on visibility, public nuisance, and the National Ambient Air Quality Standards (NAAQS) (GCVTC, 1996), and also as required by the Environmental Protection Agency's (EPA) Regional Haze Rule (EPA, 1999).



State Governments in WRAP

The following sections describe a project that is one step in investigating the existing level of consideration given to smoke impacts in fire planning documents, and this was the overall purpose of the project. The project involved gathering and reviewing a number of different types of fire-related documents from a variety of agencies and tribal entities that perform or authorize controlled or natural burns, to assess the emphasis placed on smoke impacts. The project had several objectives, including:

- assess the status of federal, state, local, tribal, and private prescribed fire programs in considering smoke effects from prescribed fires and WFUs in strategic planning documents, known as programmatic plans,

- evaluate whether non-burning alternatives were considered by land managers in programmatic plans,

- assess the status of federal, state, local, tribal, and private prescribed fire programs in considering smoke effects from prescribed fires and WFUs in operational plans, including use of the Wildland Fire Situation Analysis (WFSA) by federal land managers,

- evaluate the smoke effects from implementation of operational plans for prescribed fires and WFUs, including use of WFSA by federal land managers,

- identify and summarize relevant guidance documents for agencies on consideration of air quality effects from prescribed fire and WFU in programmatic and operational plans, and

- identify and summarize relevant guidance documents for use of the WFSA process for assessing air quality effects for wildfire and WFU incidents.

Prescribed Fire is defined as a management-ignited wildland fire that burns under specified conditions where the fire is confined to a predetermined area and produces the fire behavior and fire characteristics required to attain planned fire treatment and resource management objectives.

WFU refers to the management of naturally-ignited fires to accomplish specific, pre-stated resource management objectives in predefined geographic areas that are outlined in the governing programmatic plan. Prescribed Natural Fire is another term often used to describe WFU, and both terms refer to the same concepts. WFU operational plans are only developed by Federal Land Management agencies that have approved Wildland Fire Management Plans. WFU does not apply to state or county agencies, private land managers or tribal entities.

WFSA is a decision-making process jointly established by the Federal Land Managers that evaluates alternative management strategies related to firefighter safety, environmental, social, economic, political, and resource management objectives. As such, WFSA plans only apply to wildland fires on federally managed lands. Consequently, WFSA plans were not received from state, county, private or tribal entities.

The documents of interest fit into three general categories: programmatic plans, operational plans, and guidance documents. The discussion of methodology and results of the project is broken out by these categories.

Steps in Federal Fire Planning Processes

2.0 Methods

The overall approach within the project was to gather various burn plans/documents from designated agencies and tribal entities, and assess the plans/documents relative to specific project evaluation criteria. The results from the assessments were recorded, tabulated, and summarized. One directive for the project was to summarize results to maintain individual agency anonymity.

A sample of various recent fire planning and execution documents prepared by a number of different agencies (or other entities) that use fire/burning for resource management was the goal of the document collection task. The sample size and contacts were predetermined by FEJF before the project began. Table 1 is a summary of the land managers and agencies that were contacted for the project. The list includes tribal entities, federal, local, private, state, and tribal land managers. It must be emphasized that most of the plans received and reviewed for the project (excluding guidance documents) were selected by the resource agencies in Table 1, not the project team.

Each land manager was requested to provide examples of the following types of documents:

- Programmatic plans
  - Programmatic for prescribed fire
  - Programmatic for WFU
- Operational plans
  - Operational for prescribed fire
  - Implementation of prescribed fire
  - Operational for WFU
  - Implementation of WFU
  - WFSA documentation
- Guidance documents, air quality regulations, and statutes supporting plan preparation

It should be noted that this plan-naming convention is not universal for all of the land managers; the plan names are most applicable to federal processes. Not every land manager uses or is required to use each of the named plan types. Therefore, each plan type was not necessarily available from every land manager. In addition, there is considerable variability in complexity within a category of plans, depending on the goals, objectives, and regulatory requirements of the land manager. Where necessary, a specific fire/burn document without an obvious category was designated as the closest matching plan type. A comprehensive list of the burn plans reviewed is presented in Appendix A.

The plans were assessed by comparing the contents of the plans/documents against a set of evaluation criteria. The evaluation criteria were developed by FEJF. Different types of plans had different evaluation criteria. The criteria by which each fire/burn plan was evaluated are presented below. Note that some of the criteria have multiple conditions joined by "and." In these cases, all criteria conditions must be true for an affirmative response to that criterion. With an "or" or "e.g.," a single true condition elicits an affirmative response. The results for each evaluation criterion were recorded on data forms. The data were then transferred to an electronic database developed specifically to contain project information, to facilitate analysis of the results. The database enabled the project team to view data in both specific and anonymous terms as the project progressed. The database was also used to track the progress of receipt and review of the various plans.

Table 1. Land Managers Requested to Provide Fire/Burn Plans for the Project

Type	Agency	Region
Federal	Bureau of Indian Affairs	
	Bureau of Land Management	Alaska
		Arizona
		Colorado
		Idaho
		Montana
		New Mexico
		Nevada
		Oregon
		Utah
		Wyoming
	Department of Defense	
	National Park Service	Alaska
		Intermountain
		Midwest
		Pacific West
	U.S. Fish and Wildlife Service	1
		2
		6
	U.S. Forest Service	1
		2
		3
		4
		5
		6
Local	Bernalillo County, New Mexico	
	Boulder County, Colorado	
	Columbia County, Washington	
	Jefferson County, Oregon	
	Missoula County, Montana	
	Pinal County, Arizona	
	San Joaquin Valley, California	
Private	The Nature Conservancy	
	Plum Creek Timber	
	USDA Natural Resources Conservation Service	
State	Colorado Division of Forestry	
	Montana Division of Forestry	
	Nevada Division of Forestry	
	State of Arizona Agriculture	
	State of California Agriculture	
	State of Idaho Agriculture	
	State of Montana Agriculture	
	State of Oregon Agriculture	
	State of Washington Agriculture	
Tribal	Institute for Tribal Environmental Professionals	
	Intertribal Timber Council	

2.1 Programmatic Plans

Programmatic plans are strategic land management plans for prescribed fire and/or WFU that include fuel treatment activities at a program level. They usually cover a 1- to 20-year planning period for a specific management area.

Examples of federal programmatic plans are Resource Management Plans or Fire Management Plans for a specific land management unit (e.g., a BLM district or national forest). Comparable planning documents are uncommon outside federal agencies for burning that occurs on private lands, tribal lands or under open burning permits issued to the general public. Nevertheless, example programmatic documents that had been prepared within the past 3 years (or their equivalent) were requested from all of the contacts listed in Table 1.

The programmatic plans were evaluated for two types of beneficial fire use: prescribed fire and WFU. Different evaluation criteria were used for prescribed fire and WFU.

2.1.1 Programmatic Plans for Prescribed Fire

The evaluation criteria for programmatic prescribed fire plans were:

1. Was there evaluation of cumulative effects of smoke (qualitative and/or quantitative analysis)?

2. Was there evaluation of potential intrusions to Class I or other identified smoke-sensitive areas?

3. Was there identification and determination of compliance with applicable laws and relevant policies?

4. Any identification of smoke management techniques to reduce fire emissions and mitigate smoke impacts?

5. Analysis of recent historic (within 10 years) and projected (for life of plan) annual or seasonal emissions from prescribed fire and WFU?

6. Identification of non-burning alternatives that were analyzed or utilized as a fuel treatment method?

7. Completion of General Conformity determination for projects in nonattainment areas?

2.1.2 Programmatic Plans for Wildland Fire Use

The evaluation criteria for programmatic WFU plans were:

1. Was there consideration of cumulative effects of smoke (qualitative and/or quantitative analysis)?

2. Was there assessment of potential intrusions to Class I or other identified smoke-sensitive areas?

3. Are any burn decisions tied to specific air quality criteria?

4. Identification of non-burning alternatives that were analyzed or utilized as a fuel treatment method?

2.2 Operational Plans

The operational plan category contains two general groups of documents: pre-burn and post-burn. The true “operational” plans in this category are the pre-burn plans that describe in advance how beneficial fire is planned for a specific land unit. The post-burn plans in this category consist of the implementation of a pre-burn operational plan and are referred to as implemented plans below.

Operational plans for this project are relevant for prescribed fire, WFU, and WFSA. Once again, this is primarily federal terminology, however, most non-federal land managers have an equivalent pre-burn operational document. Most planned beneficial fire, whether it occurs under a simple burning permit or a complex program to accomplish a large wildland fire, has some type of operational plan. For the purposes of this survey, a recent operational plan was requested from the sources listed in Table 1. In the case of implemented plans, any available documentation on the results of the fire was requested, as formal post-burn reports proved to be uncommon.

2.2.1 Operational Plans for Prescribed Fire, WFU and WFSA

To identify and assess federal, state and local-level operational plans with respect to air quality effects from prescribed fire, WFU and WFSA smoke effects, available documents were gathered and evaluated. The documents were gathered through telephone requests from contacts specified by FEJF at the beginning of the project (Table 1). The evaluation criteria for operational plans for prescribed fire, WFU, and WFSA were as follows:

1. Did the document estimate emissions of visibility-impairing air pollutants and their effects on visibility (regional haze and plume blight), NAAQS, and nuisance?

2. Did the document discuss actions to be taken to minimize fire emissions and/or smoke impacts?

3. Was the use of smoke dispersion evaluation or criteria discussed in the document?

4. Did the document discuss the use of public notification procedures?

5. Did the document discuss the use of air quality monitoring?

6. Were predetermined “trigger points” for designating air quality impact discussed in the document?

7. Did the document discuss predetermined contingency actions to be taken when air quality impacts occurred?

8. Was planned cooperation with downwind receptors, regulatory agencies, and compliance with their laws, rules, and guidance discussed in the document?

9. Was planned coordination with adjacent and downwind land managers discussed in the document?

10. For projects in nonattainment areas, did the document discuss completion of the General Conformity determination? (Note: This criterion is for prescribed fire plans only.)

In reviewing these documents, an affirmative evaluation was given if the criterion topic was mentioned or discussed, even if only briefly. The project team did not attempt to assess the thoroughness or adequacy of the criterion discussion, only its presence. If the criterion topic was not found, a negative evaluation was given. In some cases, a criterion may not be applicable (e.g., Criterion 10) for a plan.

2.2.2 Implementation of Prescribed Fire and WFU

Implementation of WFSAs did not seem to be documented typically and was consequently not available for evaluation under the project. Therefore, the evaluation criteria for implemented prescribed fire and WFU plans were as follows.

1. Were smoke effects avoided?
2. Were unfavorable smoke effects experienced?
3. Was the frequency of verified public nuisance complaints reported in the document?
4. Were air quality regulatory citations documented?
5. Were contacts made with downwind receptors, regulatory agencies, and land managers according to predetermined plans?
6. Were all of the smoke management elements of the burn plan implemented?
7. Were any contingency actions taken as a result of air quality impacts?
8. Were public notification and exposure reduction procedures followed?
9. Was compliance met with all applicable air quality laws, rules, and guidance?
10. Was the air quality monitoring plan followed?
11. Were actions taken to avoid smoke impacts and effects?

In reviewing these documents, an affirmative evaluation was given if the criterion topic was mentioned, even if only briefly. If the criterion topic was not found, a negative evaluation was given. In some cases, a criterion may not be applicable (e.g., Criterion 10) for a plan. It must be emphasized that formal implementation reports seem to be uncommon, so the "implementation plan" often consisted of field notes, participant summaries, etc. The project team had no way to verify independently the completeness of the data provided for review, rather we relied on the diligence of the providing agency.

2.3 Guidance Documents

To identify and assess federal, state, and local-level guidance with respect to air quality effects of prescribed fire and WFU smoke effects, available guidance documents were gathered and evaluated. An initial set of guidance documents to be reviewed was specified by FEJF at the beginning of the project, but other guidance was identified and added by the project team. The documents included smoke management plans from throughout the West, local open burning permit requirements, national smoke management guidance and training materials, agricultural burning smoke management program documents from Oregon and Washington, as well as federal and state and local air quality regulations. The documents were gathered from the Internet, from personal libraries, by telephone requests and from local libraries. These documents were selected with the intent of assessing reporting requirements for smoke effects from a representative set of air quality regulations as well as land manager guidance documents. The guidance documents reviewed are listed in Appendix B.

The evaluation criteria used for guidance documents were as follows:

1. Did the document provide guidance on the use of categorical exclusions under the National Environmental Policy Act (NEPA)?

2. Was guidance provided on the use of non-burning alternatives?

3. Did the document include information on applicable air quality laws, rules, and guidance and the general conformity requirements of the Clean Air Act?

4. Was guidance provided on estimation of air pollutant emissions and their effects on visibility (regional haze and plume blight) as well as the National Ambient Air Quality Standards (NAAQS)?

5. Were predetermined "trigger points" to indicate when an air quality impact occurs discussed in the document?

6. Were contingency actions to be taken when air quality impacts occur discussed?

7. Was coordination with adjacent and downwind land managers, regulatory agencies, and other downwind receptors discussed?

8. Did the guidance cover cumulative effects of smoke through either a qualitative or quantitative analysis of prescribed fire projections from other land managers and other stationary or mobile sources?

In reviewing these documents, an affirmative evaluation was given if any guidance on the criterion topic was provided, no matter how brief. If discussion of the criterion topic was not present, a negative evaluation was given. In addition, the criteria as provided by the FEJF were treated quite literally. For example, the phrasing of Criterion 3 with "and" requires several conditions all to be met for a document to receive an affirmative response. As a result, any documents that might address some of the conditions of the criterion but not others received a negative evaluation for the criterion.

3.0 Findings

In considering the results from the project tasks, a few points must be emphasized. The great majority of the plans (excluding guidance documents) included in this project were selected at the sole discretion of the providing agency. The project team mentioned some desired characteristics of the plans to be reviewed (such as 1998 or more recent, and fully completed) but the agencies ultimately selected the individual plans on their own. (In a few instances at the end of the project, the project team acquired a few plans on their own to fill gaps in the overall project matrix.) In addition, the project team had no access to the agency files and therefore had no control over the completeness of the documentation provided for review. Every effort was made to ensure that the contacted agencies were aware of the project goals, but the project team had no way of knowing if relevant documentation was not provided by the agencies. Follow-up calls to the agencies were made to ensure the relevant information was provided, but ultimately this was beyond the project team's control.

The findings from the evaluations of programmatic plans, operational plans and guidance documents are presented below. The findings are divided into tables according to plan type. Each table is summarized by agency type. The tables show the total number of each type of plan reviewed, the number of those plans with an affirmative (i.e., "yes") evaluation for each criterion, and the corresponding percentage of the total represented by the latter number. Negative evaluations for a criterion could be due to absence from the document reviewed or non-applicability of the criterion to the particular document. Please note that negative evaluations do not necessarily mean a "poor" or "bad" finding, as in the case of whether any air quality citations were issued.

Finally, the following sections present few findings regarding tribal activities. This outcome appeared to be due to several factors, including (1) limited suppliers of tribal documents (Institute for Tribal Environmental Professionals [ITEP], Intertribal Timber Council, Bureau of Indian Affairs), and (2) an official request process through tribal entities that was too lengthy for the time constraints on the project. The ITEP study (*An Assessment of Tribal Air Quality Data and Programs in the Western United States*) indicated that some Federal Implementation Plans and tribal Smoke Management Plans have been developed, but copies of those plans, programmatic plans or operations plans are not readily available. Therefore, it would be incorrect to presume that the lack of numbers of tribal plans below corresponds to a lack of involvement in smoke issues by tribal agencies; rather, the project team had difficulty acquiring plans within the framework of the project.

3.1 Programmatic Plans

A total of 18 prescribed fire and 12 WFU programmatic plans were received from federal agencies. One local prescribed fire programmatic plan was reviewed (a county prescribed fire planning document), and one tribal prescribed fire plan was reviewed. Results of the assessment for programmatic plans are presented in Tables 2 and 3.

3.1.1 Programmatic Plans for Prescribed Fire

The review of prescribed fire programmatic plans prepared by federal agencies indicates that while most plans do address the assessment criteria in very qualitative terms, none of the plans provided quantitative analysis of the effects of smoke on air quality and Class I visibility. Many of the plans defer such matters to the smoke management program under which they operate, noting only that the burning to be conducted will comply with smoke management plan requirements. This infers that all applicable laws and relevant policies are complied with and that smoke management techniques will be applied. The majority of the plans also note that prescribed burning may temporarily impact air quality and Class I area visibility.

A programmatic plan for prescribed fire was obtained from both a tribal and a local agency. These seemed to be rather rare occurrences. These two plans were somewhat hit-and-miss regarding coverage of evaluation criteria, and the large range in percentages (Table 2) is reflective of the low number of plans available.

Table 2. Affirmative Criterion Responses for Programmatic Plans for Prescribed Fire

	Agency Type					
	Tribal		Local		Federal	
Criteria	Count	Percent	Count	Percent	Count	Percent
1) cumulative effects of smoke	0	0	1	100	7	39
2) intrusions into Class I or other areas	0	0	1	100	10	56
3) applicable laws and relevant policies	0	0	0	0	15	83
4) smoke management techniques	0	0	1	100	11	61
5) annual or seasonal emissions	1	100	0	0	4	22
6) non-burning alternatives	1	100	1	100	8	44
7) General Conformity (in nonattainment/maintenance areas only)	NA		NA		1	6
Number of Documents	1		1		18	

NA—not applicable

Table 3. Affirmative Criterion Responses for Programmatic Plans for WFU

	Agency Type	
	Federal	
Criteria	Count	Percent
1) cumulative effects of smoke	4	33
2) intrusions into Class I or other areas	7	58
3) burn decisions tied to air quality criteria	12	100
4) non-burning alternatives	9	75
Number of Documents	12	

♦ Criterion 1: Cumulative effects

About a third of the federal plans discussed this topic, usually rather minimally. It was covered in the local plan, but not the tribal plan.

- Criterion 2: Impacts on Class I areas

About half the federal plans covered this, often as a component of smoke estimation. It was covered in the local plan, but not the tribal plan.

- Criterion 3: Laws and policies

A large majority of the federal plans discussed the laws that the plans must comply with, and this was often done in terms of the governing local Smoke Management Plan. It was not covered in the local plan or the tribal plan.

- Criterion 4: Smoke management techniques

This was kind of a mixed bag with the federal plans, though a majority of plans addressed the topic. Some made mention of techniques such as backing fires. It was covered in the local plan, but not the tribal plan.

- Criterion 5: Annual or seasonal emissions estimates

Few of the federal plans discussed this topic. It was not covered in the local plan, but was in the tribal plan.

- Criterion 6: Non-burning alternatives

Just under half of the federal plans discussed this topic and such discussions are often quite brief and not comprehensive. It was also covered in the local plan, and briefly in the tribal plan.

- Criterion 7: General Conformity

This criterion is relevant only for planned federal activities (e.g., prescribed fire) in areas that are nonattainment or maintenance areas for one or more NAAQS; conformity is not an issue in attainment areas. This topic was relevant for only one of the federal resource areas, and it was discussed in the relevant plan. This topic was not relevant to either the local or tribal resource areas and was therefore not presented.

3.1.2 Programmatic Plans for WFU

All of the programmatic plans for WFU reviewed were from federal agencies (Table 3). The other agency types generally suppress any naturally-started fires.

- Criterion 1: Cumulative effects

Only about a third of the federal plans discussed this topic, usually rather minimally

- Criterion 2: Impacts on Class I areas

About half the federal plans covered this, often as a component of smoke modeling. Some plans deferred this evaluation until ready to burn.

♦ Criterion 3: Burn decision tied to air quality

Each of the federal plans indicated that atmospheric conditions must be favorable for the action to proceed, although the required atmospheric conditions were not always identical.

♦ Criterion 4: Non-burning alternatives

Three-quarters of the plans discussed alternatives such as mechanical treatments. In some instances, there are agency policies or other limitations on use of mechanical treatments.

3.2 Operational Plans

There are five subgroups of operational plans for the project, covering both operational plans and the implementation of operational plans. For the project, a total of 47 operational plans and 19 implementation "reports" were reviewed. These documents were provided by a variety of agency types and covered a wide gamut of technical needs. The results are presented in Tables 4, 5 and 6.

Table 4. Affirmative Criterion Responses for Operational Plans for Prescribed Fire

	Agency Type									
	Tribal		Private		Local		State		Federal	
Criteria	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
1) estimation of emissions	0	0	0	0	0	0	0	0	0	0
1a) estimation of emissions, but ignoring regional haze portion	0	0	0	0	3	50	2	25	8	44
2) actions to minimize emissions	1	100	2	100	5	83	7	88	12	67
3) smoke dispersion evaluation	1	100	2	100	6	100	8	100	18	100
4) public notification	1	100	1	50	2	33	4	50	16	89
5) air quality monitoring	1	100	2	100	4	67	5	63	16	89
6) predetermined trigger points	0	0	1	50	3	50	5	63	10	56
7) predetermined contingency actions	1	100	2	100	4	67	6	75	14	78
8) cooperation with downwind receptors	1	100	1	50	4	67	8	100	16	89
9) coordination with adjacent and downwind land managers	1	100	1	50	2	33	4	50	11	61
10) completion of General Conformity	NA		NA		NA		NA		NA	
Number of Plans	1		2		6		8		18	

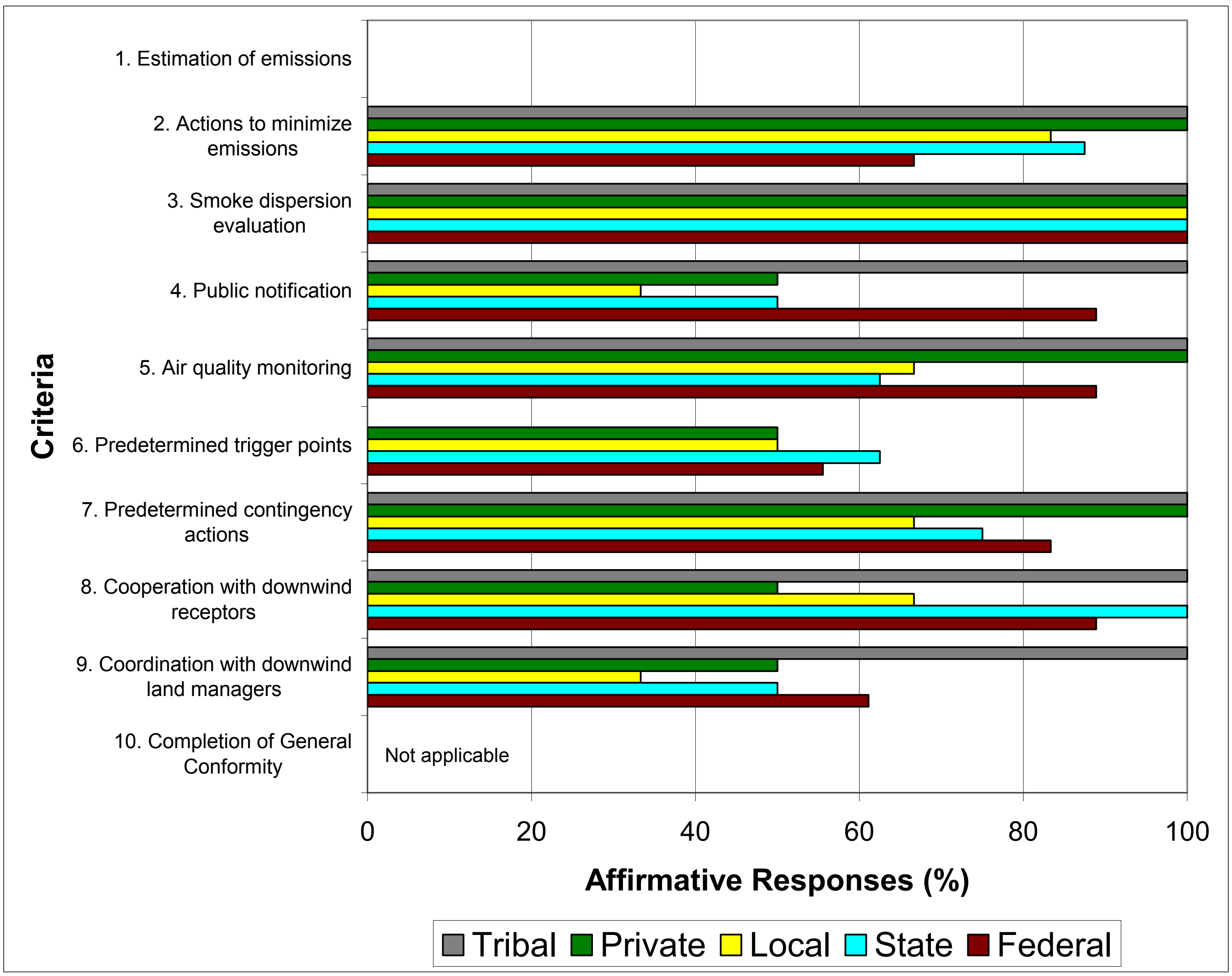
NA—not applicable

3.2.1 Operational Plans for Prescribed Fire

A total of 35 operational plans for prescribed fire were reviewed for the project, and plans were received from all five agency categories (Table 4). This was the plan type that was most complete for the project. The types of plans received in this category ranged from simple 1-page county open burn forms to Environmental Impact Statements. The results from the evaluations of operational plans for prescribed fire are presented in Table 4 and are graphed in Figure 1.

Comparison of plans from different agency categories showed a wide range in plan content and complexity. However, the operational plans for prescribed fire from federal agencies (Table 1) were fairly consistent in content as well as appearance. In general terms, federal plans tended to be the most comprehensive and complete. State forestry agencies often use prescribed fire on lands they manage. These agencies typically prepare burn plans prior to unit ignition, as required by their respective state smoke management plans.

Figure 1. Results from Operational Plans for Prescribed Fire



Several states also regulate agricultural burning and require simple plans as a condition of burn permit issuance. A variety of documents were provided by the various state agricultural and local entities on the list (Table 1), but these documents fit into two general categories: those prepared for state/local agency approval and those that were not. Examples of documents provided that *were not* for state/local approval included copies of burn plans by other agencies (e.g., Forest Service) that were distributed through burn notification requirements. These documents were evaluated for the project, but were materially different from the next category. The documents that *were* prepared for state/local approval were limited to open burning permit applications. These permits were for ditch burning on private lands, burning of agricultural debris from orchards and grass seed production, forestlands and general land clearing operations. The open burn documents are typically simple in scope, limiting the kinds of materials that can be burned, the notification procedures that must be used and burn day smoke dispersion requirements. The one exception was a local parks department that provided an operational plan for prescribed fire that resembled the operational plans for prescribed fire acquired from federal agencies.

The private land owners contacted for this project operated under open burn permits, and sometimes they must prepare burn plans as a condition of permit issuance. Some of the land owners proactively prepare burn plans for their own internal planning purposes, even if not required in the permitting process. The scope of these plans can vary considerably depending on smoke management program requirements.

One operational prescribed fire plan was obtained from a tribal organization. All of the project document types discussed in this section were included in the operational plan assessment for prescribed burns.

Generally speaking, the operational plans for prescribed fire covered the evaluation criteria pretty well, as most of the results are well over 50% (Table 4). This indicates that the fire planners are giving the topics of concern at least some consideration. Criterion 3 had universal recognition in the plans. Criteria 1 and 6 showed some of the lowest recognition. Criterion 10 received no recognition because none of the reviewed plans were in NAAQS non-attainment areas. Results for the other criteria fell somewhere in between, but were generally relatively high. The following discusses findings relevant to each of the assessment criteria.

- ♦ Criterion 1: Estimation of emissions

The wording of this criterion should be noted. There are a number of conditions that must all be true for an affirmative response to this criterion, and typically impacts to regional haze (or more) were not addressed. Therefore, none of the reviewed plans received an affirmative response when following the wording of the criterion. When the regional haze portion of the criterion is ignored (Table 4 Line 1a), there are several affirmative responses. In most cases, SASEM was run to estimate emissions.

- ♦ Criterion 2: Actions to minimize emissions

A large majority of the plans addressed this topic. For the federal reports, the most common actions discussed were aerial ignition and ignition patterns. For the state it was limiting the area burned and for local it was ignition technique.

- Criterion 3: Smoke dispersion evaluation

Every operational plan for prescribed fire that was reviewed addressed this criterion. Scheduling involving the time of day and/or year that burning was permitted was the most common way that achieving dispersion was addressed in all report types. Wind speed and direction, mixing height were also very common.

- Criterion 4: Public notification

A large majority of the plans addressed this topic. All but two of the federal reports indicated that public notification would take place usually via press releases to local newspapers. Radio and signage were other methods mentioned. The majority of the reports from other agency types address this criterion as well.

- Criterion 5: Air quality monitoring

A large majority of the plans addressed this topic. All but two of the federal reports indicated that air quality monitoring would take place. The most common form of monitoring for all agency types was visual monitoring, except for the state reports in which instrument monitoring was mentioned.

- Criterion 6: Predetermined trigger points

For about half the federal reports the most common trigger point was smoke hitting a major roadway within the vicinity of the burn. Other agency types tended to have very qualitative assessment points.

- Criterion 7: Predetermined contingency actions

A large majority of the plans addressed this topic. Halting of ignition was the most common recommended action in federal reports while extinguishing the fire was more common for state reports.

- Criterion 8: Cooperation with downwind receptors

Planned cooperation with downwind receptors was discussed in all but five of the operational plan for prescribed fire that were reviewed.

- Criterion 9: Coordination with other managers

Planned coordination with other managers was discussed in approximately half of the operational plan for prescribed fire that were reviewed.

- Criterion 10: General Conformity in nonattainment areas

All responses to this question were “not applicable” because none of the sites were in nonattainment areas.

3.2.2 Operational Plans for WFU

A total of 5 operational plans for WFU were reviewed for the project. Only federal agencies make use of these types of plans. The results from the evaluations of operational plans for WFU are presented in Table 5.

Generally speaking, the operational plans for WFU did not cover the evaluation criteria as well as prescribed fire (Table 5). There were not nearly as many plans to review, but at least one plan gave each topic at least some consideration. The following discusses findings relevant to each of the assessment criteria.

- Criterion 1: Estimation of emissions

The wording of this criterion should be noted. There are a number of conditions that must all be true for an affirmative response to this criterion, and typically impacts to regional haze (or more) were not addressed. Therefore, none of the reports received an affirmative response when following the wording of the criterion. When the regional haze portion of the criterion is ignored (Table 5 Line 1a), there are two affirmative responses. Two of the reports indicated that emissions had been estimated as well as their effects on visibility, NAAQS, and nuisance. In one case SASEM had been run.

Table 5. Affirmative Criterion Responses for Operational Plans for WFU

	Agency Type	
	Federal	
Criteria	Count	Percent
1) estimation of emissions	0	0
1a) estimation of emissions, but ignoring regional haze portion	2	40
2) actions to minimize emissions	2	40
3) smoke dispersion evaluation	4	80
4) public notification	5	100
5) air quality monitoring	4	80
6) predetermined trigger points	1	20
7) predetermined contingency actions	2	40
8) cooperation with downwind receptors	3	60
9) coordination with adjacent and downwind land managers	4	80
Number of Plans	5	

- Criterion 2: Actions to minimize emissions

Two reports discussed actions to minimize emissions.

- Criterion 3: Smoke dispersion evaluation

The majority of the reports addressed smoke dispersion. Wind speed and direction and the use of other meteorological data were the most common methods.

- Criterion 4: Public notification

All of the reviewed plans indicated that public notification would take place through various types of media.

- Criterion 5: Air quality monitoring

Four of the five reports indicated that air quality monitoring would take place. The most common type of monitoring was visual.

- Criterion 6: Predetermined trigger points

Only one report addressed trigger points.

- Criterion 7: Predetermined contingency actions

Two reports addressed contingency actions such as stopping ignitions.

- Criterion 8: Cooperation with downwind receptors

Three reports addressed planned cooperation with downwind receptors.

- Criterion 9: Coordination with other managers

Four reports addressed planned coordination with other managers.

3.2.3 Operational Plans for WFSA

A total of 7 operational plans for WFSA were reviewed for the project. Only federal agencies make use of these types of plans. The results from the evaluations of operational plans for WFSA are presented in Table 6.

Generally speaking, the operational plans for WFSA did not cover the evaluation criteria as well as either prescribed fire or WFU. This is likely a function of WFSAs being nearly "after the fact" plans where the fire is already burning before the WFSA process begins. The following discusses findings relevant to each of the assessment criteria.

- Criterion 1: Estimation of emissions

The wording of this criterion should be noted. There are a number of conditions that must all be true for an affirmative response to this criterion, and typically impacts to regional haze (or more) were not addressed. Therefore, none of the reviewed plans received an affirmative response when following the wording of the criterion. When the regional haze portion of the criterion is ignored (Table 6 Line 1a), there is one affirmative responses. One of the WFSA documents mentioned estimated emissions.

♦ Criterion 2: Actions to minimize emissions

Few of the plans mentioned this. Most typically, the fundamental emissions control action is to put the fire out as quickly as possible. One plan mentioned that safety and suppression were the priorities.

♦ Criterion 3: Smoke dispersion evaluation

One of the WFSA documents mentioned this.

Table 6. Affirmative Criterion Responses for Operational Plans for WFSA

	Agency Type	
	Federal	
Criteria	Count	Percent
1) estimation of emissions	0	0
1a) estimation of emissions, but ignoring regional haze portion	1	14
2) actions to minimize emissions	2	29
3) smoke dispersion evaluation	1	14
4) public notification	4	57
5) air quality monitoring	1	14
6) predetermined trigger points	1	14
7) predetermined contingency actions	0	0
8) cooperation with downwind receptors	1	14
9) coordination with adjacent and downwind land managers	1	14
Number of Plans	7	

♦ Criterion 4: Public notification

About half of the plans mentioned this, the other half did not.

♦ Criterion 5: Air quality monitoring

Only one plan mentioned any kind of air monitoring.

- Criterion 6: Predetermined trigger points

One plan described a rather qualitative trigger; if smoke becomes noticeable in an adjacent area.

- Criterion 7: Predetermined contingency actions

One of the WFSA documents mentioned this.

- Criterion 8: Cooperation with downwind receptors

One of the plans discussed this criterion. One plan seemed to indicate there would be communication only if complaints were received.

- Criterion 9: Coordination with other managers

One of the WFSA documents mentioned this.

3.2.4 Implementation of Prescribed Fire

A total of 15 reports detailing the implementation of operational plans for prescribed burns were reviewed for the project, and plans were received from three of the five agency categories. The results from the evaluations of operational plans for WFSA are presented in Table 7 and graphed in Figure 2.

The majority of these reports (13) were received from federal agencies, although it should be noted that these were not truly "reports" but rather collections of information. These reports were often a collection of individual documents obtained from a number of sources including air agencies, smoke management programs, and district and regional offices. In cases where adverse smoke impacts occurred as a result of a fire, the post-burn report can be voluminous, but in most cases the reports were brief and often incomplete with respect to the assessment criteria. Only Criterion 1 exceeded 50% in coverage.

Most of the non-federal reports gave next to no consideration to the evaluation criteria, and usually the documentation was quite thin. The following discusses findings relevant to each of the assessment criteria.

- Criterion 1: Avoided smoke effects

The majority of reports indicated that there was no smoke effect because of good dispersion; the others (from all agency categories) were silent on the topic.

- Criterion 2: Unfavorable smoke effects

Two federal reports mentioned that there were effects. None of the other reports mentioned this topic.

- Criterion 3: Verified public nuisance complaints

Three federal reports addressed the topic by indicating there had been complaints. None of the other reports mentioned this topic.

Table 7. Affirmative Criterion Responses for Implementation of Prescribed Fire

	Agency Type					
	Private		Local		Federal	
Criteria	Count	Percent	Count	Percent	Count	Percent
1) avoided smoke effects	1	100	1	100	9	69
2) unfavorable smoke effects	0	0	0	0	2	15
3) verified public nuisance complaints	0	0	0	0	5	38
4) air quality citations	0	0	0	0	0	0
5) contacts made with downwind receptors	0	0	0	0	5	38
6) smoke management elements of burn plan implemented	0	0	1	100	6	46
7) contingency actions taken as a result of air quality impacts	0	0	0	0	1	8
8) public notification and exposure reduction	0	0	0	0	4	31
9) compliance with air quality laws	0	0	0	0	4	31
10) air quality monitoring plan followed	0	0	1	100	5	38
11) actions taken to avoid smoke impacts	0	0	0	0	2	15
Number of Plans	1		1		13	

- Criterion 4: Air quality citations

One of the federal reports indicated that a citation had been issued, but it was later rescinded upon further investigation. That was the only mention of the topic.

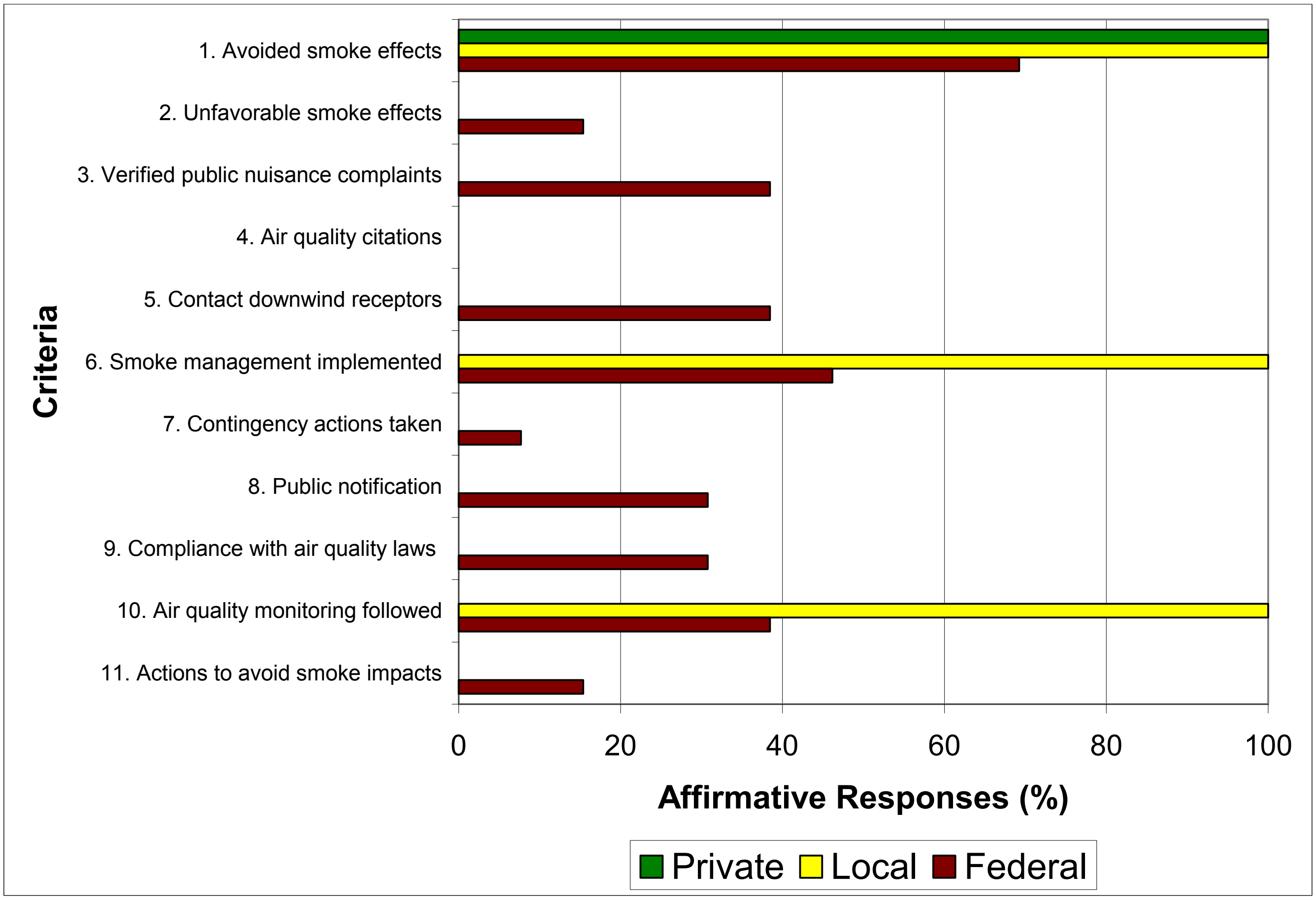
- Criterion 5: Contacts made with downwind receptors

Most of the operational plans indicated that this would be done during the burn. If this was executed during implementation, it was not well documented in most of the reports.

- Criterion 6: Smoke management elements implemented

The local agency report seemed to indicate that this was done. A few federal reports indicated that this was done, while most of the reports were silent on the topic. One federal report seemed to indicate that the data specified in the operational plan was not all collected during the burn. The private agency report did not mention the topic.

Figure 2. Results from Implementation of Prescribed Fire



- Criterion 7: Contingency actions

For one federal burn, new ignitions were halted. No other such actions were mentioned.

- Criterion 8: Public notification

Again, if this was executed during implementation, it was not well documented in most of the reports.

- Criterion 9: Compliance with air quality laws

The reports typically did not discuss their status with this criterion.

- Criterion 10: Air quality monitoring

The majority of reports did not contain data showing this was done. It is possible monitoring was performed but was not provided in the data package.

- Criterion 11: Actions taken to avoid smoke impacts

Very few of the documented burns needed to act to reduce smoke (water drops, reduce fuel consumed, etc.). This complements Criterion 1 where good smoke dispersion was typically reported.

3.2.5 Implementation of WFU

A total of four reports detailing the implementation of operational plans for WFU were reviewed for the project. The results from the evaluations of operational plans for WFU are presented in Table 8.

Table 8. Affirmative Criterion Responses for Implementation of WFU

	Agency Type	
	Federal	
Criteria	Count	Percent
1) avoided smoke effects	1	25
2) unfavorable smoke effects	2	50
3) verified public nuisance complaints	2	50
4) air quality citations	0	0
5) contacts made with downwind receptors	4	100
6) smoke management elements of burn plan implemented	3	75
7) contingency actions taken as a result of air quality impacts	1	25
8) public notification and exposure reduction	4	100
9) compliance with air quality laws	2	50
10) air quality monitoring plan followed	3	75
11) actions taken to avoid smoke impacts	1	25
Number of Plans	4	

These reports were available only from federal agencies. Again, these were not truly “reports” but often just collections of information. These post-burn reports may include information on how the burn was actually accomplished, tons of fuel actually burned, smoke complaints (if any) received, plume transport and other information detailing what actually happened during the burn. These reports were often a collection of individual documents obtained from a number of sources including air agencies, smoke management programs, and district and regional offices. The reports tended to be brief and often incomplete with respect to the assessment criteria. There were few reports available for review, and the results were inconsistent (Table 8). The following discusses findings relevant to each of the assessment criteria.

- Criterion 1: Avoided smoke effects

Two burns had poor dispersion and some smoke effects, one had good dispersion and one did not mention the topic.

- Criterion 2: Unfavorable smoke effects

Half the burns had effects from poor dispersion.

- Criterion 3: Verified public nuisance complaints

Half the burns had some complaints, though these were not always the same burns as Criterion 2.

- Criterion 4: Air quality citations

No citations were reported.

- Criterion 5: Contacts made with downwind receptors

All the reports described contacting downwind receptors.

- Criterion 6: Smoke management elements implemented

One burn did not document smoke modeling. Otherwise, the elements seemed to have been implemented.

- Criterion 7: Contingency actions

In one case, any new fires were extinguished as a contingency action.

- Criterion 8: Public notification

The reports indicated that this was done.

- Criterion 9: Compliance with air quality laws

One burn report did not mention the topic. Another burn report did not show daily monitoring as recommended in the agency guidelines.

- Criterion 10: Air quality monitoring

As with Criterion 9, one burn report did not show daily monitoring.

- Criterion 11: Actions taken to avoid smoke impacts

An action was taken for one burn by removing vegetation on ridge tops.

3.3 Guidance Documents

In total, 68 guidance documents were reviewed for the project: 25 local documents, 21 state-level documents including smoke management plans, and, 22 federal guidance documents. Table 9 and Figure 3 summarize the results of the assessment. Detailed findings for each guidance document are tabulated in Appendix C.

Table 9. Affirmative Criterion Responses for Guidance Documents

	Agency Type					
	Local		State		Federal	
Criteria	Count	Percent	Count	Percent	Count	Percent
1) categorical exclusions	0	0	0	0	5	23
2) non-burning alternatives	5	20	9	43	13	59
3) evaluation of air quality laws and rules including general conformity	1	4	2	10	12	55
4) estimation of air pollu-tants and visibility impacts	5	20	9	43	14	64
5) predetermined trigger points	1	4	7	33	8	36
6) contingency actions to be taken	4	16	7	33	7	32
7) coordination with adjacent and downwind land managers	2	8	5	24	7	32
8) cumulative effects of smoke	0	0	1	5	3	14
Number of Documents	25		21		22	

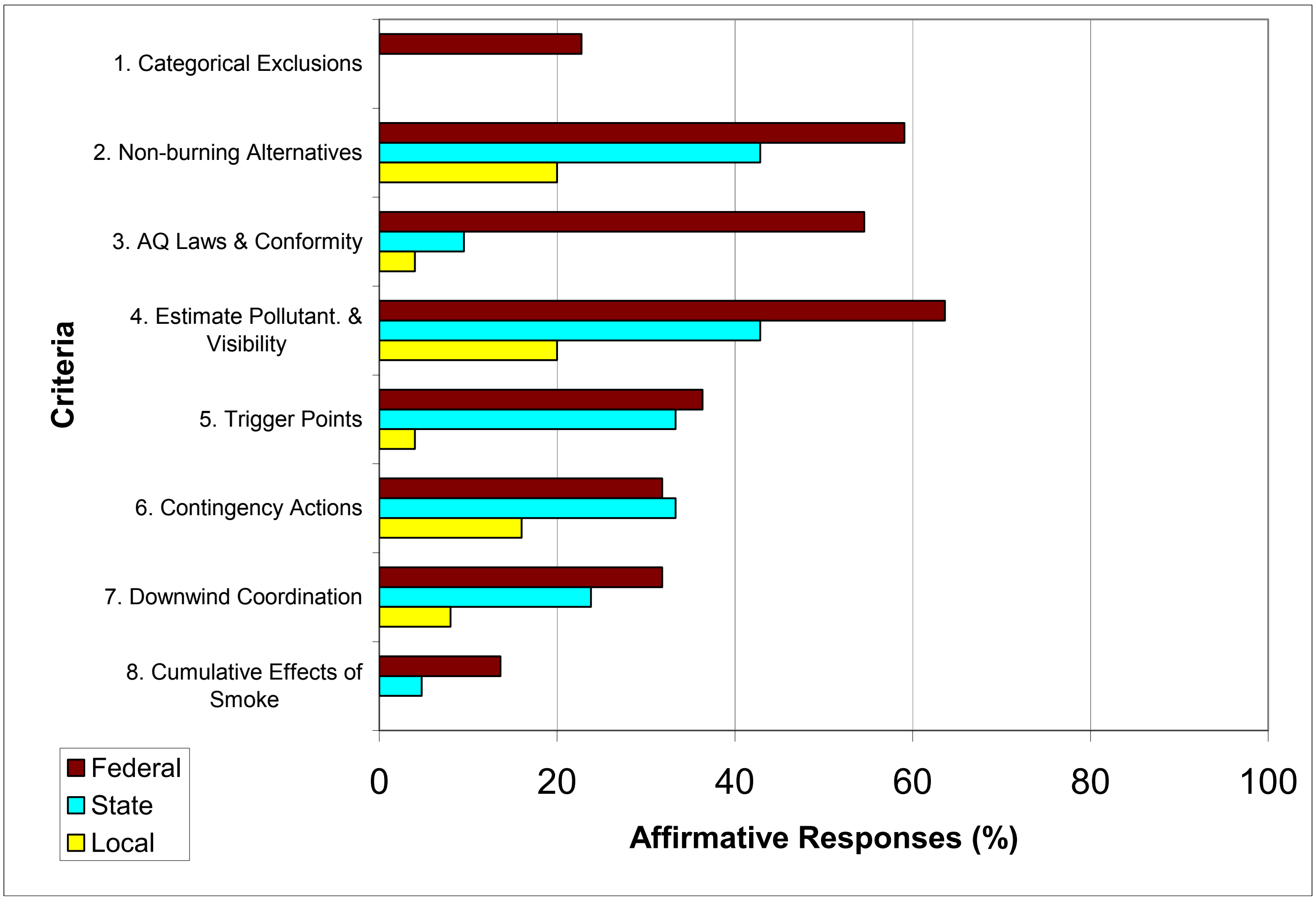
- Findings presented in Table 9 underscore the scarcity of General Conformity guidance in state or local-level documents relative to wildland fire use or agricultural burning. All of these documents do, however, address air quality regulatory requirements of state or local air agencies or districts. Most of the General Conformity guidance is found in documents drafted by federal agencies and about half of documents reviewed provide guidance on this issue.

- Few of the documents discuss categorical exemptions within NEPA as applied to smoke effects.

- About one-third of the federal and state guidance and fewer than 10% of the local documents define “trigger points” used to quantitatively determine when smoke impacts occur. In most of the guidance, smoke impacts that exceed NAAQS are the implied “trigger point” level, but in many cases the meaning of “smoke impact” is left undefined.

- Guidance on the cumulative impacts of smoke when considered in combination with other point and area sources (including other burning activity) is either not generally available or is treated only in very qualitative terms. Less than one-fifth of the federal guidance and none of the state or local guidance discuss this issue. While many smoke management plans include centralized, daily burn authorization to coordinate burning activity and collectively minimize smoke effects on visibility and NAAQS, few of these programs also coordinate with WFU or agricultural or general open burning activity. Guidance on quantitative assessment of cumulative impacts of smoke is in the realm of regional transport modeling, not the practitioner guidance/air quality regulations reviewed here. Fire practitioners are typically concerned about smoke effects from the single fire they are responsible for managing rather than the broad-scale cumulative effects of smoke.

Figure 3. Results from Evaluation of Guidance Documents



- Local guidance documents generally consisted of open burning permit requirements that are intended to minimize the nuisance effects of smoke, regulate the kinds of materials burned and fire hazard issues, only. As a result, much of the local guidance/air quality regulations reviewed dealt only with compliance with county or district air quality rules and regulations. Many of the criteria assessed here do not apply to these documents.

- Private landowners and tribal entities commonly use federal and state guidance documents in their fire use programs. We were unable to identify or obtain any smoke management (or any other guidance documents) from tribal entities for this assessment.

Nationally, there are no adopted Tribal Implementation Plans, so none could be reviewed.

3.3.1 Federal Guidance Documents

In overview, the federal guidance documents provided the best and most thorough discussion of air quality-smoke effect issues. Many of these documents are widely used by fire practitioners and air quality regulators, nationwide and cover a wealth of technical, policy, fire planning and regulatory issues that apply to most forestland managers. Since federal guidance documents focus on national issues that apply to federal land managers, discussions of matters of more local significance, such as fire permit authorization, are not generally included in these documents. In response to new air regulatory requirements, National Wildfire Coordinating Group (NWCG) Smoke Management Guide has greatly expanded sections on regional haze, visibility, emission reduction methods and non-burning alternatives. NWCG provides both guidance and training materials.

3.3.2 State Guidance Documents

Documents in this category include the state smoke management plans for both wildland fire and agricultural burning. They describe air quality rules and regulations, programs and policies that apply to wildland fire, agricultural, and open burning. They also provide useful information and describe services to fire practitioners that help minimize emissions and smoke impacts, including meteorological forecasting. They do not address issues of special significance to Federal Land Managers such as NEPA categorical exclusions. As noted in Table 9, about one-quarter of the state guidance documents reviewed included coordination with downwind agencies and the public, as this is a common element of smoke management plans. About one-third included either a requirement that contingency actions be specified in the burn plan in the event of smoke impacts or that actual measures to be taken are identified.

3.3.3 Local Guidance Documents

The local-scale guidance, as noted above, is almost solely limited to local air quality open burning and, in a few cases, smoke management programs adopted by local air quality agencies and districts. With the exception of the smoke management plans adopted by county and district-level agencies, the majority of these documents describe procedures for issuance of open burn permits, coordination with fire protection agencies and reporting requirements.

3.3.4 Review of the Assessment Criteria

The following discusses findings relevant to each of the assessment criteria.

- Criterion 1: NEPA Categorical Exclusions

Of the 22 federal guidance or air quality regulations reviewed, very few provided any guidance on NEPA categorical exclusions. The most extensive discussion was found in the National Park Service National Director's Guidance 12: NEPA and in the BLM Land Use Planning Handbook H-1601. The US Forest Service guidance "Describing Air Resource Impacts of Prescribed Fire Projects in NEPA documents" is also useful. No other documents were found that addressed the topic. None of the state or local-level guidance documents addressed this issue.

- Criterion 2: Non-Burning Alternatives

Consideration of non-burning alternatives in the prescribed fire/WFU planning process is a relatively new requirement of many state/local smoke management plans and as a result, newly published federal guidance documents now include more guidance on this topic. For example, the 1985 NWCG Prescribed Fire Smoke Management Guide had only brief mention of alternatives to fire while Chapter 8 of the new NWCG Smoke Management Guide 2001 Edition has extensive information of the subject. The discussions in state/local guidance documents and air quality rules are principally focused on their requirements for fire practitioners to consider and document non-burning alternatives to fire in the state/local smoke management programs and permitting process.

- Criterion 3: Air Quality Laws and General Conformity

Most of the federal documents did discuss air quality laws, rules applicable to prescribed fire or WFU but few provided any guidance on General Conformity. Within the federal guidance category, the most extensive guidance is found in NWCG RX-450/410 training course materials and in Chapter 4 of the new NWGC Smoke Management Guide 2001 Edition. The EPA Interim Air Quality Policy outlines relatively new and groundbreaking policy with respect to wildland fire smoke impacts on air quality. The Policy recognizes the important role that fire plays in the ecosystems of the nation's forests while urging wildland managers to consider air quality impacts of fires and take steps to minimize these impacts, emphasizing consideration of alternative treatments rather than the use of fire. State and local regulations deal almost exclusively with applicable air quality regulations that apply to wildland and agricultural burning but exclude the issue of General Conformity.

- Criterion 4: Estimation of Pollutants and Visibility Effects

Calculations of pollutant emissions are commonly required in state and local regulations but only 20% of the local and 43% of the state guidance or air quality regulations require estimation of both pollutant emissions and evaluation of the effect of these pollutants on Class I visibility. The federal guidance (Table 9) more commonly (about two-thirds) addresses both topics. In the case of state and local regulations, estimation of PM-10 emissions prior to unit ignition is required by the smoke management plans. Some also require SASEM modeling but none of the guidance reviewed require modeling of smoke effects on Class I visibility. Most smoke management plans do, however, strive to protect Class I area visibility through meteorological forecasting and burn scheduling. Again, the NWCG Smoke Management Guide provides the most up-to-date guidance on emission estimates (Chapter 11) and visibility effects (Chapter 3).

- Criterion 5: Evaluation of Predetermined Trigger Points

Clear definitions of "trigger points" that signal a smoke impact is unusual in local regulations (less than 10%). About one-third of the state air regulations and federal guidance documents use NAAQS exceedances as a benchmark of an unacceptable smoke impact. Only two of the guidance documents reviewed used a quantitative measure of extinction (light scattering) as a "trigger point" which, if exceeded, would require action to minimize fire emissions. None of the guidance documents reviewed adequately addressed this issue. What constitutes a “trigger point” defining an unacceptable smoke impacts involves considerations of public nuisance, visibility impairment, possible human health effects and how regulatory agencies define a “significant contribution” to particulate matter under the NAAQS.

- Criterion 6: Contingency Actions

About one-third of the state and federal documents reviewed either provided guidance on or required that contingency actions be taken in the event of a smoke impact. Less than one-fifth of the local air regulations required contingency plans to minimize emissions from a burn causing a smoke impact. In state and federal documents, which do include a required contingency action plan, the specific measures that must be taken are left to the fire practitioner managing the fire. The best and most current guidance is found in two documents. The NWCG Smoke Management Guide describes smoke management and emission reduction techniques, including rapid mop-up and fuels isolation. Section VI.C.3 of the EPA Interim Air Quality Policy on Wildland and Prescribed Burning provides a helpful list of contingency actions that can be taken to reduce public exposure to smoke.

- Criterion 7: Coordination with Downwind Agencies

Again, federal guidance documents provide the best source of information on coordination measures to be taken with downwind air agencies, the media or the public. This coordination is usually done (if done at all) through the respective smoke management program. About one-third of the federal guidance specifically discussed this topic but only one-quarter of the state air regulations or smoke management plans reviewed required downwind coordination. Less than one-tenth of the local air regulations mentioned downwind coordination. Section 6.0 (Public Awareness) of the EPA BACM Technical Information Document provides helpful guidance on coordination with downwind agencies, the public and the burn community.

- Criterion 8: Evaluation of Cumulative Effects of Smoke

Very little guidance on evaluation of the cumulative effects of smoke when considered in combination with other stationary and mobile sources of air pollution was found in the guidance reviewed. This topic was not addressed in any of the local guidance and in only one of the state-level documents. The best guidance was found in the NWCG Smoke Management Guide 2001 Edition, which discusses the role of smoke in regional haze, numeric models that may be used to evaluate visibility impacts of smoke on Class I areas and research activities. Comprehensive guidance on this topic is, however, beyond the scope of the documents reviewed here.

4.0 Summary

The preceding section detailed the findings from the plan reviews performed for the project. For a number of reasons, there were some holes in the agency/plan type matrix. Some of the contacts did not respond in a timely fashion so their plans could not be included. Some of the contacts did not utilize certain plan types, so they had no plans to contribute to the project. Other contacts chose not to participate. While the number of plans reviewed for the project may have been less than originally envisioned, a number of plans and guidance documents were reviewed.

The preceding sections present few findings regarding tribal activities. This outcome appeared to have several contributors that were previously discussed. It would be incorrect to presume that the lack of numbers of tribal plans corresponds to a lack of involvement in smoke issues by tribal entities; rather, the project team had difficulty in acquiring plans.

Several project objectives were listed in the Introduction. To summarize the overall project, the outcome for each objective is listed below.

- Many of the agency contacts (i.e., non-federal) do not use programmatic plans, so they can not consider smoke effects in such plans. Those that do use programmatic plans showed mixed results regarding the evaluation criteria.

- Just over half of the programmatic plans discussed non-burning alternatives.

- Operational plans for prescribed fire (or its equivalent) were obtained from all five agency categories. Only federal agencies used WFU or WFSA as tools. Content and complexity of these plans was quite variable. The results regarding the evaluation criteria were somewhat mixed, but, in general, the plans addressed the criteria reasonably well.

- Relatively few of the implemented plans showed smoke effects (of any kind) from the fires.

- Guidance documents for programmatic and operational plan preparation were reviewed. The findings were that there was often incomplete or inconsistent guidance regarding the evaluation criteria.

- Guidance documents for WFSA were reviewed.

Again, the project review process tended to be generous. If a document discussed the topic of a criterion, even briefly, then credit was given for addressing the topic. The project team did not attempt to assess the thoroughness or adequacy of the criterion discussion, only its presence. This approach has the effect of painting a more optimistic picture of the comprehensiveness of the documents that were reviewed.

Appendices

Appendix A: List of Plans Reviewed for Project

Agency Type	Agency	Region	Plan Type	Plan/Burn Name
Federal	Bureau of Land Management	AZ	Implemented Rx	Sam Springs
	Bureau of Land Management	AZ	Operational Rx	Sam Springs
	Bureau of Land Management	AZ	WFSA	Mt. Emma
	Bureau of Land Management	CO	Implemented Rx	Big Duck
	Bureau of Land Management	CO	Operational Rx	Lobo/China Wall
	Bureau of Land Management	CO	Programmatic Rx	Little Snake/Brown's Park
	Bureau of Land Management	CO	Programmatic WFU	Little Snake/Brown's Park
	Bureau of Land Management	ID	Programmatic Rx	Owyhee Resource Management Plan
	Bureau of Land Management	MT	Implemented Rx	Elk Creek
	Bureau of Land Management	MT	Operational Rx	Elk Creek
	Bureau of Land Management	MT	Programmatic Rx	Missoula Field Office Fire Mgmt. Plan
	Bureau of Land Management	MT	Programmatic WFU	Elkhorn Wildland Fire Guidebook
	Bureau of Land Management	MT	WFSA	High Ore Road/Boulder Hill
	Bureau of Land Management	NV	Implemented RX	Stormy
	Bureau of Land Management	NV	Operational Rx	Stormy
	Bureau of Land Management	NV	Programmatic Rx	Elko Fire Management Plan
	Bureau of Land Management	NV	Programmatic WFU	Elko Fire Management Plan
	Bureau of Land Management	OR	Operational Rx	Brady Butte
	Bureau of Land Management	OR	Programmatic Rx	Lakeview RMP DEIS
	Bureau of Land Management	UT	Implemented Rx	Dry Creek
	Bureau of Land Management	UT	Operational Rx	Dry Creek
	Bureau of Land Management	UT	Programmatic Rx	Cedar City Fire Management Plan
	Bureau of Land Management	UT	WFSA	Lydia's Canyon
	Bureau of Land Management	WY	Implemented Rx	Sawmill
	Bureau of Land Management	WY	Operational Rx	Sawmill
	Bureau of Land Management	WY	Programmatic Rx	Kemmerer RMP-FEIS
	National Park Service	Intermountain	Implemented WFU	Langston Fire Complex
	National Park Service	Intermountain	Operational WFU	Langston Fire Complex
	National Park Service	Intermountain	Operational Rx	Loop Hazard Fuels Reduction Plan Unit 4 Pile
	National Park Service	Intermountain	Programmatic Rx	Wildland FMP-Zion NP
	National Park Service	Intermountain	Programmatic WFU	Wildland FMP-Zion NP
	National Park Service	Midwest	Implemented Rx	Bison Flats
	National Park Service	Midwest	Operational Rx	Bison Flats
	National Park Service	Midwest	Programmatic Rx	Wind Cave NP FMP
	National Park Service	Midwest	Programmatic WFU	Wind Cave NP FMP
	National Park Service	Midwest	WFSA	Highland Creek
	National Park Service	Pacific West	Implemented Rx	East Buttress Meadow
	National Park Service	Pacific West	Operational Rx	East Buttress Meadow
	National Park Service	Pacific West	Programmatic Rx	Yosemite Fire Management Plan 1991

Agency Type	Agency	Region	Plan Type	Plan/Burn Name
Federal	National Park Service	Pacific West	Programmatic WFU	Yosemite Fire Management Plan 1991
	U.S. Fish and Wildlife Service	1	Operational Rx	Kern NWR Marsh Unit 1
	U.S. Fish and Wildlife Service	1	Programmatic Rx	Hart Mountain
	U.S. Fish and Wildlife Service	2	Implemented Rx	Buenos Aries Hill 1
	U.S. Fish and Wildlife Service	2	Operational Rx	Buenos Aries Hill 1
	U.S. Fish and Wildlife Service	2	Programmatic Rx	Buenos Aires NWR Fire Mgmt. Plan
	U.S. Fish and Wildlife Service	6	Implemented Rx	Ruppel Waterfowl Production Area (WPA)
	U.S. Fish and Wildlife Service	6	Operational Rx	Fish Springs NWR
	U.S. Fish and Wildlife Service	6	Programmatic Rx	Brown's Park
	U.S. Fish and Wildlife Service	6	Programmatic WFU	Brown's Park
	U.S. Forest Service	1	Implemented WFU	Birk Fire
	U.S. Forest Service	1	Operational WFU	Birk Fire
	U.S. Forest Service	1	Operational Rx	South Fork Sun Burn
	U.S. Forest Service	1	Programmatic Rx	Bitterroot NF FMP
	U.S. Forest Service	1	Programmatic WFU	Bitterroot NF FMP
	U.S. Forest Service	1	WFSA	Little Blue
	U.S. Forest Service	2	Implemented Rx	Polhemus Prescribed Burn
	U.S. Forest Service	2	Operational Rx	Polhemus Prescribed Burn
	U.S. Forest Service	2	Programmatic Rx	San Juan FMP
	U.S. Forest Service	2	Programmatic WFU	San Juan FMP
	U.S. Forest Service	3	Implemented Rx	Water Canyon
	U.S. Forest Service	3	Implemented WFU	Bloodgood Complex Fire
	U.S. Forest Service	3	Operational WFU	Bloodgood Fire Complex
	U.S. Forest Service	3	Operational Rx	Water Canyon
	U.S. Forest Service	3	Programmatic Rx	Gila NF Fire Management Plan
	U.S. Forest Service	3	Programmatic WFU	Gila NF Fire Management Plan
	U.S. Forest Service	3	WFSA	Homestead
	U.S. Forest Service	4	Implemented Rx	Gregory-Johnson
	U.S. Forest Service	4	Implemented WFU	Iron Creek Fire
	U.S. Forest Service	4	Operational WFU	Iron Creek Fire
	U.S. Forest Service	4	Operational Rx	Gregory-Johnson
	U.S. Forest Service	4	Programmatic Rx	Bridger-Teton Forest Fire Management Plan
	U.S. Forest Service	4	Programmatic WFU	Bridger-Teton Forest Fire Management Plan
	U.S. Forest Service	4	WFSA	Sawyer
	U.S. Forest Service	5	Operational Rx	Georgetown R2H2 Burn
	U.S. Forest Service	5	Programmatic Rx	Sierra Nevada Forest Plan Amendment
	U.S. Forest Service	5	Programmatic WFU	Sierra Nevada Forest Plan Amendment
	U.S. Forest Service	6	Operational WFU	French Creek

Agency Type	Agency	Region	Plan Type	Plan/Burn Name
Local	Boulder County	Colorado	Implemented Rx	Rabbit Mtn.-Little Thompson Overlook
	Boulder County	Colorado	Operational Rx	Rabbit Mtn.-Little Thompson Overlook
	Boulder County	Colorado	Programmatic Rx	General regulations
	Jefferson County	Oregon	Operational Rx	Open Burning Permit, SMP, & Regulations
	Missoula County	Montana	Operational Rx	Unified Outdoor Burning Permit
	Pinal County	Arizona	Operational Rx	Agricultural Open Burn Permit
	San Joaquin Valley	California	Operational Rx	Nobe A Burn--Forest Service
	San Joaquin Valley	California	Operational Rx	Hercules Restoration Burn--Park Service
Private	Nature Conservancy		Implemented Rx	Albany Pine Bush-Firebrand
	Nature Conservancy		Operational Rx	Albany Pine Bush-Friendly
	Plum Creek Timber		Operational Rx	General burn permit
State	Colorado State Forest Service		Operational Rx	Woodland Park Section 16
	Montana Division of Forestry		Operational Rx	Open Burn Permit
	Nevada Division of Forestry		Operational Rx	Incline Village
	State of Arizona Ag		Operational Rx	Yuma County Pest Control
	State of Idaho Ag		Operational Rx	Field Burning Registration From & Rules
	State of Montana Ag		Operational Rx	2001 USFS Region 1 permit
	State of Oregon Ag		Operational Rx	Not specified
	State of Washington Ag		Operational Rx	Wagoner Toychet Farm
Tribal		Chippewa Cree	Operational Rx	Centennial Mountain
		Colville Confederated	Programmatic Rx	Colville Integrated Resource Management Plan

Appendix B: Guidance Documents Reviewed

State/Local Open Burning and Smoke Management

1. California Rules & Regulations

a. Smoke Management Guidelines for Agricultural & Prescribed Burning, Title 17 of the California Code of Regulations

b. Northeast Air Alliance Smoke Management Plan for Butte, Lassen, Modoc, Plumas, Shasta, Siskiyou, Tehama. August 2000

c. Amador County Air Pollution Control District Open Burning Rules 306; Wildland Vegetation Management Burning Rule 308.1 and Forest Management Burning 309.1.

d. Antelope Valley Air Pollution Control District Rule 444 Open Fires

e. Bay Area Air Quality Management District Regulation 5 Open Burning

f. Butte County Air Quality Management District Rule 300 Open Burning

g. Colusa County Air Pollution Control District Rule VI Agricultural Burning

h. Great Basin Unified Air Pollution Control District Rule 410 Forest Management Burning and Rule 411 Wildland Vegetation Management Burning in Wildland and Wildland/Urban Interface Areas.

i. Mariposa County Air Pollution Control District Rule 307 Wildland Vegetation Management Burning

j. Northern Sierra Air Quality Management District Rule 306 Forest Management Burning and 307 Wildlands Vegetation Management Burning.

k. Placer County Air Pollution Control District Rule 316 Range Improvement /Forest Management Burning and 317 Wildland Vegetation Management Burning.

l. Sacramento Air Quality Management District Rule 501 Agricultural Burning (includes forest management burning)

m. San Joaquin Valley Unified Air Pollution Control District Rule 4106 Prescribed Burning and Hazard Reduction Burning.

n. Shasta County Air Quality Management District Rule 2:6 Open Burning

o. Siskiyou County Air Pollution Control District Rule 7 Open Burning

p. South Coast Air Quality Management District Rule 444 Open Fires

q. Tuolumne County Air Pollution Control District Rule 300 Open Burning

r. Feather River Air Quality Management District Rule 2.17 Wildland Vegetative Management Burning.

s. Calaveras County Air Pollution Control District Rule 300 Open Burning

t. San Joaquin Valley Unified APCD Prescribed Burning MOU

u. Proposed Amendments to California's Agricultural Burning Guidelines. Staff Report. California Air Resources Board. February 2000.

v. Sacramento Valley Smoke Management Program. Sacramento Valley Basinwide Air Pollution Control Council. June 15, 2001.

2. Montana

a. Open Burning Rule 17.8

b. Missoula County Open Burning Rules Chapter 7

c. It's Fall. Why Can't I Burn? – Missoula County Health Department

d. Montana – Idaho State Airshed Group Smoke Management Program 8/2001

3. Arizona

a. Forest and Range Management Burns Chapter 2 Article 15

b. Smoke Management Plan Chapter 3

4. Colorado

a. State Open Burning Procedure E008

b. Smoke Management Memorandum of Understanding Feb. 2001

c. Boulder County Health Department Air Quality/Prescribed Fire Guidance Document. March 1, 1999.

d. Boulder County Health Department Open Burning Policy. Jan. 1, 2001

e. Desk Guide for CSFS Prescribed Fire Procedures

5. Nevada Smoke Management Plan

6. Wyoming Open Burning & Smoke Management Regulations: Chapter 10

7. Oregon

a. Smoke Management Program, Administrative Rules & Directives

b. Open Burning Rules Division 264

c. Willamette Valley Field Burning Permit Agent Manual. March 2001.

8. Utah

a. Smoke Management Plan

b. Utah DEQ Smoke Management Rule R307-204

9. Washington

   a. State Smoke Management Plan

   b. Agricultural Burning Best Management Practices, Permit and Focus Sheet

10. Alaska

   a. Open Burning Rules, Policy & Guidelines

   b. Open Burning Rule 18AAC50

11. New Mexico Smoke Management MOU

Federal Guidance Documents, Training Materials & Laws

1. EPA Interim Air Quality Policy on Wildland and Prescribed Fires
2. NWCG Prescribed Fire Smoke Management Guide, 1985
3. EPA Prescribed Burning Background and Technical Information Document for Prescribed Burning Best Available Control Measures
4. USDI Bureau of Land Management Handbook H-1601-1
5. USDI National Park Service Director's Order #18: Wildland Fire Management
6. USDI National Park Service Director's Order #12: NEPA
7. US Fish & Wildlife Service Part 621 Fire Management – Prescribed Fire
8. Clean Air Act – Title I: Part A Air Quality and Emission Limitations Sec. 101-131
9. Clean Air Act – Title I: Part C Prevention of Significant Deterioration Sec. 160-169; Subpart 2, Sec. 169A and 169B
10. Clean Air Act – Title I, Part D, Sec. 176c Conformity
11. CFR Title 40, Part 51 Subpart P Protection of Visibility
12. USDI Bureau of Land Management Manual M-1601- Land Use Planning
13. USDA Forest Service Guidelines for Preparing a NEPA Air Quality Analysis
14. Describing Air Resource Impacts from Prescribed Fire Projects in NEPA Documents For Montana and Idaho in Region 1 and Region 4
15. Forest Service Manual
16. Forest Service Desk Guide for Integrating Air Quality and Fire Management into Land Management Planning--Draft

17. NWCG Smoke Management Techniques RX-450 Training Manual-Instructor's Guide

18. USDA Forest Service Air Quality Conformity Handbook

19. USDA Forest Service Desk Reference for NEPA Air Quality Analysis

20. US Fish & Wildlife Service Fire Management Handbook

21. NWCG Smoke Management Guide for Prescribed and Wildland Fire

22. NWCG Wildland & Prescribed Fire Mgmt Policy Implementation Procedures Reference Guide

Tribal Laws & Plans

A number of potential sources were contacted in an effort to obtain information on tribal laws, programs and plans. Calls to EPA Regions 8, 9 and 10 indicated that (1) EPA could not provide Tribal Implementation Plans or relevant Federal Implementation Plans and (2) EPA could not provide tribal smoke management plans. Other calls to the White Mountain Apache Tribe, the Intertribal Forestry Council, the Institute for Tribal Environmental Professionals (ITEP) and BIA staff at the National Interagency Fire Center all failed to produce any guidance documents that (1) could be made available for review or (2) were in existence somewhere else. A study by ITEP (available on the WRAP website) indicated that 15 tribes have smoke management plans, but those tribes were not identified in the study. ITEP has been a tribal liaison for FEJF in the past, but ITEP was not able to provide the types of documents needed in the timeframe available for the project.

Appendix C. Evaluation Results and Review Comments for Guidance Documents

Guidance Type	Agency	Guidance Title	Criterion 1		Criterion 2		Criterion 3		Criterion 4		Criterion 5		Criterion 6		Criterion 7		Criterion 8	
			Response	*Comment*	*Response*	*Comment*	*Response*	*Comment*	*Response*	*Comment*	*Response*	*Comment*	*Response*	*Comment*	*Response*	*Comment*	*Response*	*Comment*
State	Alaska Department of Environmental Conservation	Alaska Department of Environmental Conservation Open Burning Rule 18AAC50. Jan. 1997.	No	No	No	No	No	Guidance on open burning laws, only	No	No	No	No	No	No	No	No	No	No
	Alaska Department of Environmental Conservation	Alaska Open Burning Policy and Guidelines	No	No	No	No	No	Conformity not mentioned	No	No	Yes	NAAQS	No	No	No	No. Burners must specify how public will be advise	No	No
	Arizona Department of Environ. Quality	Forest and Range Management Burns: Title 18, Chapter 2, Article 15	No	No	Yes	R18-2-1509; Best Management Practices	No	Conformity not mentioned	No	No	No	No	No	No	No	No	No	No
	Arizona Department of Environ. Quality	State of Arizona Smoke Management Plan: Title 18, Chapter 3. Dept. Env Qual. Article 15.	No	No	Yes	Under BMP requirements	No	Conformity not mentioned	No	Plan only requires that this be done	No	No	Yes	Under BMP-Managing Smoke Impacts	No	No	No	No
	California Air Resources Board	Proposed Amendments to California's Agricultural Burning Guidelines: Staff Report. February 2000	No	No	Yes	Page 19. Brief.	No	No. Conformity not discussed	No	No	No	No	No	No	No	No	No	No
	California EPA	Title 17, California Code of Regulations Subchpt 2: Smoke Management for Agriculture & Rx Fire	No	No	No	No. If done, it must be attached to burn plan.	No	Conformity	Yes		No	Only with reference to NAAQS	No	No	No	No	No	No
	Colorado Department of Public Health	Colorado Open Burning Rules Document E008. Nov. 24, 1995	No	No	No	No	No	Conformity not mentioned	No	No	No	No	No	No	No	No	No	No
	Colorado Department of Public Health	Colorado Smoke Management MOU. Jan 1, 2001	No	No	Yes	Required. Form SMP-C	No	Conformity guidance in Appendix F	Yes	SASEM modeling required;	Yes	NAAQS; <20 deciview	Yes	Required	Yes	Public notification req'd. Agency contacts listed	No	No
	Colorado State Forest Service	Desk Guide for CSFS Prescribed Fire Procedures	No	State does not do NEPA	Yes		Yes		Yes		Yes		Yes		No	No	No	No
	Montana Department of Environmental Quality	State of Montana Open Burning Rule Chapter 8, Sub-Chapter 6	No	No	No	No	No	Conformity not mentioned	No	No	No	No	No	No	No	No	No	No
	Montana/Idaho Airshed Group	Montana/Idaho Airshed Group Operating Guide. Aug. 2001	No	No	No	No. Encourages use of alternative methods	No	Conformity not mentioned	No		No	No definition of "intrusion" provided	No	No	No	No	No	No
	Nevada Division of Environmental Protection	Nevada Smoke Management Plan - July 6, 1999	No	No	Yes	Detailed description of alternatives required	No	Conformity not mentioned	Yes	Distance from Class I & nonattainment areas	Yes	NAAQS	Yes	Requires that such plans be identified by burners	Yes	Affected agency notification required	No	No

Appendix C. Evaluation Results and Review Comments for Guidance Documents

Guidance Type	Agency	Guidance Title	Criterion 1		Criterion 2		Criterion 3		Criterion 4		Criterion 5		Criterion 6		Criterion 7		Criterion 8	
			Response	Comment	Response	Comment	Response	Comment	Response	Comment	Response	Comment	Response	Comment	Response	Comment	Response	Comment
State	New Mexico Environment Department	New Mexico Smoke Management MOU 1997-2002	No	No	No	No	No	Conformity not mentioned	Yes	Emission calculations	Yes	NAAQS	Yes	Managers must have contingency plans.	No	No. Burners must notify local officials	No	No
	Oregon Department of Environmental Quality	Oregon Open Burning Rules Division 264 (Nov. 15, 2001)	No	No	No	No	No	Conformity not mentioned	No	No	No	No	No	No	No	No	No	No
	Oregon Department of Forestry	Oregon Smoke Management Plan and Rules	No	No	No	No	No	Conformity not mentioned	Yes	Emission calculations	Yes	Light scattering and visibility	Yes	Directives Appendix 4	Yes		No	No
	Oregon Dept. Agriculture	Field Burning Permit Agent Manual: Willamette Valley, Oregon. March 2001	No	No	No	No	No	No. Conformity not mentioned	No	No	No	No	No	No	No	No	No	No
	Utah Department of Environmental Quality	Utah Emission Standards: Smoke Management. Rule 307-204. Sept 1, 2001	No	No	Yes	Description required	Yes	R307-204-7(k)	Yes	Emission calculations	Yes	NAAQS:	Yes	Contingency plan required	No	No	No	No
	Utah Division of Air Quality	Utah Smoke Management Plan 7/20/00 Rev. 3/23/00	No	No	No	No	No	Conformity not mentioned	Yes	Requires daily emissions estimates	No	No	No	No	Yes	Public notification required	Yes	Eastern Great Basin Coord Center does daily report
	Washington Department of Ecology	Agricultural Burning Permit Application and Best Management	No	No	Yes	Growers reqd to evaluate	No	No mention of conformity	No	No	No	No	No	No	No	No	No	No
	Washington Department of Natural Resources	Washington State Smoke Management Plan. Rev. 1995.	No	No	Yes	Alternative use required when possible	No	Conformity not mentioned	Yes	Requirements to calculate emissions	No	No	No	No	Yes		No	No
	Wyoming DEQ	Wyoming Smoke Management Chapter 10	No	No	No	No	No	Conformity not mentioned	No	No	No	No	No	No	No	No	No	No
Local	Amador County CA	Amador County Air Pollution Control District Open Burning Rules	No	No	No	No	No	Conformity not mentioned	No	No	No	No	No	No	No	No	No	No
	Antelope Valley APCD	Antelope Valley APCD Open Fires	No	No	No	No	No	Conformity no referenced	No	No	No	No	No	No	No	No	No	No
	Bay Area AQMD	Bay Area AQMD Open Burning Regulation 5	No	No	No	No	No	Conformity	No	No	No	No	No	No	No	No	No	No
	Boulder County Health Department	Air Quality/Prescribed Fire Guidance Document	No	No	Yes	Brief	No	No discussion of conformity	Yes	Briefly	No	No	Yes	Briefly	No	No	No	No
	Boulder County Health Department	Open Burning Policy	No	No	No	No	No	No	Yes	SASEM modeling required	No	No	No	No	No	No	No	No

Appendix C. Evaluation Results and Review Comments for Guidance Documents

Guidance Type	Agency	Guidance Title	Criterion 1 Response	Criterion 1 Comment	Criterion 2 Response	Criterion 2 Comment	Criterion 3 Response	Criterion 3 Comment	Criterion 4 Response	Criterion 4 Comment	Criterion 5 Response	Criterion 5 Comment	Criterion 6 Response	Criterion 6 Comment	Criterion 7 Response	Criterion 7 Comment	Criterion 8 Response	Criterion 8 Comment
Local	Butte County AQMD	Butte County AQMD Open Burning Rule 300, 309	No	No	No	No	No	Conformity	No	No	No	No	No	No	No	No	No	No
	Calaveras County APCD	Calaveras County APCD Open Burning Rule 300	No	No	No	No	No	Conformity	No	No	No	No	No	No	No	No	No	No
	Colusa County APCD	Colusa County APCD Reguation VI-Agricultural Burning Rule 6.18 & 6.19	No	No	No	No	No	Conformity	No	No	No	No	No	No	No	No	No	No
	Feather River AQMD	Feather River AQMD Open Burning Rule 2.17 & 2.8: Wildland Veg. & Range Burning	No	No	No	No	No	Conformity not mentoned	No	No	No	No	No	No	No	A notification procedure must be submitted	No	No
	Great Basin Unified APCD	Great Basin Unified APCD Wildland Veg. Burning & Forest Management Burning Rules 410, 411	No	No	No	Analysis must be attached to burn application	No	Conformity not mentioned	No	No	No	No	No	No	No	Public notification procedures need be submitted	No	No
	Mariposa County APCD	Mariposa County APCD Rule307 Wildland Burning	No	No	No	No	No	Burn permit requirements. Conformity	No	No	No	No	No	No	No	No but procdures to distribute burn info is reqd	No	No
	Missoula County Health Dept.	It's Fall: Why Can't I Burn?	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	Missoula County Health Dept.	Missoula County Open Burning Rules, Chapter 7	No	No	No	No	No	Conformity not mentioned	No	No	Yes	NAAQS	No	No	No	No	No	No
	Northern Sierra AQMD	Northern Sierra AQMD Open Burn Rules 300,306, 307 & 315	No	No	No	No	No	Permit requirements only. Conformity not mentioned	No	No	No	No	No	No	No	No	No	No
	Placer Cty APCD	Placer County APCD Open Burning Rule 316 & 317 Wildland Fire and Veg. Management Rules	No	No	No	No	No	Burn permit requirments only	No	No	No	No	No	No	No	No	No	No
	Sacramento County AQMD	Sacramento AQMD Agricultural Burning Rule 501 (Applies to forestry burning)	No	No	No	No	No	Requirements for OB Permit	No	No	No	No	No	No	No	No. Method of public notification must be specifid	No	No
	Sacramento Valley AQMD	Sacramento Valley Smoke Management Program. June, 2001	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
	San Joaquin APCD	San Joaquin APCD Prescribed Burning Rule 4106	No	No	Yes	Requires description of BACM considered	No	Burn plan requirements only but not conformity	Yes	Requires ID of smoke sensitive areas	No	No	Yes	Requires that contingencies be identified	Yes	Requires description of public notification method	No	No
	San Joaquin Valley Unified APCD	San Joaquin Valley Unified APCD Prescribed Burning MOU (7/21/97 Draft)	No	No	Yes	BACM Workplan Sec.7	No	Conformity not mentioned	Yes	Requries calculation of emissions	No	No	No	No. Does require description of methods to be used	No	No	No	No

Appendix C. Evaluation Results and Review Comments for Guidance Documents

Guidance Type	Agency	Guidance Title	Criterion 1		Criterion 2		Criterion 3		Criterion 4		Criterion 5		Criterion 6		Criterion 7		Criterion 8	
			Response	*Comment*	*Response*	*Comment*	*Response*	*Comment*	*Response*	*Comment*	*Response*	*Comment*	*Response*	*Comment*	*Response*	*Comment*	*Response*	*Comment*
Local	Seven Air Districts in Northern CA	Northeast Air Alliance Smoke Management Plan	No	No	No	No but requires an analysis be done	No	No	No	No but requires an estimate be submitted	No	No	No	No but requires contingencies be identified	No	No	No	No
	Shasta County AQMD	Shasta County AQMD Open & Ag. Burning Rules 2:6-	No	No	Yes	Evaluation of alternatives must be attached	No	Conformity not mentioned	No	No	No	No	Yes	Contingency action must be described	No	No. Public notification procedures required	No	No
	Siskiyou County APCD	Siskiyou County APCD Open Burning Rule 7.1; 7.5	No	No	No	No	No	Conformity not mentioned	No	No	No	No	No	No	Yes	Requires a procedure to disseminate project info.	No	No
	South Coast AQMD	South Coast AQMD Open Fires Rule 444; Conformity Rule 1901	No	No	No	No	Yes	Rule 1901. Applies to federal actions	No	No	No	No	No	No	No	Specs for disseminating project info is required	No	No
	Tuolumne County APCD	Tuolumne County APCD Open Burn Rule 300; Wilaland Veg. Management Burning Rule 307,	No	No	No	No	No	Conformity not mentioned	No	No	No	No	No	No	No	Specs. For disseminating project info required	No	No
Federal	Congress/EPA	Clean Air Act Title 1 Part A: Air Quality and Emission Limititations Sectioins 101-131	No	No	No	No	No	This section does not include Conformity	No	No	No	No	No	No	No	No	No	No
	Congress/EPA	Clean Air Act Title 1 Part C Prevention of Significant Deterioration Sec. 160 - 169.	No	No	No	No	No	Conformity not in this section of the CAA	No	No	Yes	PSD increments	No	No	No	No	Yes	If applicable to prescribed fire
	Congress/EPA	Clean Air Act Title 1 Part D Section 176c	No	No	No	No	Yes	Conformity section of the CAA	No	No	No	No	No	No	No	No	No	No
	Interagency	NWCG Wildland & Prescribed Fire Mgmt Policy Implementation Procedures Reference	No	No	Yes		No	No	Yes		No	No	Yes		Yes		No	
	National Wildfire Coordinating Group	Prescribed Fire Smoke Management Guide, Feb. 1985	No	No	No	No	No	Nothing on Conformity	Yes		No	No	No	No	No	No	No	No
	National Wildfire Coordinating Group	Smoke Management Guide for Prescribed and Wildland Fire 2000 Edition (draft)	No	No	Yes	Extensive	Yes	Part I Sections 4.1 and 4.2	Yes		Yes	Part I Section 3.3	Yes		Yes		Yes	
	National Wildfire Coordinating Group	Smoke Management Techniques: RX-450 Instructor and Student Guides	No	No	Yes		Yes		Yes		No	No	Yes		Yes		No	No
	US EPA	40 CFR Chapter 1, Subpart C, Part 51 Subpart P - Protection of Visibility	No	No	Yes	51.309 (d) (6) (iii)	No	Visibility Protection requirements, Excl Conform.	Yes		Yes	Sec. 51.301 definition of adverse impact	Yes	General requirements of	No	No	No	No

Guidance Type	Agency	Guidance Title	Criterion 1		Criterion 2		Criterion 3		Criterion 4		Criterion 5		Criterion 6		Criterion 7		Criterion 8	
			Response	Comment	Response	Comment	Response	Comment	Response	Comment	Response	Comment	Response	Comment	Response	Comment	Response	Comment
Federal	US EPA	Interim Air Quality Policy on Wildland and Prescribed Fires	No	No	Yes	Brief description	Yes	Section IX A	Yes	Briefly	No	No	No	No	Yes		Yes	Briefly
	US EPA OAQPS Sept 92	Prescribed Burning Background Document and Technical Information Document for Prescribed Burn BACM	No	No	Yes	Extensive	No	Conformity	Yes		Yes	In State smoke management plan summaries	Yes		Yes	Briefly in state smoke plan summaries	No	No
	US Fish and Wildlife Service	Fire Management Policies and Responsibilities for Fire Managers Part 621 Chpt. 3	No	No	No	No	No	Conformity not specifically noted	No	No	No	No	No	No	No	No	No	No
	US Fish and Wildlife Service	USFWS - Fire Management Handbook	Yes		Yes		Yes		Yes		Yes		Yes		Yes		No	
	USDA Forest Service	A Desk Reference for NEPA Air Quality Analysis	Yes	Pg. 2-9. Refers to FSH 1909.15.	Yes	Pg. 3.1.2-7.	Yes	Page 2-6 to 2-8.	Yes	Chapter 3.	Yes	Page 2-14.	No		No		No	
	USDA Forest Service	Air Quality Conformity Handbook	No		No		Yes		Yes		No	NAAQS implied	No		No		No	
	USDA Forest Service	Describing Air Resource Impacts from Prescribed Fire Projects in NEPA Documents for Montana & Idaho	Yes		Yes	Appendix A	No	Conformity not specifically addressed	Yes	Fuels consumption and emission estimates	Yes	NAAQS	No	No	No	No	No	No
	USDA Forest Service	Guidelines for Preparing a NEPA Air Quality Analysis	No	Not directly. When NEPA anal. Is needed included.	Yes		Yes	Conformity discussion included	Yes	Emissions calculations guidance	No	No	No	No	No	No	No	No
	USDA Forest Service	USDA Forest Service Manual System 2580 & 5100	No	No	Yes		Yes		Yes		Yes		Yes		Yes		No	
	USDA Forest Service	Desk Guide for Integrating Air Quality and Fire Management into Land Management Planning	No		No		Yes		Yes		No		No		No		No	
	USDI Bureau of Land Management	USDI Bureau of Land Management Land Use Planning Handbook H-1601-1	Yes	Ref. Manual 516 DM2, App1 and 516 DM6 App 5.4	Yes	App C Page 9	Yes	App. C Page 2	No	No	No	No	No	No	No	No	No	No
	USDI Bureau of Land Management	USDI Bureau of Land Management Manual 1601: Land Use Planning	No	No	No	No	Yes	Requires compliance with Fed., state, local regs.	No	No	No	No	No	No	No	No	No	No
	USDI National Park Service	NPS Director's Order 12: NEPA	Yes	Secs. 3.0 has an extensive discussion	No	No	No	Conformity not specifically noted	No	No	No	No	No	No	No	No	No	No
	USDI National Park Service	USDI National Park Service Director's Order #18: Wildland Fire Management. Nov. 17, 1998	No	No	Yes	Item 10a describes mechanical treatment. Vs fire	No	Item 10F requires air rule compliance	No	No	No	No	No	No	No	No	No	No

<u>Appendix A-10b. EPA's "Interim Air Quality Policy on Wildland and Prescribed Fires"</u>

INTERIM
AIR QUALITY POLICY ON
WILDLAND AND PRESCRIBED
FIRES

April 23, 1998

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LIST OF WHITE PAPERS AVAILABLE ON THE WORLD WIDE WEB

Background on the Role of Fire

What Wildland Fire Conditions Minimize Emissions and Hazardous Air Pollutants and Can Land Management Goals Still Be Met?

Air Monitoring for Wildland Fire Operations

Emissions Inventories for SIP Development

Estimating Natural Emissions From Wildland and Prescribed Fire

I. PURPOSE

This policy statement has been prepared in response to plans by some Federal, tribal and State wildland owners/managers to significantly increase the use of wildland and prescribed fires to achieve resource benefits in the wildlands.[1] Many wildland ecosystems are considered to be unhealthy as a result of past management strategies. The absence of fire effects has allowed plant species (e.g., trees and shrubs) that would normally be eliminated by fires to proliferate, vegetation to become dense and insect infestations to go unchecked. Wildland owners/managers plan to significantly increase their use of fires to correct these unhealthy conditions and to reduce the risk of wildfires to public and fire fighter safety. The largest increases are expected mainly on Federal lands in western States in ecosystems where fires would naturally occur every few years (35 years or less) if not suppressed. Fire has continued to be a management tool used by many public and private wildland owners/managers in the southeastern States. However, Federal land managers in the southeast also plan to significantly increase their use of fire above current annual levels.

This policy statement integrates two public policy goals, (1) to allow fire to function, as nearly as possible, in its natural role in maintaining healthy wildland ecosystems, and (2) to protect public health and welfare by mitigating the impacts of air pollutant emissions on air quality and visibility. This document provides guidance on mitigating air pollution impacts caused by fires in the wildlands and the wildland/urban interface. It identifies the responsibilities of wildland owners/managers and State/tribal air quality managers to work together to coordinate fire activities, minimize air pollutant emissions, manage smoke from wildland and prescribed fires managed for resource benefits, and establish emergency action programs to mitigate the unavoidable impacts on the public. This policy is not intended to limit opportunities by private wildland owners/ managers to use fire so that burning can be increased on publicly owned wildlands. Thoughtful use of fire by private, public and Indian wildland owners/managers within SMP's is promoted to maintain healthy wildland ecosystems. Neither is this policy intended to

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[1]This document contains EPA policy and, therefore, does not establish or affect legal rights or obligations. It does not establish a binding norm and it is not finally determinative of the issues addressed. In applying this policy in any particular case, the EPA will consider its applicability to the specific facts of that case, the underlying validity of the interpretations set forth in this memorandum, and any other relevant considerations, including any that may be required under applicable law and regulations.

imply that States/tribes should relax existing SMP's or limit a State's/tribe's ability to regulate fires managed for resource benefits.

The EPA used a deliberative process involving a multi-stakeholder workgroup to develop recommendations for this policy. The workgroup did not reach consensus on all of the issues raised. The EPA addressed all of the recommendations and concerns raised by the stakeholders to the extent possible. The multi-stakeholder workgroup also produced several "white papers" on a number of topics previously identified in earlier drafts of the policy as Appendices to the policy. These papers will be published as a separate document and can also be found on EPA's TTN2000 website:
http://134.67.104.12/html/o3pmrh/pbissu.htm, and on the Western States Air Resources Council (WESTAR) website: http://www.westar.org/proj_frame.html. A list of these papers is provided in the Table of Contents.

II. SCOPE AND APPLICABILITY

The EPA does not directly regulate the use of fire within a State or on Indian lands. The EPA's authority is to enforce the requirements of the CAA. The CAA requires States and tribes to attain and maintain the NAAQS adopted to protect public health and welfare. This policy recommends that States/tribes implement SMP's to mitigate the public health and welfare impacts of fires managed for resource benefits. While SMP's will also mitigate nuisance smoke intrusions, nuisance issues have been left for the individual air quality agencies to address.

This policy applies to all wildland and prescribed fires managed to achieve resource benefits on public, Indian and privately owned wildlands, regardless of the cause of ignition (e.g., lightning, arson, accidental, land management decision, etc.) or purpose of the fire (e.g., natural, resource management, hazard reduction, etc.).

Federal land management agencies sometimes manage naturally ignited fires to achieve resource benefits. Planning for naturally ignited fires is obviously limited, but the agencies require fire management plans to be included in land use plans for an area before a naturally ignited fire can be managed for resource benefits. Fires ignited in areas without fire management plans are unwanted or wildfires. The interface between this policy and the Natural Events Policy[2] regarding ambient PM_{10} concentrations caused by wildfires is addressed in section VII.

This policy does not apply to other open burning activities, such as burning at residential, commercial or industrial sites; open burning of land clearing waste or construction debris. It also does not apply to open burning of agricultural waste, crop residue or land in the USDA Conservation Reserve Program. The EPA is working with the USDA Agriculture Air Quality Task Force to develop equitable policies for emissions from activities that could be classified as agricultural burning.

This policy addresses the impacts of air pollutant emissions from fires managed for resource benefits on public health and welfare. The primary indicators of public health impacts used are ambient air quality impacts above the NAAQS for fine particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers ($PM_{2.5}$), and particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers (PM_{10}). There are both 24-hour (daily) and annual NAAQS for $PM_{2.5}$ and PM_{10}. Emissions of nitrogen oxides (NO_x), VOC, and CO from fires can also impact the NAAQS for NO_2, O_3, and CO. However, the actions required to reduce VOC and CO emissions are the same as those recommended in this document to mitigate impacts on the $PM_{2.5}$, and PM_{10} NAAQS. Emissions of NO_x, on the other hand, can increase under some of the burning conditions used to decrease emissions of other pollutants.

The effects of fire emissions on the public welfare aspects of the NAAQS for PM are addressed in terms of visibility impairment and regional haze. The policy also addresses the treatment of fire emissions to meet other CAA requirements, such as prevention of significant deterioration (PSD) and conformity with SIP's or TIP's.

III. BACKGROUND

A. The Role of Fire in the Wildlands

The role of fire in North American ecosystems has been undergoing change since people began to play a more active role in managing their natural resources. Native Americans actively used fire to alter vegetative patterns, to ease travel, or for hunting purposes. Prior to European

[2] See memorandum from Mary D. Nichols, Assistant Administrator for Air and Radiation to EPA Regional Offices titled Areas Affected by PM_{10} Natural Events, May 30, 1996.

settlement, fire played a natural role as a necessary disturbance phenomena, keeping fuel density in check as well as insects and the diseases they carry, thereby maintaining North American wildlands in a healthy state. After European settlement and the introduction of grazing herds of cattle and sheep, and the practice of fire suppression, public land management agencies have recognized that not allowing fire to play its natural role in our wildlands has had unintended negative effects. When forests and grasslands are not allowed to burn naturally (lighting serving as the principal source of ignition) the result can be heavy accumulation of dead vegetation which provides fuel for unwanted fires (wildfires). Because of this unhealthy build-up of fuels, the risk of catastrophic wildfires is much greater as evidenced by several recent fires in our national forests and other publicly owned lands. These fires put firefighters and the general public in danger while destroying millions of acres of forests and costing millions of dollars to suppress. The lack of fire also has unintended ecological effects, leading to the loss of habitat for rare species and the decline of ecosystems. Fire exclusion can lead to an alteration in natural community types, and an important loss of biodiversity. Many plant and animal species are on the decline because they exist in fire-dependent habitats that haven't burned in decades. This situation has led to a rethinking of Federal land management and fire management policy.

B. Changes in Fire Management Policy

In 1995, a Federal Wildland Fire Management Policy and Program Review was conducted in response to the unhealthy condition of our public wildlands, and the increase in unplanned fires that occurred in 1987, 1988, 1992 and again in 1994. As a result of this review, the five principal Federal fire/land management agencies [the Forest Service (FS) under the Department of Agriculture; and the Bureau of Land Management (BLM), National Park Service (NPS), Fish and Wildlife Service (FWS), and the Bureau of Indian Affairs (BIA) under the DOI] agreed on need for several changes to existing fire/land management practices. Their recommendations include the reintroduction of fire (allowing it to play its natural role) into Federal land management programs in “an ongoing and systematic manner, consistent with public health and environmental quality considerations.” The goals of this change in land management policy are to reduce unnatural fuel densities that contribute to increasing unplanned fire hazards, and to restore wildland ecosystems to their healthy natural states. The Federal agencies previously mentioned began increasing the use of fire in their most vulnerable wildlands in 1997. Annual treatment targets for all Federal land management agencies will be increased to more than 5 million acres per year by 2005.

C. <u>Air Quality Considerations</u>

Burning wildland vegetation causes emissions of many different chemical compounds such as small particles, No_x, CO and organic compounds. The components and quantity of emissions depends in part on the types of fuel burned, its moisture content, and the temperature of combustion. Complex organic materials may be absorbed into or onto condensed smoke particles. Tests indicate that, on average, 90 percent of smoke particles from wildland and prescribed fires are PM_{10}, and 70 percent are $PM_{2.5}$.

Historically, EPA's NAAQS for PM have tended to focus emission control efforts on "coarse" particles--those larger than $PM_{2.5}$. Before 1987, EPA's PM standards focused on "Total Suspended Particles," including particles as large as 100 micrometers in diameter. The EPA revised the standards in 1987 to focus control on PM_{10} in response to new science showing that it was the smaller particles capable of penetrating deeply into the lungs that were associated with the most adverse health effects. For comparison, a human hair is about 70 micrometers in diameter.

The most recent review of health studies focused attention on the need to better address the "fine" fraction particles - $PM_{2.5}$. These more recent studies provide consistent and coherent, "evidence that serious health effects (mortality, exacerbation of chronic disease, increased hospital admissions, etc.) are associated with exposures to ambient levels of PM found in contemporary urban airsheds even at concentrations below current U. S. PM standards" (Criteria Document-U.S. EPA 1996a, p. 13-1). PM concentrations currently found in many communities are associated with adverse health effects in the general population, including increased mortality and morbidity, altered lung function, increased respiratory symptoms, aggravated respiratory and cardiovascular disease. Sensitive sub-populations, such as children, the aged and those with existing cardiopulmonary or infectious respiratory disease, may experience effects at lower levels of PM than the general population, and the severity of effects might be greater. These studies are the basis for the July, 1997 promulgation of new NAAQS for $PM_{2.5}$, which are designed to protect public health, with an adequate margin of safety.

Fine particles are also a major cause of visibility impairment in such places as national parks that are valued for their scenic views and recreation.

D. <u>Visibility Impairment</u>

Visibility conditions are affected by scattering and absorption of light by particles and gases. The fine particles most responsible for visibility impairment are sulfates, nitrates, organic compounds, soot and soil dust. Fine particles are more efficient per unit mass than coarse particles at scattering light. Light scattering efficiencies also go up as humidity rises, due to water adsorption on fine particles, which allow the particles to grow to sizes comparable to the wavelength of light. There are distinct regional variations in visibility between eastern and western States, due, to generally higher relative humidities in the East. Naturally occurring visual range in the East may be between 105 to 190 kilometers, while natural visual range in the West is between 190 to 270 kilometers.

Visibility is an important public welfare consideration because of its significance to enjoyment of daily activities in all parts of the country. Protection of visibility as a public welfare consideration is addressed nationally through the secondary PM NAAQS which are equivalent to the primary PM NAAQS. Visibility protection is particularly important in the 156 mandatory Class I Federal areas, "Areas of Great Scenic Importance," and is addressed for these areas by the special provisions of Sections 169A and 169 B of the CAA.

The effects of smoke from wildland and prescribed fires on air quality will be discussed throughout this document. The term air quality, as used in this document, refers to ambient concentrations of pollutants (primarily PM in locations accessible to the general public), and, where applicable, to impacts on visibility in mandatory Class I Federal areas. Thus, wherever this document discusses the need for wildland owners/managers to consider the impacts of their actions on air quality, this may include consideration of the effects of their actions on visibility in mandatory Class I Federal areas.

Existing requirements to consider effects on visibility which are reasonably attributable to a single nearby source or small number of sources are contained in the regulations published by EPA in 1980 at 40 CFR 51.300 (Protection of Visibility). Additional regulations are currently being developed to address impairment of visibility that is more regional in its character and origins ("regional haze"). This interim policy may be revised to be made consistent with the regional haze rules when they become final.

Please refer to the white paper, "Background on the Role of Fire," for more complete background information. See Section I to obtain a copy.

IV. DESCRIPTION OF POLICY

The EPA's policy regarding wildland and prescribed fires managed for resource benefits is that owners/managers of public, private and Indian wildlands should collaborate with State/tribal air quality managers (air regulators) to achieve their goals of: (1) allowing fire to function in its natural role in the wildlands, and (2) protecting public health and welfare by minimizing smoke impacts. The EPA urges air quality managers to participate in public land use planning activities which involve selecting appropriate resource management treatments, including the use of fire, and to help identify air quality criteria for fire management plans. Air quality managers are urged to help evaluate the potential impacts of alternative resource treatments and assure that air quality concerns (also visibility and regional haze concerns, where appropriate) are adequately addressed in the public land use planning process. They are urged to solicit information from private and Indian wildland owners/managers on plans to use fire for resource management, to encourage them to consider appropriate alternative treatments, and to assist them in evaluating the potential air quality impacts of alternatives to meet particular management objectives.

Wildland owners/managers are urged to: (1) notify air quality managers of plans to significantly increase their future use of fire for resource management, (2) consider the air quality impacts of fires and take appropriate steps to mitigate those impacts, (3) consider appropriate alternative treatments, (4) and participate in the development and implementation of State/tribal SMP's.

The EPA will allow States/tribes flexibility in their approach to regulating fires managed for resource benefits. They are not required to change their existing fire regulations if those regulations adequately protect air quality. However, there are incentives for States/tribes to certify to EPA that they have adopted and are implementing a SMP that includes the basic components identified in this policy. The main incentive is that, as long as fires do not cause or significantly contribute to daily or annual PM2.5 and PM10 NAAQS violations, States/tribes may allow participation by burners in the basic SMP to be voluntary and the SMP does not have to be adopted into the SIP. Another incentive is the commitment by EPA to use its discretion not to redesignate an area as nonattainment when fires cause or significantly contribute (see section VII.B.) to PM NAAQS violations, if the State/tribe required those fires to be conducted within a basic SMP. Rather, if fires cause or significantly contribute violations, States/tribes will be required to review the adequacy of the SMP, in cooperation with wildland owners/managers, and make appropriate improvements.

If States/tribes do not certify that a basic SMP is being implemented, no special consideration will be given to PM violations attributed to fires managed for resource benefits. Rather, EPA will call for a SIP revision to incorporate a basic SMP and/or will notify the governor of the State or the tribal government that the area should be redesignated as nonattainment. The SMP adopted in response to the SIP/TIP call must require mandatory participation for greater than de minimis fires, and must be adopted into the SIP/TIP so that it is Federally enforceable. Also, the SIP/TIP must meet all other CAA requirements applicable to nonattainment areas.

Fire data requirements for SIP's/TIP's are addressed in section VIII of this policy. Guidance for meeting CAA requirements to show conformity of Federal fire activities with SIP's, to address visibility/regional haze impacts, and to address prevention of significant deterioration of air quality are addressed in section IX.

The following are guiding principles for implementing this policy:

- Air quality and visibility impacts from fires managed for resource benefits should be treated equitably with other source impacts.
- Land and vegetation management practices should be promoted that are best for wildland ecosystems, yet protect public health and avoid visibility impairment.
- States/tribes should foster collaborative relationships among wildland owners/managers, air quality managers and the public to develop and implement SMP's.
- States/tribes will be allowed the flexibility (prior to measuring violations of the $PM_{2.5}$ or PM_{10} NAAQS attributable to fires managed for resource benefits) to decide when a SMP

is needed and how the program will be designed to prevent adverse air quality impacts. This does not preclude wildland owners/managers from including smoke management components in burn plans for fires they conduct in the absence of an applicable State/tribal program.

- All parties (wildland owners/managers, air quality managers and the public) are expected to act in good faith and will be held accountable for implementing their respective parts of fire and SMP's.

V. COLLABORATION AMONG LAND AND AIR QUALITY MANAGERS

Wildland owners/managers and air quality managers can overcome the barriers to achieving their goals of: (1) returning fire to its natural role in the wildlands and (2) protecting air quality and visibility, by working together toward those ends. Wildland owners/managers should notify State/tribal air quality managers if they are planning to significantly increase the use of fire to manage wildland resources. Air quality managers with Federal/State/local public wildlands within their jurisdictions have a responsibility to participate in the public planning processes conducted for the management of those publicly owned lands. To arrive at the best choice of resource treatments and response to fire, it is essential that the air quality impacts of planned land management activities are adequately addressed. Air quality managers, by participating in the public land use planning process, can help select the scope of land uses; help evaluate alternative management tools and help identify when fire is appropriate; and review projected air quality and visibility impacts. Air quality managers should also consult with private wildland owners/managers to determine long-range resource management objectives and help them evaluate the applicability of alternative treatments based on air quality and visibility considerations.

Wildland owners/managers also have a responsibility to participate with the other stakeholders and State/tribal air quality managers in developing rules and SMP's for fires managed for resource benefits. Air quality managers that intend to develop or revise regulations, plans or policies applicable to fires should solicit the early participation of all affected wildland owners/managers in making those revisions.

A. Land and Vegetation Management

Wildlands are managed by Federal, State and local public agencies (referred to in this document as public land management agencies); tribal and BIA authorities; and private land owners. The goals of public land management agencies vary, but are generally to develop, maintain and enhance wildlife habitat; protect endangered plant and animal species; preserve and protect cultural resources, scenic vistas and wilderness; provide for recreation; and to sustain production of natural resources. The goals of private wildland owners/managers may be sustained production of natural resources, preservation of wildlife habitat, improved grazing conditions, etc. The goals of tribal wildland owners/managers are generally similar to public land management agency goals, but may also include aspects of private land owners. Another common goal of all wildland owners/managers is to minimize the potential for catastrophic wildfires that could result from heavy accumulations of vegetative fuels.

1. Alternative Treatments

Wildland owners/managers may have an array of tools, including fire, that can be used to accomplish land use plans, depending on the resource benefits to be achieved. Several factors should be considered when selecting appropriate treatments. Those factors include the costs of treatment, the environmental impacts (e.g., air and water quality, soils, wildlife, etc.), and whether fire must be used to meet management objectives. The best combination of treatments are those that meet management goals with the most favorable environmental impacts at the most reasonable costs.

a. <u>Utilization and mechanical treatments</u>

Mechanical treatments may be appropriate tools when management objectives are to reduce fuel density to reduce a wildfire hazard, or to remove logging waste materials (slash) to prepare a site for replanting or natural regeneration. On-site chipping or crushing of woody material, removal of slash for off-site burning or biomass utilization, whole tree harvesting, and yarding (pulling out) of unmerchantable material may accomplish these goals. Mechanical treatments are normally limited to accessible areas, terrain that is not excessively rough, slopes of 40 percent or less, sites that are not wet, areas not designated as national parks or wilderness, areas not protected for threatened and endangered species and areas without cultural or paleological resources.

b. **<u>Chemical treatments</u>**

When the management objective is to preclude, reduce or remove live vegetation and/or specific plant species from a site, chemical treatments may be appropriate tools. Other potential environmental impacts caused by applying chemicals must also be considered, however.

c. <u>Fire treatments</u>

Fire is one of the basic tools relied upon by wildland owners/managers to achieve a myriad of management objectives in fire dependent ecosystems. Most North American plant communities evolved with recurring fire and, therefore, are dependent on recurring fire for maintenance. The natural fire return interval may vary from 1-2 years for prairies, 3-7 years for some long-needle pine species, 30-50 years for species such as California chaparral, and over one hundred years for species such as lodgepole pine and coastal Douglas-fir. When one management objective is to maintain a fire dependent ecosystem the effects of fire cannot be duplicated by other tools. In such cases, fire may be the preferred management tool even when other treatments may be equally effective for meeting other objectives. Fire can also be used to reduce heavy fuel loads and prevent catastrophic wildfires.

When fire is the chosen management tool, a combination of treatment methods may be the best approach to achieving the desired resource benefits with minimum air quality impacts. Combinations of treatments may include mechanically pretreating an area to thin the fuel load prior to the use of fire.

2. Role of Federal Land Managers (FLM's)

The major Federal agencies with land management responsibilities include the USDA FS, the DOI NPS, and FWS, BLM, and BIA. These agencies manage national parks, forests, monuments, wilderness areas, prairie grasslands, sea shores, Indian lands, wildlife refuges, etc. The Department of Defense and Department of Energy also manage millions of acres of Federal land at military bases, training centers and for other purposes.

a. <u>Federal land use and fire management planning</u>

Federal land use planning is an open process for setting land use and management goals and objectives. The planning process is designed for public participation, and must comply with NEPA. State/tribal air quality managers are given the opportunity to participate in land use planning as part of normal intergovernmental consultation procedures. It is important for air quality managers to participate in public land use planning decisions to ensure that air quality concerns are adequately addressed. Through the public participation process, issues are identified and alternatives are discussed regarding methods for implementing land management activities such as trail building, improvement of wildlife habitat, timber harvesting, use of fire, etc. The environmental impacts of these activities are analyzed including, among other things, impacts on cultural resources, wildlife, vegetation, soils, riparian areas, wetlands, water quality, air quality, and visibility. Consideration of the air quality impacts of land management activities is essential to arriving at the best choice of treatments and response to fire.

Two or more levels of land use planning are conducted by FLM's to achieve management goals. First, broad scale and long-range land use plans must be developed for administrative units (e.g., forests, parks, refuges, sanctuaries, etc.). The land use plan identifies the scope of actions and goals for the lands and resources administered, and typically covers a 10 to 15-year period.

In addition to land use plans, there are other shorter term (typically 1-5 years) planning efforts where decisions are made concerning specific activities and programs, including the use of fire to achieve resource benefits. These may include programmatic plans, such as FMP's, or specific project plans.

The FMP's are strategic plans that define how wildland and prescribed fires will be managed to meet land use objectives. The FMP's must contain prescriptive criteria which are measurable and will guide selection of appropriate management actions in response to fires. The criteria can relate to suppression actions or describe when fire can be managed to gain resource benefits. This allows the use of a full range of appropriate management responses to fire, which may include: full suppression of a wildland fire; suppression on part of a wildland fire while allowing another portion of the fire to continue playing a natural ecological role and achieve resource benefits; or the use of prescribed fire.

Project plans are strategic plans to accomplish specific actions and goals established in a land use plan. Project plans may involve decisions regarding trade-offs between using mechanical, chemical and fire treatments. When projects include fires treatments, burn plans are also required. Burn plans are operational plans for managing specific fires. Burn plans prepared by

FLM's should include smoke management components to minimize fire emissions and mitigate air quality impacts.

b. Evaluating environmental impacts

Federal agencies evaluate the environmental impacts of the tools used for resource management on publicly owned lands using NEPA. They generally consider the impacts on, among other things, plant and animal species in the area, aquatic life, cultural resources, soil conditions, riparian areas, wetlands, water quality, air quality and visibility. Such analyses should be undertaken at both the individual project planning level and at the regional planning level if warranted by the extent of similar activities over a large area.

The impacts of resource management activities, particularly fire, on air quality can vary significantly by region. The impacts can be strongly affected by meteorology; existing air quality; the size, timing and duration of the activity; and other activities occurring in the same airshed at the same time. State/tribal air quality managers can provide technical assistance with evaluating potential air quality impacts, thus aiding FLM's in their selection of tools and evaluation of the environmental impacts.

Air quality and visibility impact evaluations of fire activities on Federal lands should:

- include recent historic (e.g. 10 years) and projected (life of the plan) annual or seasonal emissions from wildland and prescribed fires. Emission projections should be based on estimates provided by wildland owners/managers of acres burned, pre-burn fuel loading by vegetation type and consumption,
- be related to analyses of cumulative impacts of fires on regional and subregional air quality, when possible.
- identify applicable regulations, plans or policies (e.g. burn plans, authorization to burn, conformity, etc.),
- identify sensitive receptors,
- include description of planned measures to reduce smoke impacts,
- identify the potential for smoke intrusions into sensitive areas, and model air quality and visibility impacts, when possible,
- describe ambient air monitoring plans, when appropriate.

3. Role of State and Other Public Land Managers

State and local land management agencies manage publicly owned lands similar to Federal lands. These agencies differ from agency to agency, but can include forestry, conservation, park service, or fish and game agencies, as well as State or local fire protection agencies. Many agencies prepare long-range land use plans as well as project specific plans. The FMP's, similar to those prepared by Federal agencies, may also be prepared. Public land management agencies generally assess the environmental impacts of proposed projects, such as fires managed for resource benefits, although the impacts evaluated vary from agency to agency.

Some State/local wildland managers also have responsibilities for private lands. Such responsibilities may include using fires and other fuels reduction programs aimed at reducing the potential for wildfires in the wildland/urban interface.

Land use planning for State and locally owned wildlands, although somewhat different from the Federal process, also requires preparation of written documents that are subject to public review. State/local wildland managers should notify air quality managers of long-range plans to use fire for resource management. They should consider alternative management tools and evaluate the potential air quality impacts of fires. State/local wildland managers should also participate in the development of State SMP's.

4. Role of Private Land Managers

Private wildland owners/managers may or may not prepare written land use or project plans depending on the organization and the size of the property. States/tribes may or may not require written plans, but activities on privately owned lands must meet all applicable State and Federal environmental requirements. State requirements include any specific SIP requirements applicable to private land owners which are designed to ensure that the State complies with CAA requirements. Private land owners/managers should provide information to the State on long-range plans to use fire for resource management and should participate in the development of State SMP's.

5. Role of Indian Land Managers

Land use plans for Indian wildlands are not subject to review by the general public and are not subject to State regulations. Activities on Indian lands must meet the requirements of the CAA and the TIP, however, if one has been adopted. It is important that Indian wildland managers consider alternative vegetation management tools and consider the air quality impacts of the management practices chosen both on and off of Indian lands. They are encouraged to collaborate with other near-by wildland owners/managers and air quality managers on regional SMP's to assure that fires managed for resource benefits will not cause adverse air quality impacts at sensitive receptors in the region.

6. Role of Air Quality Managers

State air quality managers which have publicly owned wildlands within their jurisdiction, have a responsibility to participate in the public planning process conducted for those lands to be assured that air quality concerns are adequately addressed and they can meet the goals of their SIP's. They can participate in selecting the scope of land uses, identify air quality issues, and participate in evaluating and selecting alternative resource management tools. They can also participate in identifying basic air quality criteria for fire prescriptions. To accomplish this, air quality agencies should heed solicitations of public participation from land managers and contact public land management agencies within their jurisdiction

State/tribal air quality managers should also encourage private and Indian wildland owners/managers to consider alternative treatments and help them evaluate the potential air quality impacts of alternatives to meet particular management objectives.

B. Air Quality Management

State/tribal air quality managers are responsible for adopting plans and rules sufficient to attain and maintain national and State air quality standards, prevent significant deterioration of air quality, remedy existing visibility impairment and prevent future impairment in mandatory Class I Federal areas caused by manmade sources of pollution. This is accomplished mainly by developing SIP's and TIP's. The SIP's/TIP's include all programs and rules required by the CAA to meet and assure maintenance of Federal standards. The SIP's/TIP's are frequently amended as State/tribal rules are revised and new rules are adopted to meet changing CAA requirements. The

EPA has the authority to adopt and implement Federal Implementation Plans (FIP's) to address air quality protection in areas where States or tribes do not adopt plans.

1. Role of State/Local Air Quality Managers

The SIP's are developed in an extensive public process involving workshops and public hearings in which all stakeholders are invited to participate in developing the technical components of the plans including: (1) emission inventories; (2) modeling analyses; (3) attainment demonstrations; (4) transportation and general conformity emission budgets; (5) analyses of air quality data; and (6) control strategy development. State/local air quality managers should solicit information on the planned use of fire for resource management from all wildland owners/managers, just as they obtain information on other emission sources within their jurisdiction, when fires are expected to significantly impact air quality. Air quality managers should also work with adjacent States to mitigate potential impacts from interstate transport of smoke.

2. Role of Tribal Air Quality Managers

Eligible tribes may develop TIP's to administer CAA requirements on Indian lands. The CAA recognizes tribal governments as the most appropriate parties to regulate the environment on Indian lands and grants EPA the authority to approve tribal programs. The EPA has developed strategies for Federally implementing CAA requirements if tribes do not adopt TIP's.

Tribal air quality managers should solicit information on the planned use of fire for resource management within their jurisdiction and the potential for air quality impacts on or from adjacent jurisdictions. They are encouraged to collaborate with other near-by air quality managers to develop regional SMP's which assure that fire activities will not cause adverse air quality impacts at sensitive receptors in the region.

3. Role of Public Land Managers

Public land managers have the responsibility to participate with the other stakeholders and air quality managers in developing SIP's. Public land managers, as experts in what is needed to meet land use and other environmental objectives, need to provide information on the areas that are to be treated with fire, air pollutant emissions estimates, and assistance in developing programs to track emissions, monitor air quality and visibility, and mitigate air quality impacts.

The FLM's of mandatory Class I Federal areas must participate in the development of SIP's for regional haze and visibility impairment. Congress gave FLM's a key consulting role in the administration of visibility protection and "affirmative responsibility to protect air quality related values (including visibility) in mandatory Class I Federal areas." [See section 165 of the CAA.]

VI. SMOKE MANAGEMENT PROGRAMS (SMP's)

The SMP's establish a basic framework of procedures and requirements for managing smoke from fires managed for resource benefits and are typically developed by States/tribes with cooperation and participation by wildland owners/managers. The purposes of SMP's are to mitigate the nuisance and public safety hazards (e.g., on roadways and at airports) posed by smoke intrusions into populated areas; to prevent deterioration of air quality and NAAQS violations; and to address visibility impacts in mandatory Class I Federal areas. Some strong indications that an area needs a SMP are: (1) citizens increasingly complain of smoke intrusions; (2) the trend of monitored air quality values is increasing (approaching the daily or annual NAAQS for $PM_{2.5}$ or PM_{10}) because of significant contributions from fires managed for resource benefits; (3) fires cause or significantly contribute to monitored air quality that is already greater than 85 percent of the daily or annual NAAQS for $PM_{2.5}$ or PM_{10}; or (4) fires in the area significantly contribute to visibility impairment in mandatory Class I Federal areas.

If a State/tribe determines that a SMP is needed, they can adopt any type of program they believe will prevent NAAQS violations and address visibility impairment. For example, general fire regulations may establish basic parameters, such as wind speed, direction, location and distance to sensitive receptors, etc., within which fires can be ignited or naturally ignited fire can be allowed to continue to burn. States/tribes may allow wildland owners/managers to voluntarily notify them of fire plans or may require prior authorization. They may also exempt de minimis fires (fires that will cover fewer than X acres or consume less than Y tons of fuel, as established by the State/tribe) from meeting the regulations. Such regulations leave much discretion to wildland owners/managers as to when to ignite fires, and what management strategy to follow with naturally ignited fires. States/tribes may exercise enforcement authorities when wildland owners/managers are found to have ignited the fire outside of the parameters of the rule, or not to have appropriately responded to air quality impacts caused by naturally ignited fires.

General fire regulations may be adequate for areas where fires managed for resource benefits rarely cause or contribute to air quality problems. However, when plans to use fire on a large scale could cause significant air quality impacts, or several wildland owners/managers within an airshed are expected to use fires concurrently, a more structured SMP requiring cooperation and coordination of fire activities may be required to minimize emissions and mitigate the air quality impacts.

State/tribal air quality managers, public wildland managers, private and Indian wildland owners/managers, and the general public should collaborate in the development and implementation of State/tribal SMP's. The State/tribal air quality manager must certify in a letter to the Administrator of EPA that at least a basic program has been adopted and implemented in order to receive special consideration under this policy of air quality data resulting from fire impacts, as explained in section VII. The SMP does not have to be incorporated into the SIP/TIP or be Federally enforceable, however. The following describes the basic components (A - F) of a certifiable SMP. There is considerable latitude within the components for individual State/tribal preferences.

A. <u>Authorization to Burn</u>

The SMP should include a process for authorizing or granting approval to manage fires for resource benefits within a region, State, or on Indian lands and identify a central authority responsible for implementing the program. The process may be as simple as receiving applications for permission to burn and granting approval via telephone or facsimile. The SMP central authority must review fire applications, consult with the applicants, if necessary, and promptly make burn/no burn decisions. When authorizing a fire, the authority should consider all open burning activities (land clearing and construction wastes, agricultural wastes, etc.) allowed within an airshed. The central authority should strive to treat public and private wildland owners/managers equitably when authorizing fires. Neighboring States/tribes are encouraged to create partnerships to coordinate fire projects when inter-jurisdictional impacts are expected, so as to meet air quality and fire management objectives. Fire emissions should be minimized and the air quality impacts should be mitigated regardless of political boundaries.

States/tribes may or may not require written burn plans for de minimis fires, especially if the central authority records pertinent fire information. However, written burn plans are strongly recommended for greater than de minimis fires. Burn plans should be prepared by the wildland owners/managers. The central authority should assist private land owners that cannot prepare their own plans. When written burn plans are required, especially for fires on publicly owned lands, they should include such information as the:

- location and description of the area to be burned,
- personnel responsible for managing the fire,
- type of vegetation to be burned,
- area (acres) to be burned,
- amount of fuel to be consumed (tons/acre),
- fire prescription including smoke management components (discussed below),
- criteria the fire manager will use for making burn/no burn decisions,
- safety and contingency plans addressing smoke intrusions.

The central authority's criteria for authorizing fires should be based on existing air quality and the ability of the airshed to disperse emissions (e.g., meteorological conditions) from all burning activities on the day of the burn. For fires lasting longer than one day, predicted meteorological conditions for several days should be considered to avoid aggravating existing problems. Persons receiving authorization to ignite fires must comply with all applicable local, State, tribal and Federal requirements. Persons responsible for managing greater than de minimis fires should be adequately trained in fire and smoke management. Fire managers should be required to follow the authorized burn plan or explain why it was necessary to deviate from the plan.

B. Minimizing Air Pollutant Emissions

The SMP should encourage wildland owners/managers to consider the alternative treatments discussed in section V.A.1., above. Public land managers typically consider and evaluate alternative treatments that may achieve management objectives, their costs and the environmental impacts of each method. States/tribes should assist private land owners to also identify economically feasible treatments that will meet their objectives with minimum air pollutant emissions. When the use of fire is selected as the best means to accomplish management goals, there are several ways to reduce emissions from a single fire. The approaches fall into four categories and their applicability varies by fuel type, (1) minimize the area burned, (2) reduce the fuel loading in the area to be burned, (3) reduce the amount of fuel consumed by the fire, (4) minimize emissions per ton of fuel consumed. These emission reduction techniques rely almost exclusively on reducing the amount of fuel consumed by a particular fire. The excluded fuels could be consumed by a subsequent fire, however, unless they are removed from the area or biologically decompose. Also, generally these techniques cannot be used to reduce emissions from naturally ignited fires.

Emission reduction techniques are discussed further in the white paper "What Wildland Fire Conditions Minimize Emissions and Hazardous Air Pollutants and Can Land Management Goals Still be Met?" See Section I to obtain a copy.

C. <u>Smoke Management Components of Burn Plans</u>

When burn plans are required they should include the following smoke management components.

1. Actions to Minimize Fire Emissions

The burn plan should document the steps taken prior to the burn and actions that will be taken during and after the burn to reduce air pollutant emissions. This includes measures that will be taken to reduce residual smoke, such as rapid and complete mop-ups, mop-ups of certain fuels, etc.

2. Evaluate Smoke Dispersion

The central authority should evaluate dispersion conditions prior to authorizing fires. Burn plans should evaluate potential smoke impacts at sensitive receptors and time fires to minimize exposure of sensitive populations and avoid visibility impacts in mandatory Class I Federal areas. The plan should identify the distance and direction from the burn site to local sensitive receptor areas and to regional/interstate areas where appropriate. Fire prescriptions submitted prior to the day of the fire must specify minimum requirements for the atmospheric capacity for smoke dispersal such as minimum surface and upper level wind speeds, desired wind direction, minimum mixing height, and dispersion index. It may be necessary to purchase meteorological services from private companies if they are not available from the National Weather Service.

3. Public Notification and Exposure Reduction Procedures

The plan should identify actions that will be taken to notify populations and authorities (e.g., local air quality managers) at sensitive receptors, including those in adjacent jurisdictions, prior to the fire. The plan should also identify contingency actions that will be taken during a fire to reduce the exposure of people at sensitive receptors if smoke intrusions occur. The central authority should perform these functions, if needed, for some private land owners. Appropriate short-term (less than 24-hour) contingency actions may, among other things, include:

- Notifying the affected public (especially sensitive populations) of elevated pollutant concentrations,
- Suggesting actions to be taken by sensitive persons to minimize their exposure (e.g., remain indoors, avoid vigorous activity, avoid exposure to tobacco smoke and other respiratory irritants),
- Providing clean-air facilities for sensitive persons,
- Halting ignitions of any new open burning that could impact the same area,
- Analyzing the fire situation and identifying alternative management responses upon becoming aware that a fire is out of air quality prescription with regard to the air quality criteria, (Federal land management agencies perform a Wildland Fire Situation Analysis)[3],
- Consulting State/tribal air quality managers regarding appropriate short-term fire management response to abate verified impacts,
- Implementing management responses that will mitigate the adverse impacts to public health,

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[3] A Wildland Fire Situation Analysis (WFSA) is a decision-making process that evaluates alternative fire management strategies considering fire fighter and public safety, risk to property and resources, fire fighting resources available, land management objectives, and environmental, social, economic and political constraints. The environmental and social constraints considered include, among other things, how air quality and/or visibility will be affected at sensitive receptors by each alternative fire management strategy. The positive, neutral or negative effects of each alternative on the criteria above are weighed to select the appropriate management response to the fire. Therefore, while mitigating air quality and visibility impacts must be considered by the FLM when managing a fire that is not within a prescription, they are just two of several important criteria evaluated.

- Reporting the steps taken to mitigate adverse impacts to the public and appropriate State/tribal agencies after they have been completed.

4. Air Quality Monitoring

The plan should identify how the effects of the fire on air quality at sensitive receptors, and visibility in mandatory Class I Federal areas will be monitored. The extent of the monitoring plan should match the size of the fire. For small fires, visual monitoring of the direction of the smoke plume and monitoring nuisance complaints by the public may be sufficient. Other monitoring techniques include posting personnel on vulnerable roadways to look for visibility impairment and initiate safety measures for motorists; posting personnel at other sensitive receptors to look for smoke intrusions; using aircraft to track the progress of smoke plumes; and continued tracking of meteorological conditions during the fire. For large fires expected to last more than one day, locating real-time PM monitors at sensitive receptors may be warranted to facilitate timely response to smoke impacts. If needed, the central authority may perform these monitoring functions for some private land owners.

For additional information on monitoring wildland fire impacts see the white paper "Air Monitoring for Wildland Fire Operations." See Section I to obtain a copy.

D. <u>Public Education and Awareness</u>

The SMP should establish criteria for issuing health advisories when necessary, and procedures for notifying potentially affected populations, including those in adjacent jurisdictions, of planned fires. A program should be implemented to explain the use and importance of fire for ecosystem management, the implications to public health and safety, and the goals of the SMP. Wildland and air quality managers should work with the press to announce pre-fire health advisories, and post-fire results including such things as the management objectives met; smoke intrusions observed, and/or successful minimization of air quality impacts.

E. <u>Surveillance and Enforcement</u>

The SMP should include procedures to ensure that wildland owners/managers will comply with the requirements of the SMP. Fire managers must follow the burn plan, including the fire prescription and smoke management components, or explain any deviations from the plan. Memorandums of understanding may be used to specify the responsibilities of each State/tribal agency in implementing the SMP.

F. Program Evaluation

The SMP should provide for periodic review by all stakeholders of its effectiveness and revision of the program as necessary. The effectiveness review should be based on observations such as reports of smoke intrusions, nuisance complaints, and monitored air quality impacts. Post-burn reports should be required for fires that exceed their air quality prescription and/or fires that cause smoke impacts at sensitive receptors. Post-burn reports for escaped fires should describe the incident, describe the contingency plan implemented, and provide recommendations to prevent future smoke related problems.

State/tribal SMP's should include procedures for re-evaluating the effectiveness of rules and regulations every 3 to 5 years. Such procedures should involve all the original participants (e.g., wildland owners/managers, air quality managers, the public, etc.) and should review the:

- Acres of fires managed for resource benefits planned for the next 5 years,
- Need to expand the scope of the program to include authorization of other open burning,
- Need for changes in the SMP.

G. Optional Air Quality Protection

The following components are not required in a basic SMP, but States/tribes may adopt more stringent SMP's or include additional smoke management requirements. For example, "special protection zones" may be established to provide better protection against smoke impacts. Special protection zones could be buffers (e.g., 10 - 25 miles) around wildland/urban interface areas, nonattainment areas, or mandatory Class I Federal areas. Additional requirements for burns within a special protection zone may include no burning if high pollution levels already exist in the area. Also, special protections may only be required for burns that will last overnight, for multi-day burns or burns during specific seasons.

States/tribes may also establish "performance standards" that would trigger implementation of additional smoke management requirements if exceeded in an area. The performance standards could set limits on the frequency and intensity (e.g., hours/day, PM concentration, visibility impairment) of smoke intrusions. Implementation of performance standards may require real-time monitoring of air quality. Additional requirements for fires after the performance standards are exceeded may include better dispersion parameters (e.g., increased wind speed, mixing height, dispersion index, etc.).

VII. ACCOUNTABILITY

A. Role of State/Tribal Air Quality Managers

High PM concentrations attributable to fires managed for resource benefits are valid air quality data that can be used to determine the attainment status of the area represented by the data for both the daily and annual NAAQS. State/tribal air quality managers are responsible for monitoring citizen complaints and air quality trends attributable to fires to determine when a SMP is needed to minimize emissions and mitigate air quality impacts. Air quality managers should initiate the collaborative process needed to develop and adopt regulations for a SMP. If the State/tribal air quality manager certifies in a letter to the Administrator of EPA that at least a basic program (described in section VI) has been adopted and implemented, special consideration will be given under this policy to air quality data resulting from fires managed for resource benefits.

1. Wildfires

High PM concentrations attributable to wildfires (unwanted wildland fires) can be treated as due to a natural event under EPA's Natural Events Policy. The Natural Events Policy provides that when areas violate the PM_{10} NAAQS due to a natural event, EPA will: (1) exercise its discretion, under section 107(d)(3) of the CAA, not to redesignate areas as nonattainment if the State develops and implements a plan to respond to the health impacts of natural events; and, (2) redesignate nonattainment areas as attainment by applying appendix K, on a case-by-case basis, to discount [ambient air quality] data in circumstances where an area would attain but for exceedances that result from uncontrollable natural events. The elements of a State/tribal action plan to respond to the health impacts of natural events are described in the Natural Events policy statement. The EPA plans to revise the Natural Events Policy to also cover $PM_{2.5}$ NAAQS violations.

2. Fires Managed for Resource Benefits

High PM concentrations attributable to fires managed for resource benefits will be given special consideration under this policy, as described in section VII.B., if the State/tribe has certified to EPA that it is implementing a basic SMP. States/tribes should flag monitored values influenced by fires when submitting the data to EPA's Atmospheric Information Retrieval System. They must also document the basis for flagging the data. Supporting information could include the location of fires relative to the monitor, meteorological data such as wind speed and direction, filter analyses indicating heavy carbon deposits, the sample date (collected during the fire season), and the absence of other carbon sources during that period, among other things. The documentation should address the possible influence of other carbon sources such as wood-fired boilers, residential wood combustion and wildfires. The type and amount of documentation should be sufficient to demonstrate that fires managed for resource benefits caused flagged values to be above the level of the annual NAAQS. The documentation should be made available to the public for review. [For example, newspaper announcements, periodic air quality reports, distribution at public meetings.]

When smoke intrusions cause high PM concentrations, air quality managers have two goals: (1) to reduce immediate impacts on public health, and (2) to take appropriate steps to mitigate future impacts. To meet these goals, air quality managers must contact the wildland owner/manager responsible for the fire(s) to determine the cause of the impacts. The air quality manager should verify that contingency actions to reduce exposure are being implemented, and determine whether, (i) the fire was authorized, (ii) a burn plan (including the smoke management components) was followed, (iii) the prescription failed and why.

If requirements of the SMP were not met, the State/tribe can exercise various enforcement authorities to address the problem. If the fire manager complied with the SMP, the adequacy of the requirements should be reviewed. If air quality data are frequently flagged as resulting from failure of the smoke management components of the burn plan, EPA will call on the State/tribe to work with wildland owners/managers to improve future burn plans and the SMP. When a fire managed for resource benefits breaks out of its fire prescription, and cannot be returned to the prescription, the fire manager will treat it as a wildfire for the purposes of suppression. However, any resulting high PM concentrations must continue to be addressed under this policy, and the data can not be treated as due to a wildfire natural event.

B. Role of the Environmental Protection Agency

1. Impacts with a SMP

If fires managed for resource benefits cause or significantly contribute to violations (see definition) of the daily or annual $PM_{2.5}$ or PM_{10} NAAQS, the State/tribe must submit the following documentation to EPA to avoid a SIP/TIP call or redesignation of the area to nonattainment:

- Evidence supporting the finding that flagged air quality values were due to fires managed for resource benefits,
- Evidence that the fires were subject to a certified State/tribal SMP.

The State/tribe may consider that such fires caused or significantly contributed to violations of the daily NAAQS if 25 percent of all the PM concentrations that are above the level of the daily NAAQS, have been flagged as being due to fire impacts.

The State/tribe may consider that such fires caused or significantly contributed to violations of the annual NAAQS if the sum of the measured concentrations for all days flagged as due to fires, divided by the total number of sample days (fire days plus non-fire days) is greater than or equal to 25 percent of the annual NAAQS (i.e., 4 $\mu g/m^3$ for $PM_{2.5}$ or 12 $\mu g/m^3$ for PM_{10}).

If the evidence is convincing, EPA will exercise its discretion under section 107(d)(3) not to redesignate the area as nonattainment. Rather, following the first NAAQS violation based on 3 calendar years of PM air quality data, EPA will call on the State/tribe to review the effectiveness of the SMP in collaboration with wildland owners/managers and make appropriate improvements to mitigate future air quality impacts. The same procedure will be followed if a second NAAQS violation occurs the following year. If fires cause or significantly contribute to a third consecutive NAAQS violation, EPA will call for the SMP to be made part of the SIP/TIP and be Federally enforceable.[4] If the area was designated nonattainment previously, EPA will also call on the State/tribe to review the effectiveness of the SMP and make appropriate improvements.

2. Impacts Without a SMP

If a certified SMP has not been implemented, EPA will not give special consideration to the high PM concentrations attributed to fires managed for resource benefits that cause or

[4] For example, the first violation of the PM_{10} NAAQS may be determined using air quality data for calendar years 1997-1999. Subsequently, 1998-2000 data for the same area could show a second violation, and data for 1999-2001 could identify a third violation for the area.

significantly contribute to: (1) violations of a $PM_{2.5}$ or PM_{10} NAAQS, (2) visibility impairment in mandatory Class I Federal areas, or (3) failure to achieve reasonable progress toward the national visibility goal. Rather, EPA will call for adoption of the basic SMP, described in section VI, as part of the SIP/TIP for PM and visibility. The EPA will also notify the governor of the State or the tribal government that the area should be redesignated as nonattainment. The SMP adopted in response to the SIP/TIP call must require mandatory participation for greater than de minimis fires, must be adopted into the SIP/TIP, and must be Federally enforceable. The SIP/TIP will also have to meet all other CAA requirements applicable to nonattainment areas.

3. Interstate Transport of Smoke

Several key provisions of the CAA address interstate pollutant transport. Section 110(a)(2)(D) provides that a SIP must contain provisions preventing subject sources from contributing significantly to nonattainment problems or interfering with maintenance in any other State. That section also prohibits interference with any SIP required measures under part C to prevent significant deterioration or to protect visibility. Section 169A authorizes EPA to promulgate regulations requiring states that "may reasonably be anticipated to cause or contribute to" visibility impairment in mandatory Class I Federal areas to include in their SIP's measures necessary to eliminate or reduce such impairment. Section 126 provides that, in response to petitions from government entities regarding significant pollutant transport, EPA may prescribe certain corrective measures. Also, sections 169B, 176A and 184 contain provisions for cooperatively addressing interstate pollution problems by establishing interstate transport regions and commissions to address region wide pollution and visibility concerns. The EPA promulgated a final rule, pursuant to the requirements of section 301(d) of the CAA that authorizes eligible Indian tribes to also implement these provisions.[5] If fires managed for resource benefits in one State (or on Indian lands) cause or significantly contribute to NAAQS violations in another State (or on Indian lands), EPA is authorized to take action under section 110(k)(5) of the CAA to address the problem. If, among other things, EPA finds that a SIP/TIP is substantially inadequate to attain or maintain the NAAQS, it may require the SIP/TIP to be revised to correct the

[5]See Volume 63 Federal Register 7254, February 12, 1998.

inadequacy (e.g., transported smoke).

C. Role of Wildland Owners/Managers

Wildland owners/managers are responsible for following State/tribal regulations applicable to fires, obtaining authorization to burn, and following the approved burn plan, when one is required. Owners/managers are responsible for taking appropriate actions to control the fire and reduce exposure to smoke when adverse air quality impacts result from a failure of the air quality prescription or an escaped fire.

There is a special need for fires managed by Federal agencies to have burn plans that include smoke management components. Fires managed by Federal agencies are most likely to impact air quality in recreation areas (national parks, forest, etc.) and impair visibility in mandatory Class I Federal areas. The EPA encourages Federal agencies to include smoke management components in all burn plans, regardless of the existence of a State/tribal SMP.

VIII. DATA ON WILDLAND and PRESCRIBED FIRES

Most of a State/tribal program to protect air quality is contained in a SIP or TIP. Since the use of fire for resource management is expected to increase substantially, especially on Federal lands, State/tribal air quality managers will need information to develop potential annual or seasonal air pollutant emission estimates for SIP/TIP planning. As for any source, emissions from fires can be estimated by multiplying the estimated level of activity by an emission factor. The level of activity for fire is the mass of biomass (fuel) consumed, usually expressed in tons. Emission factors expressed in pounds per ton of fuel consumed are available in EPA's publication AP-42 (which is scheduled to be updated). Emission factors are derived from an estimate of overall combustion efficiency (i.e. stoichiometric ratio). The mass of fuel consumed is the product of fire size (acres), pre-burn fuel loading (tons per acre), and fuel consumption (percent of pre-burn loading). An emission inventory can be compiled by the affected air agency for an individual fire, a statistical class of fires, a burn program, or a population of fires in a given area over a period of time based on this information.

Federal land management agencies currently collect data on wildland and prescribed fires, however, no standard reporting format is followed. These raw data are usually limited to the time and approximate location of the fire, fire perimeter area, weather (occasionally) and a qualitative description of fuels at the point of ignition. The data are not collected for the purpose of calculating air pollutant emissions and are probably inadequate for that purpose.

A National Interagency Fire Statistics Information Project has been initiated to develop an easily accessible system for storing a set of commonly agreed upon fire data. Post-burn data, such as that described above, on future wildland and prescribed fires would be stored in this database. The database will be accessible by air quality managers to estimate past, current, and future emission trends from this source category.

The EPA encourages the Federal land management agencies to develop the fire statistics database and FLM's to report fire data to the system. These fire data will be needed by air quality managers in regions where most wildland and prescribed fires occur on Federal lands. Air quality managers should request similar fire data for wildland and prescribed fires on State, private and Indian wildlands as well as information on other types of open burning to complete their emission inventories.

Statewide emissions from fire use in all 50 states during 1989 have been estimated based on a survey of [Federal, State and private] land owners/managers. [Ref. Peterson/Ward] Also, a spatially resolved inventory of prescribed burning by county for 1990 and by 50km grid for 1995, 2015 and 2040 was prepared for 10 western States as part of the Grand Canyon Visibility Transport Commission's activities. [Ref. Peterson/Lahm] The emission estimates are based on fuel models derived from 14 types of vegetative cover spatially mapped throughout the area and estimates of fuel loadings as either low, medium or high. The procedures followed by Peterson and Lahm to estimate emissions for the western states provide a good model for developing emissions estimates for other areas, also.

Further information on developing emissions estimates and the data required can be found in the white paper "Emission Inventories for SIP Development." See Section I to obtain a copy.

IX. MEETING OTHER CLEAN AIR ACT REQUIREMENTS

A. <u>Demonstrate Conformity of Federal Activities</u>

Activities on Federal lands must meet the requirements of the CAA, including the provisions of section 176(c), that such activities "conform" to the purpose of the applicable SIP. The EPA's Conformity rules, implementing the provisions of section 176(c), only apply to

Federal actions taken within a nonattainment or maintenance area. The Transportation Conformity rules govern transit-related activities, and all other type of activities are governed by the General Conformity rules. The rules require a Federal agency to demonstrate, prior to initiating a project, that its action conforms to all applicable requirements in a SIP and will not cause or contribute to NAAQS violations. The General Conformity rules provide Federal agencies with several options for demonstrating conformity. The following options are most typically followed : (1) a modeling demonstration to show that emissions from the project will not increase the frequency or severity of a NAAQS violation, (2) obtaining emission reductions that offset the new project emissions, or (3) showing that the project's emissions are already included in, or accommodated by, the emissions inventory of the SIP for the relevant nonattainment or maintenance area. Federal activities occurring on tribal lands will be addressed by EPA consistent with its Tribal Air Rule and the requirements of the CAA.

The above procedures can be followed to demonstrate conformity of fire projects for a Federal land management agency's administrative units based on the FMP's developed for such units. The demonstration can be made on an annual basis for all burns within the airshed of a nonattainment or maintenance area. Alternatively, the demonstration can be made for each individual fire project conducted at the administrative unit.

In addition to the previously cited methods for demonstrating conformity of Federal fire projects, EPA will pursue, in consultation with the other Federal agencies, adding an alternative method to the General Conformity rules through rulemaking. At a minimum, EPA believes that the alternate method should require a Federal agency to document that its fire projects are managed within a certified SMP. The SMP also must require regional coordination (cooperation of all jurisdictions in an airshed) of burn plan authorization and real-time air quality monitoring at sensitive receptors, when warranted, in addition to the basic program components discussed in section VI.

B. <u>Visibility/Regional Haze Requirements</u>

The EPA's visibility regulations (45 FR 80084, December 2, 1980) protect mandatory Class I Federal areas from manmade impairment that is "reasonably attributable" to a single emission source or small group of sources. FLM's for mandatory Class I Federal areas have a key consultative role and responsibility to participate in the development of SIP's for visibility impairment that is reasonably attributable to specific sources. In Part C of the CAA which includes the visibility protection mandate, Congress assigned FLM's the "affirmative responsibility to protect air quality related values (including visibility)" in mandatory Class I Federal areas. Under EPA's regulations, States must take appropriate actions to address all sources of visibility impairment, including fires, in response to a FLM's certification of reasonably attributable impairment in mandatory Class I Federal areas.

A new regulatory program to protect mandatory Class I Federal areas from "regional haze" impairment was proposed by EPA on July 31, 1997 (62 FR 41137). After the regional haze rules become final, States will need to address the impacts of fires and other contributing sources on meeting reasonable progress in their control strategy analyses, as well as during periodic progress assessments. The EPA will revisit this section of the Air Quality Policy on Wildland and Prescribed Fires after the final rules for implementing the regional haze program have been promulgated. The EPA will also develop guidance on assessing natural background visibility to aid in implementing the regional haze rules, and will consider the following paper at that time. The white paper "Estimating Natural Emissions From Wildland and Prescribed Fire" presents preliminary options for defining natural wildland and prescribed fire emissions that may or may not be consistent with the final regional haze rules. See Section I to obtain a copy.

C. <u>Prevention of Significant Deterioration</u>

Title I, part C of the CAA requires SIP's to include provisions to prevent the significant deterioration of air quality in areas designated as attainment or unclassifiable for any NAAQS. "Significant deterioration" for any pollutant is defined as an unacceptable incremental increase in ambient concentrations above the baseline concentration for that pollutant in an area. The PSD "increments" have been established for SO_2, NO_2, and PM_{10}. The EPA adopted NAAQS for $PM_{2.5}$, which became effective on September 16, 1997. However, no increments have yet been promulgated for $PM_{2.5,}$

The SIP's are required to contain emission limits and such other measures as may be necessary to prevent significant deterioration of air quality. See section 161 of the Act. In addition, SIP's are required to include a preconstruction review permit program for new and modified major stationary sources. See section 165 of the Act. The SIP's must ensure that increases in emissions from all types air pollution sources do not cause the allowable increment for a pollutant to be exceeded.

While fires managed for resource benefits generally are not subject to a preconstruction review and the issuance of a PSD permit, the emissions from such activities may affect the air quality in a PSD area. Under adverse conditions, the combined PM emissions from increased fire activities and from other sources could possibly result in ambient concentrations that exceed the allowable PSD increments for PM. Historically, EPA has often regarded fires managed for resource benefits to be temporary activities.[6] The PM emissions resulting from fire activities differ from the PM emissions generated by most other sources because they are generally short-lived. That is, the burning generally is carried out infrequently at a specific location (once every 5-20 years) and the duration tends to be short (approximately 1-2 days). Even with the proposed increased utilization of fire as a resource management tool, the resulting PM emissions are expected to be relatively uncommon at a particular location and of short duration.

Section 163(c)(1)(C) of the Act authorizes States with approved PSD programs to exclude (with the Administrator's approval) concentrations of PM caused by "construction or other temporary emission-related activities" when determining compliance with the PSD increments. The EPA generally supports the concept of allowing States with approved SIP's to exclude emissions caused by temporary managed fire activities from increment analyses, provided the exclusion does not result in permanent or long-tern air quality deterioration. Nevertheless, the decision as to whether PM emissions from fire activities should be counted against the PSD increments for PM is a decision to be made by individual States. The EPA expects States to consider the extent to which a particular type of prescribed burning activity is truly temporary, as opposed to those activities which can be expected to occur in a particular area with some regularity over a period of time.

[6]See Volume 58 Federal Register 31633, June 3, 1993.

DEFINITIONS

Air Quality: The characteristics of the ambient air (all locations accessible to the general public) as indicated by concentrations of the six air pollutants for which national standards have been established [i.e., particulate matter (PM), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO) and lead], and by visibility in mandatory Federal Class I areas. For the purposes of this policy, concentrations of PM are taken as the primary indicators of ambient air quality.

Air Quality Manager: The regulatory body responsible for managing the air quality protection program for a State, local or tribal government.

Air Quality Related Values (AQRV): Those special attributes of a mandatory Class I Federal area that deterioration of air quality may adversely affect. Some examples of AQRV include: flora and fauna, water, visibility, and odor among others.

Ambient Air: That portion of the atmosphere, external to buildings, to which the general public has access.

Administrative Unit: A unit of land (Forest, Refuge, Park, etc.) under the administration of a public land management agency.

AP-42: The Environmental Protection Agency's (EPA) Compilation of Air Pollutant Emission Factors for stationary point, area, and mobile sources. An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. Emission factors are then used to estimate the magnitude of a source's pollutant emissions.

The plan includes the project objective, fire prescription (including smoke management components), personnel, organization, equipment, etc.

Class I Area: An area set aside under the Clean Air Act (CAA) to receive the most stringent protection from air quality degradation. Mandatory Class I Federal areas are (1) international parks, (2) national wilderness areas which exceed 5,000 acres in size, (3) national memorial parks which exceed 5,000 acres in size, and (4) national parks which exceed 6,000 acres and were in existence prior to the 1977 CAA Amendments. The extent of a mandatory Class I Federal area includes subsequent changes in boundaries, such as park expansions.

De Minimis Fires: Fires that will cover fewer than X acres or consume less than Y tons of fuel, as established by a State or tribe.

Federal Implementation Plan (FIP): A plan (or portion thereof) promulgated by the Administrator, as provided for under the CAA and any applicable EPA regulations, including regulations governing tribal air plans, to fill all or a portion of a gap or otherwise correct all or a portion of an inadequacy in a State or tribal implementation plan (TIP), and which may include enforceable emission limitations or other control measures, means or techniques (including economic incentives, such as marketable permits or auctions of emissions allowances), and provides for attainment of the relevant national ambient air quality standard (NAAQS).

Federal Land Manager (FLM): With respect to any lands in the United States, the Secretary of the Federal department with authority over such lands. Generally, the Secretaries delegate their authority to specific elements within each department. For example, the National Park Service and the Fish and Wildlife Service manage those areas under the authority of the Department of the Interior.

Fire Dependent Ecosystem: A community of plants and animals that must experience recurring disturbances by fire, in order to sustain its natural plant succession, structure and composition of vegetation, and maintain appropriate fuel loading and nutrient cycling to ensure proper ecosystem function.

Fire Management Plan (FMP): A strategic plan that defines a program to manage wildland and prescribed fires, and documents the FMP to meet management objectives outlined in the approved land use plan. The plan is supplemented by operational procedures such as preparedness plans, burn plans and prevention plans.

Fuel: Includes combustible vegetative matter such as grass, trees, shrubs, limbs, branches, duff, and stumps.

Indian Land: Indian land in this document refers to Indian country which is (a) all land within the limits of any Indian reservation under the jurisdiction of the United States Government, notwithstanding the issuance of any patent, and, including rights-of-way running through the reservation, (b) all dependent Indian communities within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of a state, and (c) all Indian allotments, the Indian titles to which have not been extinguished, including rights-of-way running through the same. [See 18 U.S.C. 1151.]

Land Use Plan: A broad scale, long range plan (e.g., forest plan, refuge plan or resource management plan) that identifies the scope of actions and goals for the land and resources administered by a land owner/manager.

National Ambient Air Quality Standards (NAAQS): Standards for maximum acceptable concentrations of pollutants in the ambient air to protect public health with an adequate margin of safety, and to protect public welfare from any known or anticipated adverse effects of such pollutants (e.g., visibility impairment, soiling, materials damage, etc.) in the ambient air.

National Environmental Policy Act (NEPA): Establishes procedures that Federal agencies must follow in making decisions on Federal actions which may impact the environment. Procedures include evaluation of environmental effects of proposed actions, and alternatives to proposed actions; involvement of the public and cooperating agencies.

Nuisance Smoke: Amounts of smoke in the ambient air which interfere with a right or privilege common to members of the public, including the use or enjoyment of public or private resources.

Particulate Matter (PM): Any airborne finely divided material, except uncombined water, which exists as a solid or liquid at standard conditions (e.g., dust, smoke, mist, fumes, or smog).

$PM_{2.5}$: Particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

PM_{10}: Particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers (including $PM_{2.5}$).

Prescribed Fire: Any fire ignited by management actions to meet specific objectives (i.e., managed to achieve resource benefits).

. **Prescription**: Measurable criteria which guide selection of appropriate management response and actions. Prescription criteria may include the meteorological conditions affecting the area under prescription, as well as factors related to the state of the area to be burned such as the fuel moisture condition and other physical parameters. Other criteria which may be considered include safety, economic, public health, environmental, geographic, administrative, social or legal considerations, and ecological and land use objectives.

Prevention of Significant Deterioration (PSD): A requirement in the CAA, which establishes the maximum allowable increases in ambient air concentrations of selected air pollutants above baseline concentrations in areas designated as Class I, Class II, or Class III.

Project Plan: A strategic plan for accomplishing specific actions and goals (objectives) established in a land use plan. A project may include several activities such as cutting and hauling trees and shrubs, planting trees, building trails, and fire treatment.

Regional Haze: Generally, concentrations of fine particles in the atmosphere extending up to hundreds of miles across a region and promoting noticeably hazy conditions; wide-spread visibility impairment, especially in mandatory Class I Federal areas where visibility is an important value.

Sensitive Receptors: Population centers such as towns and villages, camp grounds and trails, hospitals, nursing homes, schools, roads, airports, mandatory Class I Federal areas, etc. where smoke and air pollutants can adversely affect public health, safety and welfare.

Smoke Management Program (SMP): Establishes a basic framework of procedures and requirements for managing smoke from fires that are managed for resource benefits. The purposes of SMP's are to mitigate the nuisance and public safety hazards (e.g., on roadways and at airports) posed by smoke intrusions into populated areas; to prevent deterioration of air quality and NAAQS violations; and to address visibility impacts in mandatory Class I Federal areas in accordance with the regional haze rules.

State Implementation Plan (SIP): A CAA required document in which States adopt emission reduction measures necessary to attain and maintain NAAQS, and meet other requirements of the Act.

Suppression: A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.

Tribal Implementation Plan (TIP): A document authorized by the CAA in which eligible tribes adopt emission reduction measures necessary to attain and maintain NAAQS, and meet other requirements of the CAA for lands within tribal jurisdictions.

Violation of the PM NAAQS: As revised in 1997, the daily PM_{10} standard is violated when the 99th percentile of the distribution of 24-hour concentrations for a period of 1 year (averaged over 3 calendar years) exceeds 150 $\mu g/m^3$ at any monitor within an area. The annual PM_{10} standard is violated when the arithmetic average of 24-hour concentrations for a period of 1 year (averaged over 3 calendar years) exceeds 50 $\mu g/m^3$ at any monitor within an area.

The new NAAQS levels for $PM_{2.5}$ are set at a daily concentration less than or equal to 65 $\mu g/m^3$, and an annual mean concentration of less than or equal to 15 $\mu g/m^{3.}$ The daily standard is violated when the 98th percentile of the distribution of the 24-hour concentrations for a period of 1 year (averaged over 3 calendar years) exceeds 65 $\mu g/m^3$ at any monitor within an area. The annual standard is violated when the annual arithmetic mean of the 24-hour concentrations from a network of one or more population-oriented monitors (averaged over 3 calendar years) exceeds 15 $\mu g/m^3$. Compliance with the annual $PM_{2.5}$ NAAQS is based on population-oriented monitors because the health information, upon which the standard is based, relates area-wide health statistics to area-wide air quality as measured by one or more monitors.

Volatile Organic Compounds (VOC): Any organic compound which participates in atmospheric photochemical reactions, which are measured by a reference method, an equivalent method, or an alternative method. Some compounds are specifically listed as exempt due to their having negligible photochemical reactivity. [See 40 CFR 51.100.] Photochemical reactions of VOC's with oxides of nitrogen and sulfur can produce O_3 and PM.

Wildfire: An unwanted wildland fire.

Wildland: An area where development is generally limited to roads, railroads, power lines, and widely scattered structures. The land is not cultivated (i.e., the soil is disturbed less frequently than once in 10 years), is not fallow, and is not in the United States Department of Agriculture (USDA) Conservation Reserve Program. The land may be neglected altogether or managed for such purposes as wood or forage production, wildlife, recreation, wetlands or protective plant cover. **[The distinction between wildlands, to which the recommendations in this document apply, and agricultural lands is subject to further discussion.]**

Wildland Fire: Any non-structural fire, other than prescribed fire, that occurs in the wildland. Note: Wildland fires include unwanted (wild) fires and naturally ignited fires that are managed within a prescription to achieve resource benefits.

Wildland Fire Situation Analysis (WFSA): A real time decision-making process carried out by federal land management agencies to select an appropriate management response to wildland fire. The WFSA considers fire fighter and public safety, risk to property and resources, fire fighting resources available, land management objectives and environmental, social economic and political constraints. The environmental and social constraints considered include, among other things, how air quality and/or visibility will be affected at sensitive receptors by each alternative fire management strategy.

Wildland/Urban Interface: The line, area or zone where structures and other human development meets or intermingles with the wildland.

Appendix A-10c. Revised Arizona R18-2-602, "Unlawful Open Burning" and Article 15, "Forest and Range Management Burns"

NOTICE OF FINAL RULEMAKING

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY -

AIR POLLUTION CONTROL

PREAMBLE

1. **Sections Affected** **Rulemaking Action**

Sections Affected	Rulemaking Action
Article 6	
R18-2-602	Amend
Article 15	
R18-2-1501	Amend
R18-2-1502	Amend
R18-2-1503	Amend
R18-2-1504	Amend
R18-2-1505	Amend
R18-2-1506	Amend
R18-2-1507	Amend
R18-2-1508	Amend
R18-2-1509	Amend
R18-2-1510	Renumber
R18-2-1510	New Section
R18-2-1511	Renumber
R18-2-1511	Amend
R18-2-1512	Renumber
R18-2-1512	Amend
R18-2-1513	Renumber
R18-2-1513	Amend
R18-2-1514	Repeal
R18-2-1514	Renumber
R18-2-1514	Amend
R18-2-1515	Amend

2. **The statutory authority for the rulemaking, including both the authorizing statute (general)**

and the statutes the rules are implementing (specific):

Authorizing statute: A.R.S. '' 49-414, 49-414.01 and 49-425

Implementing statutes: A.R.S. ' 49-501

3. The effective date of the rules:

60 days after filing with the Secretary of State.

4. A list of all previous notices appearing in the Register addressing the final rules:

Notice of Rulemaking Docket Opening: 9 A.A.R. 3386, August 1, 2003

Notice of Proposed Rulemaking: 9 A.A.R. 4066, September 19, 2003

5. The name and address of agency personnel with whom persons may communicate regarding the rulemaking:

Name: Kevin Force

Address: Arizona Department of Environmental Quality
1110 W. Washington Ave.
Phoenix, AZ 85007

Telephone: (602) 771-4480 (This number may be reached in-state by dialing 1-800-234-5677 and requesting the seven digit number.)

Fax: (602) 771-2366

6. An explanation of the rules, including the agency=s reasons for initiating the rules:

Summary. This final rule amends Arizona=s existing open burning and prescribed burning rules to make them conform to EPA requirements for states= Regional Haze State Implementation Plans. In addition, these amendments make other technical changes, including improvements of the rules= clarity, conciseness, and understandability.

Regional Haze SIP Requirements. The revisions to R18-2-602 and Article 15 will allow the state=s Regional Haze SIP that Arizona is required to submit to EPA by December 31, 2003, to meet the approvability test. (40 CFR 51.309(c)) The specific requirements for state regional haze SIPs are found at 40 CFR 51.308 and 51.309.

Under 40 CFR 51.309(d)(6), *Programs Related to Fire*, the plan must provide for:

A(i) Documentation that all Federal, State, and private prescribed fire programs within the State evaluate and address the degree visibility impairment from smoke in their planning and application. In addition the plan must include smoke management programs that include all necessary components including, but not limited to, actions to minimize emissions, evaluation of smoke dispersion, alternatives to fire, public notification, air quality monitoring, surveillance and enforcement, and program evaluation.

(ii) A statewide inventory and emissions tracking system (spatial and temporal) of VOC, NOX, elemental and organic carbon, and fine particle emissions from fire. In reporting and tracking emissions from fire from within the State, States may use information from regional data-gathering and tracking initiatives.

(iii) Identification and removal wherever feasible of any administrative barriers to the use of alternatives to burning in Federal, State, and private prescribed fire programs within the State.

(iv) Enhanced smoke management programs for fire that consider visibility effects, not only health and nuisance objectives, and that are based on the criteria of efficiency, economics, law, emission reduction opportunities, land management objectives, and reduction of visibility impact.

(v) Establishment of annual emission goals for fire, excluding wildfire, that will minimize emission increases from fire to the maximum extent feasible and that are established in cooperation with States, tribes, Federal land management agencies, and private entities.@

In early 2002, ADEQ's Regional Haze stakeholders established a Fire Emissions Work Group (FEWG) to discuss visibility issues related to fire emissions and make recommendations to ADEQ for the Regional Haze SIP. Fifteen stakeholders, representing public and private entities in geographically diverse areas of the state, agreed to participate in the work group.

The FEWG held a series of meetings from June 2002 through May 2003 to learn about and discuss options for all categories of burning activities that occur in the state. The draft rules were presented at public workshops in Casa Grande, Flagstaff, Phoenix, Show Low, and Yuma from April 10-17, 2003. The extensive meeting schedule was proposed by work group members in order to provide local access to the rulemaking process and obtain early input from sectors of the community who would be most affected by these rules. The current final rule is a joint effort of ADEQ and the FEWG based on input received at those public meetings and the decisions of the FEWG.

Structure of open burning authority in Arizona. A.R.S. ' 49-425 provides ADEQ with general air quality rule authority, including authority to promulgate rules for open burning permits. It requires the Director to adopt rules determined necessary and feasible Ato reduce the release into the atmosphere of air contaminants originating within the territorial limits of the state.@ A.R.S. ' 49-501 adds related authority by excepting from its provisions those open outdoor fires that are permitted by any rule issued pursuant to A.R.S. ' 49-425 (see subsections (C)(5)), and in(E), by allowing the director to delegate authority to issue open burn permits to a Acounty, city, town, or fire district.@ A.R.S. ' 49-414.01(A) sets forth regional haze goals and requires the Director to submit a plan to EPA that addresses Aprograms related to emissions from fire sources@ Aas necessary to submit an approvable plan@ and authorizes rules necessary for the revisions to the state implementation that address regional haze.@

R18-2-602 and A.R.S. ' 49-501 govern open burning activities under ADEQ=s jurisdiction. A.R.S. ' 49-501 was last amended in 1997. In 1996, the delegation subsection E was added. In 1994, the general permit for household waste was added. Based on the statute and rule, ADEQ published guidelines on open burning in February, 1997.

Open Burning Revisions

At the public meetings mentioned above, the three frequent topics for comment were: time-of-day burning restrictions in R18-2-602(D)(3), permitting requirements for air curtain destructors, and the relationship of the state rule to counties that have independent authority to permit fires. However, in the public comment period, most commenters mentioned ADEQ=s proposed inclusion of fire training in those permits that would require an open burn permit. ADEQ has returned fire training to those fires that are exempted from an open burning permit. The issue is discussed in more detail in item 11 of this preamble.

Compared to the existing rule, this final rule contains a number of additional definitions in a separate subsection. ADEQ has finalized definitions for various categories of open burning, such as agricultural, construction, and residential. In addition, there are new definitions for Adelegated authority@, Aindependent authority to permit fires@, and Aprohibited materials@. Prohibited materials were previously described in the February 97 guidelines. By placing all of the necessary material from the guidelines in the final rule, ADEQ intends that this amended R18-2-602 will replace the guidelines as of the effective date of the rule.

The final rule also clarifies which open burning activities require open burning permits and those that are exempt from a permit. The final rule contains a more complete list of information that is required to be in the permit. This is both for more efficient permit administration, and to comply with various aspects of the regional haze rule.

ADEQ considered exempting certain fires using air curtain destructors from the open burn permit requirement in order to remove an administrative barrier to this type of burning. The Regional Haze Rule requires that administrative barriers to the use of alternatives to burning be removed wherever feasible. (See 40 CFR 51.309(d)(6)(iii)) ADEQ considered a barrier to a burning method with arguably lower emissions in the same way. Air curtain destructors (ACDs) are basically incinerators with high velocity air blown across and into the upper portion of the combustion chamber. This curtain of air traps particulates (smoke) and oxygenates the chamber, resulting in better combustion and less smoke. After reviewing two studies and considering the comments, ADEQ has remained with its conclusion that these devices do require oversight and it is appropriate that they be subject to permits under the rule. ADEQ does not view the requirement that ACDs obtain an open burning permit as much of an administrative barrier. ADEQ also notes that certain air curtain destructors are subject to New Source Performance Standards (see 40 CFR 60, subparts CCCC and DDDD). The issue is discussed in more detail in item 11 of this preamble. Studies reviewed by ADEQ relevant to air curtain destructors are listed in item 7 of this preamble.

ADEQ has added language in the final rule clarifying that the state rule will not operate in counties with independent authority to permit fires, and has listed the three counties in the definition. This independent authority is derived in part from language in A.R.S. ' 49-501(C)(5) specifying that fires permitted pursuant to county rules are excepted from A.R.S. ' 49-501. The three counties referenced in the definition all have rules creating permits for open outdoor fires, other than dangerous materials. (see Maricopa County Rule 341; Pima County Rule 17.12.480, et seq.; Pinal County Rule 3-8-700 and 3-8-710.) Pursuant to A.R.S. ' 49-501(G) and the current Phoenix area PM_{10} SIP, the Maricopa County rule prohibits burning of household waste.

The final rule also clarifies provisions on burning of dangerous materials and household waste. Finally, new restrictions on permits issued by delegated authorities that minimize the potential for conflict of interest on the part of delegated authorities have been included in subsection (G). First, the final rule specifies that a delegated authority may not issue itself open burning permits. Second, the rule prohibits private fire protection providers from conditioning the issuance of open burning permits on the applicant being their customer.

Final Prescribed Burning Revisions

State and federal forest and range land make up more than half of the land in Arizona. Despite potential air quality concerns, state and federal land managers (F/SLMs) use fire as a resource management tool on this land for a variety of purposes. Article 15 governs those fires that are set or allowed to burn on these lands in Arizona from a general air quality perspective. The two primary air quality concerns are violations of national ambient air quality standards (NAAQS) for particulates, and visibility impairment. Research indicates that, on average, 90 percent of smoke particles from wildland and prescribed fires are PM_{10}, and 10 percent are $PM_{2.5}$. Arizona=s Prescribed Burning requirements in Article 15 address these air quality concerns, primarily through efforts to ensure the best times for >burns= and by promoting other techniques to reduce the amount of smoke produced and the effects of that smoke.

A.R.S. ' 49-414.01 specifically requires the Director to submit a plan to EPA, and allows ADEQ to promulgate rules addressing programs related to emissions from wildland fire, including prescribed fires and wildfires (see A.R.S. ' 49-414.01(A)(7)). The final revisions to Article 15 of the Code, which govern the procedures relating to prescribed and wildland fires, will better conform to EPA=s regional haze requirements, be more understandable, and facilitate enhanced compliance. Most of the final changes to Article 15 directly reflect the mandates of the EPA=s regional haze rule requirements, particularly those relating to the collection and recording of burn data, the evaluation of burn programs and setting of annual emission goals. The former structure of the rule remains intact: 1) Annual registration; 2) submittal of a Burn Plan at least 14 days before the burn; 3) a daily Burn Request; and 4) a Burn Accomplishment Form.

<u>Section by Section Explanation of significant final changes.</u>

Article 6

R18-2-602	This rule describes the process by which permits may be issued for open burns, and identifies open burning activities that are exempt from the permit requirement.

Article 15

R18-2-1501	This section lists the definitions applicable to Article 15. In response to the EPA regulation, there are new definitions for AAnnual Emissions Goal,@ and Anon-burning alternatives to fire.@ In addition, ABest Management Practices@ has been replaced by ASmoke management techniques@ and AEmission reduction techniques,@ and APrescribed natural fire@ has been replaced by AWildland fire use.@
R18-2-1502	This section limits the applicability of the rule to state and federal land

	mangers, while excluding Indian Trust lands. The final change clarifies that private burners, such as the Nature Conservancy, may also be subject to the Article.
R18-2-1503	This section describes the process by which land managers annually register their planned burns with ADEQ. The final changes incorporate emission reduction techniques and non-burning alternatives to fire and facilitate the setting of annual emission goals. A new annual period and other clarifying changes have been included.
R18-2-1504	This section requires the details of each burn to be included in the Burn Plan form to be submitted to ADEQ 14 days before requesting permission to ignite. The final changes clarify the process and supplement the information related to it.
R18-2-1505	This section requires land mangers to submit a daily burn request for each day of the burn and describes optional agency response to the request. The final changes are primarily clarifying.
R18-2-1506	This section describes how the agency will determine whether and how much burning to allow. The final changes also add clarifying factors not directly related to regional haze.
R18-2-1507	This section requires land managers to report acreage and fuel types burned, the emission reduction and smoke management techniques used, and requires ADEQ to keep records of this information. A subsection has been added for wildfire reporting to allow those fires= emissions to be entered into the regional haze emission tracking system.
R18-2-1508	This section describes how land managers shall inform the agency of wildfires and seek permission for wildland burn uses. Clarifications have been included based on recent experiences with wildfires.
R18-2-1509	This section replaces the former BMP section and describes Emission Reduction Techniques, many of which were listed previously as BMPs. It requires land mangers to use as many as feasible.
R18-2-1510	This section also replaces the former BMP section and describes Smoke Management Techniques, some of which were listed previously as BMPs. It requires land managers to use as many as feasible.
R18-2-1511	This section describes how the agency may require land managers to

	monitor aspects of their prescribed burns and wildland burn uses. The final changes are clarifications and minor changes to weather and air quality monitoring.
R18-2-1512	This section requires all burn projects to be conducted by personnel trained in prescribed fire and smoke management techniques. The final changes are clarifications.
R18-2-1513	This section directs the agency to conduct burn-related public awareness programs and make burn information available to the public. The final changes attempt to promote regional coordination.
R18-2-1514	This section describes how the agency may inspect, verify, and audit burn information, and actions the agency may take regarding enforcement.
R18-2-1514(former)	In a recent 5-year-review report, ADEQ stated that it would reevaluate the need for this section. ADEQ is deleting subsection (B) because the changes in R18-2-1503 provide for a more efficient and effective system. Subsection (A) has been moved to R18-2-1511(B).
R18-2-1515	This section directs the agency to make its forms and data relating to prescribed burns and wildland burn uses available in an electronic format. The final changes are clarifying only.

7. **A reference to any study relevant to the rules that the agency reviewed and either relied on in its evaluation of or justification for the rules or did not rely on in its evaluation of or justification for the rules, where the public may obtain or review each study, all data underlying each study, and any analysis of each study and other supporting material:**

The Use of Air Curtain Destructors for Fuel Reduction, Alan R. Shapiro, United States Department of Agriculture, Forest Service Technology and Development Program (September 2002).

Reducing PM2.5 Emissions Through Technology, Evaluations of the Effectiveness of an Air Curtain Incinerator, Ronald A. Scott, Ronald Babbitt, Emily Lincoln, and Wei Min Hao, USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula MT (October 2002) Studies available for review at the ADEQ Library, First Floor, 1110 W. Washington St., Phoenix, AZ 85007.

8. **A showing of good cause why the rules are necessary to promote a statewide interest if the rules**

will diminish a previous grant of authority of a political subdivision of this state:

Not Applicable

9. The summary of the economic, small business, and consumer impact:

A. Rule Identification

The sixteen rules amended in this rulemaking are R18-2-602, AUnlawful Open Burning,@ and Article 15, AForest and Range Management Burns,@ R18-2-1501 through R18-2-1515.

B. Entities Affected by R18-2-602, AUnlawful Open Burning@

Open burning may be done by many entities for a variety of purposes, such as waste disposal, weed control, site preparation, disease and pest prevention, resource management, and training and fire prevention. Unless specifically exempted by this rule, persons setting outdoor fires would have to obtain a permit from ADEQ or a delegated authority, a city or fire district, or one of the three counties with independent authority to issue permits (Maricopa, Pima, Pinal). Persons who might be subject to this final rule therefore include: (1) individuals; (2) businesses, such as farms, ranches, orchards, electric generating plants, construction and mines; (3) federal sources, such as military installations; (4) state agencies, such as the Departments of Transportation and Corrections; and, (5) political subdivisions, such as counties, cities, irrigation districts, and fire districts.

ADEQ has delegated authority to issue permits to about 50 fire departments, fire districts and cities or towns located in 9 of Arizona=s 15 counties. Authority to issue permits in Graham County is delegated to Graham County Health Department, while Maricopa, Pima and Pinal Counties have independent authority to permit fires. ADEQ has jurisdiction to issue permits in areas outside the delegated authorities= jurisdiction in these counties. ADEQ typically issues more than 100 open burning permits annually to a wide variety of permittees, most of which are for burns in Gila and Cochise Counties. Permits for burns in LaPaz, Yavapai, Santa Cruz, Apache, Greenlee and Coconino Counties are also common.

The following represents a sampling of the level of permits issued by delegated authorities based on the calendar year 2002. The City of Prescott in Yavapai County issued about 200 permits in 2002, of which the majority was for residential burning. The City of Yuma issued 15 open burning permits, mainly for agriculture. Rural Metro Fire Department, which has jurisdiction outside of the municipalities of Somerton and Yuma, typically issues 300-400 residential open burning permits and 50-60 permits for agriculture in Yuma County. The City of Payson in Gila County issued 146 open burning permits for brush and weeds. Bullhead City in Mohave County annually issues 50-70 open burning permits of which the majority is for residential burning. The 384 open burning permits issued by Graham County Health Department in fiscal year 2003 were all for purposes of weed abatement.

C. Potential Impact of R18-2-602

This rulemaking only makes minor changes and incorporates current practice, therefore ADEQ expects the rule to create minimal actual impact, such as the costs associated with minor changes in record-keeping, documentation, and reporting requirements. ADEQ and delegated authorities will have to maintain copies of effective permits, as well as prepare annual reports for submission to ADEQ. While some of these changes will generate minimal costs, ADEQ expects the overall benefits to exceed those costs. It should also be noted that ADEQ does not charge fees for open burning permits because most permits are issued in a day or two and it would require minimal administrative effort.

D. Entities Affected by Article 15, AForest and Range Management Burns@

Since ADEQ has jurisdiction, outside tribal lands, over air pollution resulting from prescribed burning, this rule will impact the following federal and state agencies that do burning: (1) Federal Land Managers (FLMs) involved in burning activities, such as U.S. Forest Service, U.S. Fish and Wildlife Service, National Parks Service, Bureau of Land Management, Bureau of Reclamation, Department of Defense; (2) State Land Managers (SLMs), such as Arizona State Land Department, Arizona Department of Transportation, Arizona Department of Game and Fish, and Parks Department. Additionally, there are entities not actually subject to this rule but who may voluntary comply with some or all of the rule provisions, such as the Bureau of Indian Affairs, one of the largest burners in Arizona. Also, private land managers, such as The Nature Conservancy, or individuals, might also need to comply with this rule or request assistance from one of the F/SLMs.
Each year, ADEQ receives more than 1,000 daily burn requests from F/SLMs. For example, in calendar year 2002, about 1,400 requests to burn were received, and slightly more than 104,000 acres were burned, which represents about 56 percent of the total acres approved to burn. This figure is approximately equal to the the number of acres burned each year for the past ten years (106,429) on federal, state, and tribal lands. The major fuel types burned in 2002 and their relative proportions include: piled ponderosa pine (22%), non-piled ponderosa pine (21%), and natural ponderosa pine (17%). The remaining 40% of fuel types include: natural

shrub, non-piled grass and ponderosa pine, natural grass, natural grass and ponderosa pine, non-piled mixed, and other.

For comparison, in 1999, F/SLMs requested nearly 450,000 acres to burn. Although ADEQ approved close to 80 percent of the requested acreage, the actual number of acres burned was about 200,000. The fuel types burned in 1999 were: broadcast slash (32%), ponderosa pine (22%), grass (20%), slash piles (14%), brush (10%), and pinyon juniper (2%). As shown with these two years, proportions, however, vary from one year to another.

Combining acres burned for 1994 through 1999, shows the percentage of acres burned by F/SLMs agencies: U.S. Forest Service (49%), Bureau of Indian Affairs (30%), National Park Service (7%), Bureau of Land Management (7%), U.S. Fish and Wildlife (6%), Arizona State Land Department (1%), and other (1%).

E. Potential Impact of Article 15

Because this rule involves forest and range management burning by federal and state land managers, private persons, political subdivisions of the state, and small businesses will not bear any direct incremental costs from the final rule changes. However, because the rule requires both better tracking of emissions, better management of smoke, and public education and notification, benefits are expected to accrue to the public, particularly to populations living close to the burns. Specifically, there is potential for incremental benefits arising from better planning and implementation of measures which increase burn efficiency, prevent wildfires, improve visibility, and reduce smoke impacts to both the general public and more sensitive segments of the population.

F/SLMs currently pay for two full-time positions to work with ADEQ at an estimated annual value of $120,000 at ADEQ. Office space and equipment are provided by ADEQ. ADEQ currently supports one full-time position for the smoke management program. Although implementing this amended rule may require minimally increased planning and evaluation time, ADEQ does not expect to need additional employees to handle the workload. This increased workload, together with administrative costs associated with making burn information publicly available and conducting public awareness programs, are all that comprise the incremental impact to ADEQ. Thus, ADEQ judges that the costs to the agency are minimal.

The incremental impact of the changes to Article 15 is based on the rule=s new requirements, and are expected to result in minimal economic impact to F/SLMs and ADEQ. For example, F/SLMs will have to provide more information about their prescribed burns, including emission reduction techniques and non-burning alternatives. They will also be encouraged to attend annual meetings for program evaluation and the establishment of annual emissions goals, and will be looked to for the development of long-term projections of future prescribed fire and wildland fire use activities. The information provided by F/SLMS will be used by ADEQ to assess visibility impairment and other air quality concerns. Additional compliance costs include those associated with the incorporation of additional emission reduction and smoke management techniques.

Together, these rule changes are expected to improve the state=s smoke management program, which could lead to improvements in air quality through reduction and better management of burns. Evidence shows that exposure to criteria pollutants, either to individual pollutants such as particulate matter (PM), or collectively to a variety of pollutants, is associated with increased mortality. The positive correlation is most closely related to ambient air concentrations of PM. Human health effects of PM, for example, include premature mortality, bronchitis, new asthma cases and exacerbated asthma in existing individuals, increased hospital admissions, lower and upper respiratory illness, shortness of breath, respiratory symptoms, restricted activity days, and lost days of work. Other health effects ascribed to exposure to PM include changes in pulmonary function, chronic respiratory diseases (other than chronic bronchitis), morphological changes, neonatal mortality, cancer, altered host defense mechanisms, and non-asthma respiratory emergency room visits. Estimated economic values have been assigned to death and other adverse health effects. For example, a statistical death has been estimated to cost $6.3 million (in year 2000 dollars), chronic bronchitis due to PM costs $260,000 per patient, mortality life years lost is valued at $293,000 per each life year, and work days lost due to PM is worth about $83 per day. (EPA, *The Benefits and Costs of the Clean Air Act 1990-2010*, Office of Air and Radiation, Office of Policy, November 1999, Table 5-1.)

F. Reduction of Impacts to Small Businesses for R18-2-602 and Article 15

These rules create minimal increased compliance costs for ADEQ to administer the open burning and prescribed forestry burning programs. ADEQ considered each of the methods prescribed in A.R.S. ' 41-1035 for reducing the impact on small businesses. Likewise, it considered each of the methods prescribed in A.R.S. ' 41-1055(B)(5)(c). For example, A.R.S. ' 41-1035 requires agencies implementing rules to reduce the impacts on small businesses by using certain methods where legal and feasible. Methods that may be used include the following: (1) exempt them from any or all rule requirements, (2) establish performance standards which could replace more costly design or operational requirements, or (3) institute reduced compliance or reporting requirements.

ADEQ cannot provide additional regulatory relief for small businesses applying for open burning permits. As the agency does not charge fees for open burning permits, ADEQ expects that R18-2-602's reporting requirement (on forms developed by ADEQ) will create minimal economic impacts to individual persons or small businesses. The rule procedures have been kept as simple and straightforward as possible. Article 15 does not directly impact small businesses as it applies primarily to public entities.

10. A description of the changes between the proposed rules, including supplemental notices, and final rules (if applicable):

In response to comments, and to improve clarity, conciseness, and understandability, ADEQ has made the following changes to the proposed rule:

ARTICLE 6. EMISSIONS FROM EXISTING AND NEW NONPOINT SOURCES

R18-2-602. Unlawful Open Burning

A. In addition to the definitions contained in A.R.S. ' 49-501, in this Section:

1. AAgricultural ~~Burning~~ burning@ means burning ~~of~~ vegetative materials related to ~~the production~~ producing and harvesting ~~of~~ crops and raising ~~of~~ animals for the purpose of marketing for profit, or providing a livelihood, but does not ~~including~~ include the burning of household waste or prohibited materials. ~~Burning may be conducted~~ A person may conduct agricultural burns in fields, piles, ditch banks, fence rows~~,~~ or canal laterals for purposes such as weed control, waste disposal, disease and pest prevention, or site preparation.
2. AApproved waste burner@ means an incinerator constructed of fire resistant material with a cover or screen ~~which~~ that is closed when in use ~~having~~ and has openings in the sides or top no greater than one inch in diameter.
3. AClass I Area@ means any one of the Arizona mandatory federal class I areas defined in A.R.S. ' 49-401.01.
4. AConstruction burning@ means burning ~~of~~ wood or vegetative material from land clearing, site preparation, or fabrication, erection, installation, demolition, or modification of any buildings or other land improvements, but does not ~~including~~ include ~~the~~ burning ~~of~~ household waste or prohibited ~~materials~~ material.
5. ADangerous material@ ~~is~~ means any substance or combination of substances that is capable

of causing bodily harm or property loss unless neutralized, consumed, or otherwise disposed of in a controlled and safe manner.

6. ADelegated authority@ means any of the following:
   a. A county, city, town, air pollution control district, or fire district that has been delegated authority to issue open burning permits by the Director under A.R.S. ' 49-501(E); or
   b. A private fire protection service provider that has been assigned authority to issue open burning permits by one of the authorities in subsection (a).
7. ADirector@ means the Director of the Department of Environmental Quality, or ~~his~~ designee.
8. AEmission reduction techniques@ ~~are~~ means ~~techniques~~ methods for controlling emissions from open outdoor fires to minimize the amount of emissions output per unit ~~or~~ of area burned.
9. AFlue,@ as used in this ~~subsection~~ Section, means any duct or passage for air or combustion gases, such as a stack or chimney.
10. AHousehold waste@means any solid waste including garbage, rubbish, and sanitary waste from a septic ~~tanks~~ tank that is generated from households including single and multiple family residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds and day-use recreation areas, but does not ~~including~~ include construction debris, landscaping rubble, or demolition debris.
11. AIndependent authority to permit fires@ means the authority of a county to permit fires by a rule adopted ~~pursuant to~~ under Arizona Revised Statutes, Title 49, Chapter 3, Article 3, and includes only Maricopa, Pima, and Pinal counties. ~~have independent authority to permit fires.~~
12. AOpen outdoor fire or open burning@ means the combustion of material of any type outdoors~~,~~ and in the open, where the products of combustion are not directed through a flue. Open outdoor fires include agricultural, residential, prescribed, and construction burning, and fires using air curtain destructors. ~~Purposes for fires can include prevention of a fire hazard, instruction in the methods of fighting fires, watershed rehabilitation, disease and pest prevention.~~
13. AProhibited materials@ means nonpaper garbage from the processing, storage, service, or consumption of food; chemically treated wood; lead-painted wood; linoleum flooring, or composite counter-tops; tires; explosives or ammunition; oleanders; asphalt shingles; tar

paper; plastic and rubber products, including bottles for household chemicals; plastic grocery and retail bags; waste petroleum products, such as waste crankcase oil, transmission oil, and oil filters; transformer oils; asbestos; batteries; anti-freeze; aerosol spray cans; electrical wire insulation; thermal insulation; polyester products; hazardous waste products such as paints, pesticides, cleaners and solvents, stains and varnishes, and other flammable liquids; plastic pesticide bags and containers; and hazardous material containers including those that contained lead, cadmium, mercury, or arsenic compounds.

14. AResidential burning@ means open burning of vegetative materials conducted by or for the occupants of residential dwellings, but does not ~~including~~ include burning ~~of~~ household waste or prohibited ~~materials~~ material.

15. APrescribed burning@ has the same meaning as in R18-2-1501.

B. Unlawful open burning. Notwithstanding any other rule in this Chapter, ~~it is unlawful for any~~ a person ~~to~~ shall not ignite, cause to be ignited, permit to be ignited, ~~or suffer,~~ allow, or maintain any open outdoor fire in a county without independent authority to permit fires except as provided in A.R.S. ' 49-501 and this Section.

C. Open outdoor fires exempt from a permit. The following fires do not require an open burning permit from the Director or a delegated authority:

1. Fires used only for:

   a. Cooking of food~~;~~,

   b. Providing warmth for human beings~~;~~,

   c. Recreational purposes~~;~~,

   d. Branding of animals~~;~~,

   e. Orchard heaters for the purpose of frost protection in farming or nursery operations~~;~~, and

   f. The proper disposal of flags under 4 U.S.C. ' 8.

2. Any fire set or permitted by any public officer in the performance of official duty, if ~~such~~ the fire is set or permission given for the following purpose ~~of~~:

   a. ~~Fire~~ Control of an active wildfire; or

   b. Instruction in the method of fighting fires, except that the person setting these fires must comply with the reporting requirements of subsection (D)(3)(f).

3. ~~Fires~~ Fire set by or permitted by the Director of Department of Agriculture for the purpose of disease and pest prevention in an organized, area-wide control of an epidemic~~s~~ or

~~infestations~~ infestation affecting livestock or crops.

4. Prescribed burns set by or assisted by the federal government or any of its departments, agencies or agents, or the state or any of its agencies, departments, or political subdivisions, ~~pursuant to~~ regulated under Article 15 of this Chapter.

D. Open outdoor fires requiring a permit.

1. The following open outdoor fires are allowed with an open burning permit from the Director or a delegated authority:
   a. Construction burning;
   b. Agricultural burning;
   c. Residential burning;
   d. Prescribed burns conducted on private lands without the assistance of a federal or state land manager as defined under R18-2-1501;
   e. Any fire set or permitted by a public officer in the performance of official duty, if ~~such~~ the fire is set or permission given for the purpose of weed abatement, the prevention of a fire hazard, ~~or instruction in the methods of fighting fires,~~ unless ~~such~~ the fire is exempt from the permit requirement under subsection (C)(3);
   f. Open outdoor fires of dangerous material under subsection (E); ~~and~~
   g. Open outdoor fires of household waste under subsection (F)~~.~~; and
   h. Open outdoor fires that use an air curtain destructor, as defined in R18-2-101.
2. A person conducting an open outdoor fire in a county without independent authority to permit fires shall obtain a permit from the Director or a delegated authority unless exempted under subsection (C). Permits may be issued for a period not to exceed one year. A person shall obtain a permit by completing an ADEQ-approved application form.
3. Open outdoor fire permits issued under this Section shall include:
   a. A list of the materials that the permittee may ~~be burned~~ burn under the permit;
   b. A means of contacting the ~~person~~ permittee authorized by the permit to set an open fire in the event that an order to extinguish the open outdoor fire is issued by the Director or the delegated authority;
   c. A requirement that burns be conducted during the following periods, unless otherwise waived or directed by the Director on a specific day basis:
      i. Year round: ~~start ignition~~ ignite fire no earlier than ~~1~~one hour after sunrise; and
      ii. Year round: extinguish fire ~~must be extinguished~~ no later than ~~2~~two hours

before sunset.

d. A requirement that the permittee conduct all open burning ~~shall be conducted~~ only during atmospheric conditions ~~which~~ that:

   i. Prevent dispersion of smoke into populated areas;

   ii. Prevent visibility impairment on traveled roads or at airports that result~~s~~ in a safety hazard;

   iii. Do not create a public nuisance or adversely affect public safety;

   iv. Do not cause an adverse impact to visibility in a Class I area; and

   v. Do not cause uncontrollable spreading of the fire;

e. A ~~listing~~ list of the ~~types of actions~~ emission reduction techniques that the permittee shall ~~be~~ ~~utilized~~ use to minimize fire emissions; ~~including any emission reduction techniques;~~

f. A reporting requirement that the permittee shall ~~be met~~ meet by providing the following information in a format provided by the Director for each date open burning occurred, on either a daily basis on the day of the fire, or ~~in~~ an annual basis in a report to the Director or delegated authority due on March 31 for the previous calendar year:

   i. The date of the burn;

   ii. The type and quantity of fuel burned for each date open burning occurred;

   iii. The fire type, such as pile or ~~windrow~~ pit, for each date open burning occurred; and

   iv. For each date open burning occurred, the legal location, to the nearest section, or latitude and longitude, to the nearest degree minute, or street address for residential burns.

g. A requirement that the person conducting the open burn notify the local fire-fighting agency~~,~~ or private fire protection service provider, if the service provider is a delegated authority, before burning. ~~or~~ If ~~none~~ neither is in existence, the person conducting the burn shall notify the state forester.~~, prior to commencement of open burning~~;

h. A requirement that the permittee start each open outdoor fire ~~be started~~ using items that do not cause the production of black smoke;

i. A requirement that the permittee attend the fire ~~shall be attended~~ at all times until it is completely extinguished;

j. A requirement that the permittee provide fire extinguishing equipment ~~must be~~ on-site for the duration of the burn;

k. A requirement that the permittee ensure that a burning pit, burning pile, or approved waste burner be at least 50 feet from any structure;

l. A requirement that the ~~burner must~~ permittee have a copy of the burn permit on-site during open burning;

m. A requirement that the permittee not conduct ~~no~~ open burning ~~shall be conducted~~ when an air stagnation advisory, as issued by the National Weather Service, is in effect in the area of the burn or during periods when smoke can be expected to accumulate to the extent that it will significantly impair visibility in Class I areas;

n. A requirement that the permittee not conduct ~~no~~ open burning ~~shall be conducted~~ when any stage air pollution episode is declared under R18-2-220.

o. A statement that the Director, or any other public officer may order that the burn be extinguished or prohibit burning during periods of inadequate smoke dispersion, excessive visibility impairment, or ~~during periods of~~ extreme fire danger; and

p. A ~~copy~~ list of the activities prohibited and the criminal penalties provided under A.R.S. ' 13-1706.

4. The Director or a delegated authority shall not issue an open burning permit under this Section:

a. That would allow ~~the~~ burning ~~of~~ prohibited materials other than under a permit for the burning of dangerous materials;

b. If the applicant has applied for a permit under this Section to burn a dangerous ~~materials~~ material which ~~are~~ is also hazardous waste under 40 CFR 261, but does not have a permit ~~for the burning~~ to burn ~~of~~ hazardous waste under 40 CFR 264, or is not an interim status facility allowed to burn hazardous waste under 40 CFR 265; or

c. If the burning would occur at a solid waste facility in violation of 40 CFR 258.24 and the Director has not issued a variance ~~approval~~ under A.R.S. ' 49-763.01~~(A)~~.

E. Open outdoor fires of dangerous material. A ~~fires~~ fire set for the disposal of a dangerous ~~materials~~ material ~~are~~ is allowed by the provisions of this Section, when the ~~materials~~ material are is too dangerous to store and transport, ~~as permitted in writing by~~ and the Director has issued a permit for the fire. A ~~permits~~ permit issued under this subsection shall contain all provisions in subsection (D)(3) except for subsections (D)(3)(e) and (D)(3)(f). The Director shall permit fires ~~set for~~ the disposal of dangerous materials ~~shall be permitted~~ only when ~~there is~~ no safe alternative method of disposal exists, and ~~when the~~ burning ~~of such~~ the materials does not result in the emission of hazardous or toxic substances either directly or as a product of combustion in amounts that will endanger health or safety.

F. Open outdoor fires of household waste. An open outdoor ~~fires~~ fire for the disposal of household waste ~~are~~ is allowed by provisions of this Section when permitted in writing by the Director or a delegated authority. ~~Permits~~ A permit issued under this subsection shall contain all provisions in subsection (D)(3) except for subsections (D)(3)(e) and (D)(3)(f). The applicant shall conduct open outdoor fires of household waste ~~shall be burned~~ in an approved waste burner and shall either:

1. Burn household waste generated on-site on farms or ranches of 40 acres or more where no household waste collection or disposal service is available; or
2. Burn household waste generated on-site where no household waste collection and disposal service is available and where the nearest other dwelling unit is at least 500 feet away.

G. Permits issued by a delegated authority. The Director may delegate authority for the issuance of open burning permits to a county, city, town, air pollution control district, or fire district. A delegated authority may not issue a permit for its own open burning activity. ~~Authority~~ The Director shall not delegate authority for issuance of permits to burn dangerous material under subsection (E). ~~shall be retained by the Director and not delegated.~~ A county, city, town, air pollution control district, or fire district with delegated authority from the Director may assign that authority to one or more private fire protection service providers that perform fire protection services within the county, city, town, air pollution control district, or fire district. A private fire protection provider shall not directly or indirectly condition the issuance of open burning permits on the applicant being a customer. Permits issued under this subsection shall comply with the requirements in subsection (D)(3) and be in a format prescribed by the Director. Each delegated authority shall:

1. Maintain a copy of each permit issued for the previous five years available for inspection by the Director;
2. For each permit currently issued, have a means of contacting the person authorized by the permit to set an open fire ~~in the event that~~ if an order ~~for extinguishing of~~ to extinguish open burning is issued; and
3. Annually submit to the Director by May 15 a record of daily burn activity, excluding household waste burn permits, on a form provided by the Director for the previous calendar year containing the information required in subsections (D)(3)(e) and (D)(3)(f).

H. The Director shall hold an annual public meeting for interested parties to review operations of the open outdoor fire program and discuss emission reduction techniques.

I. Nothing in this Section is intended to permit any practice ~~which~~ that is a violation of any statute, ordinance, rule, or regulation.

ARTICLE 15. FOREST AND RANGE MANAGEMENT BURNS

R18-2-1501. Definitions

In addition to the definitions contained in A.R.S. ' 49-501 and R18-2-101, in this Article:

1. AActivity fuels@ means those fuels created by human activities such as thinning or logging.

~~1.~~2. "ADEQ" means the Department of Environmental Quality.

~~2.~~3. AAnnual emissions goal@ means the annual establishment in cooperation with the F/SLM=s, under R18-2-1503(G), of a planned quantifiable value of emissions reduction from prescribed fires and fuels management activities.

~~3.~~4. ABurn plan@ means the ADEQ form that includes information on the conditions under which ~~the~~ a burn will occur with details of the burn and smoke management prescriptions.

~~4.~~5. "Burn prescription" means, with regard to a burn project, the pre-determined area, fuel, and weather conditions required to attain planned resource management objectives.

~~5.~~6. "Burn project" means an active or planned prescribed burn, including a wildland fire use incident.

~~6.~~7. "Duff" means forest floor material consisting of decomposing needles and other natural materials.

~~7.~~8. AEmission reduction techniques (ERT)@ means ~~techniques~~ methods for controlling emissions from prescribed fires to minimize the amount of emission output per unit of area burned.

~~8.~~9. AFederal land manager (FLM)@ means any department, agency, or agent of the federal government, including the following:

    a. United States Forest Service,
    b. United States Fish and Wildlife Service,
    c. National Park Service,
    d. Bureau of Land Management,
    e. Bureau of Reclamation,
    f. Department of Defense,
    g. Bureau of Indian Affairs, and
    h. Natural Resources Conservation Service.

~~9.~~10. "F/SLM" means a federal land manager or a state land manager.

~~10.~~11. "Local fire management officer" means a person designated by a F/SLM as responsible for fire management in a local district or area.

~~11.~~12. "Mop-up" means the act of extinguishing or removing burning material from a prescribed fire to reduce smoke impacts.

~~12.~~13. "National Wildfire Coordinating Group" means the national inter-agency group of federal and state land managers that shares similar wildfire suppression programs and ~~that~~ has established standardized inter-agency training courses and qualifications for fire management positions.

~~13.~~14. ANon-burning alternatives to fire@ ~~are~~ means techniques that replace fire for at least five years as a means to treat activity fuels created to achieve a particular land management objective (e.g., reduction of fuel-loading, manipulation of fuels, enhancement of wildlife habitat, and ecosystem restoration~~, etc.~~). These alternatives are not used in conjunction with fire. Techniques used in conjunction with fire are referred to as emission reduction techniques (ERTs).

~~14.~~15. "Planned resource management objectives" means public interest goals in support of land management agency objectives including silviculture, wildlife habitat management, grazing enhancement, fire hazard reduction, wilderness management, cultural scene maintenance, weed abatement, watershed rehabilitation, vegetative manipulation, and disease and pest prevention.

~~15.~~16. "Prescribed burning" means the controlled application of fire to wildland fuels that are in either a natural or modified state, under certain burn ~~prescription conditions~~ and smoke management prescription conditions that have been specified by the land manager in charge of or assisting the burn, to attain planned resource management objectives. Prescribed burning does not include a fire set or permitted by a public officer to provide instruction in fire fighting methods, or construction or residential burning under R18-2-602.

~~16.~~17. "Prescribed fire manager" means a person designated by a F/SLM as responsible for prescribed burning for that land manager.

~~17.~~18. "Smoke management prescription" means the predetermined meteorological conditions that affect smoke transport and dispersion under which a burn could occur without adversely affecting public health and welfare.

~~18.~~19. ASmoke management techniques@ (SMT) means management and dispersion practices used during a prescribed burn or wildland fire use incident which affect the direction, duration, height, or density of smoke.

~~19.~~20. "Smoke management unit" means any of the geographic areas defined by ADEQ whose area is based on primary watershed boundaries and whose ~~outlines are~~ outline is determined by diurnal windflow patterns that allow smoke to follow predictable drainage patterns. A map of the state divided into the smoke management units is on file with ADEQ.

~~20.~~21. "State land manager (SLM)" means any department, agency, or political subdivision of the state government including the following:

a. State Land Department,

b. Department of Transportation,

c. Department of Game and Fish, and

d. Parks Department.

~~21.~~22. "Wildfire" means an unplanned wildland fire subject to appropriate control measures. Wildfires include those incidents where suppression may be limited for safety, economic, or resource ~~limitations~~ concerns.

~~22.~~23. AWildland fire use@ means a wildland fire that is ignited by natural causes, such as lightning, ~~that~~ and is ~~subsequently~~ managed using the same controls and for the same planned resource management objectives as prescribed burning.

R18-2-1502. Applicability

A. A F/SLM that is conducting or assisting a prescribed burn shall follow the requirements of this Article.

B. A private or municipal burner with whom ADEQ has entered into a memorandum of agreement shall follow the requirements of this Article.

C. The provisions of this Article apply to all areas of the state except Indian Trust lands. All federally-managed lands and all state lands, parks, and forests are under the jurisdiction of ADEQ in matters relating to air pollution from prescribed burning.

D. Notwithstanding subsection ~~(B)~~ (C), ADEQ and any Indian tribe may enter into a memorandum of agreement to implement this Article.

E. ADEQ and any private or municipal prescribed burner may enter into a memorandum of agreement to implement this Article.

R18-2-1503. Annual Registration, Program Evaluation and Planning

A. Each F/SLM shall register annually with ADEQ on a form prescribed by ADEQ, all planned burn projects, including areas planned for wildland fire use.

B. Each planned year extends from January 1 of the registration year to December 31 of the same year. Each F/SLM shall use best efforts to register before December 31 and no later than January 31 of each year.

C. A F/SLM shall include the following information on the registration form:

1. The F/SLM's name, address, and business telephone number;
2. The name, address, and business telephone number of an air quality representative who will provide technical support to ADEQ for decisions regarding prescribed burning. The same air quality representative may be selected by more than one F/SLM;
3. All prescribed burn projects and potential wildland fire use areas planned for the next year;
4. ~~By prescribed burn project,~~ Maximum project and annual acres to be burned, maximum daily acres to be burned, fuel types within project area, and planned use of emission reduction techniques to support the annual emissions goal for each prescribed burn project;
5. ~~By prescribed burn project,~~ Planned use of any smoke management techniques for each prescribed burn project;
6. ~~By area planned for wildland fire use,~~ Maximum project and annual acres projected to be burned, maximum daily acres projected to be burned, and a map of the anticipated project area, fuel types and loading within the planned area for an area the F/SLM anticipates for wildland fire use;
7. A list of all burn projects that were completed during the previous year;
8. ~~By area to be treated using non-burning alternatives to fire,~~ Project area for treatment, treatment type, fuel types to be treated, and activity fuel loading to support the annual emissions goal for areas to be treated using non-burning alternatives to fire; and
9. The area treated using non-burning alternatives to fire ~~utilized~~ during the previous year including the number of acres, the specific types of alternatives utilized, and the location of these areas.

D. After consultation with the F/SLM, ADEQ may request additional information for registration of prescribed burns and wildland fire use to support regional coordination of smoke management, annual emission goal setting ~~utilizing~~ using ERTs, and non-burning alternatives to fire.

E. A F/SLM may amend a registration at any time with a written submission to ADEQ.

F. ADEQ ~~shall accept~~ accepts a facsimile or other electronic methods as a means of complying with the deadline for registration. If an electronic means are is used, the F/SLM shall deliver the original paper registration form to ADEQ for its records. ADEQ shall acknowledge in writing the receipt of each registration.

G. ADEQ shall hold ~~an annual~~ a meeting after January 31 and ~~prior to~~ before April 1 of each year between ADEQ and F/SLM=s ~~for program evaluation~~ to evaluate the program and ~~to~~ cooperatively establish the annual emission goal. The annual emission goal shall be developed to minimize prescribed fire emissions to the maximum extent feasible using emission reduction techniques and alternatives to burning subject to economic, technical, and safety feasibility criteria, and consistent with land management objectives.

H. At least once every five years, ADEQ shall request long-term projections of future prescribed fire and wildland fire use activity from the F/SLMs to support planning for visibility impairment and assessment of other air quality concerns by ADEQ.

R18-2-1504. Prescribed Burn Plan

Each F/SLM planning a prescribed burn~~,~~ shall complete and submit to ADEQ the "Burn Plan" form supplied by ADEQ no later than 14 days before the date on which the F/SLM requests permission to burn. ~~The information supplied on the Burn Plan Form are considered~~ ADEQ shall consider the information supplied on the Burn Plan Form as binding conditions under which the burn shall be conducted. A Burn Plan~~s~~ shall be maintained by ADEQ until notification from the F/SLM of the completion of the burn project. Revisions to the Burn Plan for a burn project shall be submitted in writing no later than 14 days before the date on which the F/SLM requests permission to burn. To facilitate the Daily Burn authorization process under R18-2-1505, the F/SLM shall include on the Burn Plan form:

1. An emergency telephone number that is answered 24 hours a day, seven days a week;
2. Burn prescription;
3. Smoke management prescription;
4. The number of acres to be burned, the quantity and type of fuel, type of burn, and the ignition technique to be used;
5. The land management objective or purpose for the burn such as restoration or maintenance of ecological function and indicators of fire resiliency;
6. A map depicting the potential impact of the smoke unless waived either ~~verbally~~ orally or in writing by ADEQ. The potential impact shall be determined by mapping both the daytime and nighttime smoke path and down-drainage flow for 15 miles from the burn site, with smoke-sensitive areas delineated. The map shall use the appropriate scale to show the impacts of the smoke adequately;
7. Modeling of smoke impacts unless waived either ~~verbally~~ orally or in writing by ADEQ, for burns greater than 250 acres per day, or greater than 50 acres per day if the burn is within 15 miles of a Class I Area, an area that is non-attainment for particulates, a carbon monoxide non-attainment area, or other smoke-sensitive area. In consultation with the F/SLM, ADEQ shall provide guidelines on modeling;
8. The name of the official submitting the Burn Plan on behalf of the F/SLM; and

9. After consultation with the F/SLM, any other information to support the Burn Plan needed by ADEQ to assist in the Daily Burn authorization process for smoke management purposes or assessment of contribution to visibility impairment of Class I areas.

R18-2-1505. Prescribed Burn Requests and Authorization

A. Each F/SLM planning a prescribed burn, shall complete and submit to ADEQ the "Daily Burn Request" form supplied by ADEQ. The Daily Burn Request form shall include:

1. The contact information of the F/SLM conducting the burn;
2. Each day of the burn;
3. The area to be burned on ~~that~~ the day for which the Burn Request is submitted, with reference to the Burn Plan, including size, legal location to the section and latitude~~/~~ and longitude to the minute;
4. Projected smoke impacts; and
5. Any local conditions or circumstances known to the F/SLM that, if conveyed to ADEQ, could impact the Daily Burn authorization process.

B. After consultation with the F/SLM, ADEQ may request additional information related to the burn, meteorological, smoke dispersion, or air quality conditions to supplement the Daily Burn Request form and to aid in the Daily Burn authorization process.

C. The F/SLM shall submit the Daily Burn Request form to ADEQ as expeditiously as practicable, but no later than 2 p.m. of the business day preceding the burn. An original form, a facsimile, or an electronic information transfer are acceptable submittals.

D. An F/SLM shall not ignite a prescribed burn without receiving the approval of ADEQ, as follows:

1. ADEQ shall approve, approve with conditions, or disapprove a burn on the same business day as the Burn Request submittal.
2. If ADEQ fails to address a Burn Request by 10 p.m. of the business day on which the request ~~was~~ is submitted, the Burn Request is approved by default after the burner makes a good faith effort to contact ADEQ to confirm that the Burn Request was received.
3. ADEQ may communicate its decision by verbal, written, or electronic means. ADEQ shall provide a written or electronic reply if requested by the F/SLM.

E. If weather conditions cease to conform to those in the smoke management prescription of either the Burn Plan or an Approval with Conditions, the F/SLM shall take appropriate action to reduce further smoke impacts, ensure safe and appropriate fire control, and notify the public when necessary. After consultation with ADEQ, the smoke management prescription or burn plan may be modified.

F. The F/SLM ~~is responsible for~~ shall ensure that there is appropriate signage and notification to protect public safety on transportation corridors including roadways and airports during a prescribed fire.

R18-2-1506. Smoke Dispersion Evaluation

ADEQ shall approve, approve with conditions, or disapprove a Daily Burn Request submitted ~~pursuant to~~ under R18-2-1505, by using the following factors for each smoke management unit:

1. Analysis of the emissions from burns in progress and residual emissions from previous burns on a day-to-day basis;
2. Analysis of emissions from active wildland fire use incidents, and active multiple-day burns, and consideration of potential long-term emissions estimates;
3. Analysis of the emissions from wildfires greater than 100 acres and consideration of their potential long-term growth;
4. Local burn conditions;
5. Burn prescription and smoke management prescription from the applicable Burn Plan;
6. Existing and predicted local air quality;
7. Local and synoptic meteorological conditions;
8. Type and location of areas to be burned;
9. Protection of the national visibility goal for Class I Areas ~~pursuant to~~ under ' 169A(a)(1) of the Act and 40 CFR 51.309;
10. Assessment of duration and intensity of smoke emissions to minimize cumulative impacts; ~~and~~
11. Minimization of smoke impacts in Class I Areas, areas that are non-attainment for particulate matter, carbon monoxide non-attainment areas, or other smoke-sensitive areas~~.~~; and
12. Protection of the National Ambient Air Quality Standards.

R18-2-1507. Prescribed Burn Accomplishment; Wildfire Reporting

A. Each F/SLM conducting a prescribed burn shall complete and submit to ADEQ the "Burn Accomplishment" form supplied by ADEQ. For each burn approval, the F/SLM shall submit a Burn Accomplishment form to ADEQ by 2 p.m. of the business day following the approved ~~burning~~ burn. The F/SLM shall include the following information on the Burn Accomplishment form:

1. Any known conditions or circumstances that could impact the Daily Burn decision process;
2. The date, location, fuel type, fuel loading, and acreage accomplishments;
3. The ERTs and SMTs described in R18-2-1509 and R18-2-1510, respectively, and may

include any further ERTs and SMTs that become available, that the F/SLM used to reduce emissions or manage the smoke from the burn.

B. The F/SLM shall submit the Burn Accomplishment form as an original form, a facsimile, or an electronic information transfer.

C. ADEQ shall maintain a record of Burn Requests, Burn Approvals/Conditional Approvals/Denials and Burn Accomplishments for ~~5~~ five years.

D. The F/SLM in whose jurisdiction a wildfire occurs shall make available to ADEQ no later than the day after the activity all required information for wildfire incidents that burned more than 100 acres per day in timber or slash fuels or 300 acres per day in brush or grass fuels. For each day of a wildfire incident that ~~exceeded~~ exceeds the daily activity threshold, the F/SLM shall provide the location, an estimate of predominant fuel type and quantity consumed, and an estimate of the area blackened that day.

R18-2-1508. Wildland Fire Use: Plan, Authorization, Monitoring; Inter-agency Consultation; Status Reporting

A. In order for ADEQ to participate in the wildland fire use decision-making process, the F/SLM shall notify ADEQ as soon as practicable of any wildland fire use incident projected to attain or attaining a size of 50 acres of timber fuel or 250 acres of brush or grass fuel.

B. For each wildland fire use incident that has been declared as such by the F/SLM, the F/SLM shall complete and submit to ADEQ a Wildland Fire Use Burn Plan in a format approved by ADEQ in cooperation with the F/SLM. The F/SLM shall submit the Wildland Fire Use Burn Plan to ADEQ as soon as practicable but no later than 72 hours after the wildland fire use incident is declared or under consideration for such designation. The F/SLM shall include the following information in the Wildland Fire Use Burn Plan:

1. An emergency telephone number that is answered 24 hours a day seven days a week;
2. Anticipated burn prescription;
3. Anticipated smoke management prescription;
4. The estimated daily number of acres, quantity, and type of fuel to be burned;
5. The anticipated maximum allowable perimeter or size with map;
6. Information on the condition of the area to be burned, such as whether it is in maintenance or restoration, its ecological function ~~or~~ , and other indicators of fire resiliency;
7. The anticipated duration of the wildland fire use incident;

8. The anticipated long-range weather trends for the site;

9. A map depicting the potential impact of the smoke. The potential impact shall be determined by mapping both the daytime and nighttime smoke path and down-drainage flow for 15 miles from the wildland fire use incident, with smoke-sensitive areas delineated. Mapping is mandatory unless waived either ~~verbally~~ orally or in writing by ADEQ. The map shall use the appropriate scale to show the impacts of the smoke adequately; and

10. Modeling or monitoring of smoke impacts, if requested by ADEQ after consultation with the F/SLM.

C. ADEQ shall approve or disapprove a Wildland Fire Use Burn Plan within ~~3~~ three hours of receipt. ADEQ shall consult directly with the requesting F/SLM before disapproving a Wildland Fire Use Burn Plan. If ADEQ fails to address the Wildland Fire Use Burn Plan within the time allotted, the Plan is approved by default under the condition that the F/SLM makes a good faith effort to contact ADEQ to confirm that the Plan was received. Approval by ADEQ of a Wildland Fire Use Burn Plan ~~shall be~~ is binding upon ADEQ for the duration of the wildland fire use incident, unless smoke from the incident creates a threat to public health or welfare. If a threat to public health or welfare is created, ADEQ shall consult with the F/SLM regarding the situation and develop a joint action plan for reducing further smoke impacts.

D. The F/SLM shall submit a Daily Status Report for each wildland fire use incident to ADEQ for each day of the burn that the fire burns more than 100 acres in timber or slash fuels or 300 acres in brush or grass fuels. The F/SLM shall include a synopsis of smoke behavior, future daily anticipated growth, and location of the activity of the wildland fire use incident in the Daily Status Report.

E. The F/SLM shall consult with ADEQ prior to initiating ~~man-made~~ human-made ignition on the wildland fire use incident when greater than 250 acres is anticipated to be burned by the ignition. Emergency ~~man-made~~ human-made ignition on the incident for protection of public or fire-fighter safety does not require consultation with ADEQ regardless of the size of the area to be burned.

F. The F/SLM ~~is responsible for~~ shall ensure that there is appropriate signage and notification to protect public safety on transportation corridors including roadways and airports during a wildland fire use incident.

R18-2-1509. Emission Reduction Techniques

A. Each F/SLM conducting a prescribed burn shall implement as many Emission Reduction Techniques as are feasible subject to economic, technical, and safety feasibility criteria, and land management objectives.

B. Emission reduction techniques include :

1. Reducing biomass to be burned by use of techniques such as yarding or consolidation of unmerchandisable material, multi-product timber sales, or public firewood access, when economically feasible;
2. Reducing biomass to be burned by fuel exclusion practices such as preventing the fire from consuming dead snags or dead and downed woody material through lining, application of fire-retardant foam, or water;
3. Using mass ignition techniques such as aerial ignition by helicopter to produce high intensity fires of high fuel density areas such as logging slash decks;
4. Burning only fuels essential to meet resource management objectives;
5. Minimizing consumption and smoldering by burning under conditions of high fuel moisture of duff and litter;
6. Minimizing fuel consumption and smoldering by burning under conditions of high fuel moisture of large woody fuels;
7. Minimizing soil content when slash piles are constructed by using brush blades on material-moving equipment and by constructing piles under dry soil conditions or by using hand piling methods;
8. Burning fuels in piles;
9. Using a backing fire in grass fuels;
10. Burning fuels with an air curtain destructor, as defined in R18-2-101, operated ~~pursuant~~ according to manufacturer specifications and meeting applicable ~~State~~ state or local opacity requirements;
11. Extinguishing or mopping-up of smoldering fuels;
12. Chunking of piles and other consolidations of burning material to enhance flaming~~,~~ and fuel consumption, and to minimize smoke production;
13. ~~Burn~~ Burning before litter fall;
14. ~~Burn~~ Burning before green-up of fuels;
15. ~~Burn~~ Burning before recently cut large fuels cure in areas with activity; and
16. ~~Burn~~ Burning just ~~prior to~~ before precipitation to reduce fuel smoldering and consumption.

R18-2-1510. Smoke Management Techniques

A. Each F/SLM conducting a prescribed burn shall implement as many Smoke Management Techniques as are feasible subject to economic, technical, and safety feasibility criteria, and land management objectives.

B. Smoke ~~Management Techniques~~ management techniques include:

1. Burning from March 15 through September 15, when meteorological conditions allow for good smoke dispersion;
2. Igniting burns under good-to-excellent ventilation conditions;
3. Suspending operations under poor smoke dispersion conditions;
4. Considering smoke impacts on local community activities and land users;
5. Burning piles when other burns are not feasible, such as when snow or rain is present;
6. Using mass ignition techniques such as aerial ignition by helicopter to produce high intensity fires with short duration impacts;
7. Using all opportunities that meet the burn prescription and all burn locations to spread smoke impacts over a broader time period and geographic area;
8. Burning during optimum mid-day dispersion hours, with all ignitions in a burn unit completed by 3 p.m. to prevent trapping smoke in inversions or diurnal windflow patterns;
9. ~~When allowing public firewood access, provide~~ Providing information on the adverse impacts of using green or wet wood as fuel when public firewood access is allowed;
10. Implementing maintenance burning in a periodic rotation to shorten prescribed fire duration and to reduce excessive fuel accumulations ~~which~~ that could result in excessive smoke production in a wildfire; and
11. Using wildland fire-use strategies to shift smoke into more favorable smoke dispersion seasons.

R18-2-1511. Monitoring

A. ADEQ may require a F/SLM to monitor air quality before or during a prescribed burn or a wildland fire use incident if necessary to assess smoke impacts. Air quality monitoring may be conducted using both federal and non-federal reference method as well as other techniques.

B. ADEQ may require a F/SLM to monitor weather before or during a prescribed burn or a wildland fire use incident, if necessary to predict or assess smoke impacts. After consultation with the F/SLM, ADEQ may also require the F/SLM to establish burn site or area-representative remote automated weather stations or their equivalent, having telemetry that allows retrieval on a real-time basis by ADEQ. An F/SLM ~~planning to make a change to any long-term established remote automated weather station~~ shall give ADEQ notice and an opportunity to comment before making ~~the~~ any change to a long-term established remote automated weather station.

C. A F/SLM shall employ the following types of monitoring, unless waived by ADEQ, for burns greater than 250 acres per day, or greater than 50 acres per day if the burn is within 15 miles of a Class I Area, an area that is non-attainment for particulate matter, carbon monoxide, or ozone, or other smoke-sensitive area:

1. Smoke plume measurements, using a format supplied by ADEQ; and
2. The release of pilot balloons (PIBALs) at the burn site to verify needed wind speed, direction, and stability.

~~In lieu~~ Instead of pilot balloons, a test burn at the burn site may be used for specific prescribed burns on a case-by-case basis as approved by ADEQ, to verify needed wind speed, direction, and stability.

D. An F/SLM shall make monitoring information required ~~pursuant to~~ under subsection (C) available to ADEQ on the business day following the burn ignition.

E. The F/SLM shall keep on file for ~~1~~ one year following the burn date any monitoring information required ~~pursuant~~ under to this Section.

R18-2-1512. Burner Qualifications

A. All burn projects shall be conducted by personnel trained in prescribed fire and smoke management techniques as required by the F/SLM in charge of the burn and established by National Wildfire Coordinating Group training qualifications.

B. A Prescribed Fire Boss or other local Fire Management Officer of the F/SLM having jurisdiction over prescribed burns shall have smoke management training obtained through one of the following:

1. Successful completion of a National Wildfire Coordinating Group or F/SLM-equivalent course addressing smoke management; or
2. Attendance at an ADEQ-approved smoke management workshop.

R18-2-1513. Public Notification and Awareness Program; Regional Coordination

A. The Director shall conduct a public education and awareness program in cooperation with F/SLMs and other interested parties to inform the general public of the smoke management program described by this Article. The program shall include smoke impacts from prescribed fires and the role of prescribed fire in natural ecosystems.

B. ADEQ shall make annual registration, prescribed burn approval, and wildfire and wildland fire use activity information readily available to the public and to facilitate regional coordination efforts and public notification.

R18-2-1514. Surveillance and Enforcement

A. An F/SLM conducting a prescribed burn shall permit ADEQ to enter and inspect burn sites unannounced to verify the accuracy of the Daily Burn Request, Burn Plan, or Accomplishment data as well as matching burn approval with actual conditions, smoke dispersion, and air quality impacts. On-ground site inspection procedures and aerial surveillance shall be coordinated by ADEQ and the F/SLM for safety purposes.

B. ADEQ may use remote automated weather station data if necessary to verify current and previous meteorological conditions at or near the burn site.

C. ADEQ may audit burn accomplishment data, smoke dispersion measurements, or weather measurements from previously conducted burns, if necessary to verify conformity with, or deviation from, procedures and authorizations approved by ADEQ.

D. Deviation from procedures and authorizations approved by ADEQ constitute a violation of this Article. Violations may require containment or mop-up of any active burns and may also require, in the Director's discretion, a ~~5~~ five-day moratorium on ignitions by the responsible F/SLM. Violations of this Article are also subject to a civil penalty of not more than $10,000 per day per violation ~~pursuant to~~ under A.R.S. ' 49-463.

R18-2-1515. Forms; Electronic Copies; Information Transfers

A. ADEQ shall make available on paper and in electronically-readable format any form required to be developed by ADEQ and completed by a F/SLM.

B. After consultation with ~~the~~ an F/SLM, ADEQ may require ~~each~~ the F/SLM to provide data in a manner that facilitates electronic transfers of information.

11. A summary of the comments made regarding the rule and the agency response to them:

Comment #1: A large number of commenters focused on the proposed requirement that fires set for the purpose of training firefighters now be permitted. In the current rule, fires set for training purposes are excepted from the permit requirement. Commenters felt that requiring permits for such fires was an unnecessary and impracticable interference in their operations.

Response #1: ADEQ had proposed to require that fires set for training purposes be permitted in an effort to better track and report emissions data from such fires through the notice requirement included in fire permits (R18-2-602(D)(3)(f)). However, ADEQ agrees that requiring fire officers to apply to ADEQ or a delegated authority could be impracticable; the data can be adequately tracked with a similar notice requirement while still exempting such fires from the actual permit requirement. ADEQ will add language to R18-2-602(C)(2), the subsection which enumerates those fires exempted from the permit requirement, to read A. . . if such fire is set or permission given for the purpose of fire control of an active wildfire, <u>or instruction in the methods of fighting fires</u>,@ with the inclusion of a notice requirement similar to the one in subsection (D)(3)(f). It should be noted that this notice requirement can be satisfied by an annual report to the Director or delegated authority; it is not required that each individual training fire be reported.

Comment #2: One commenter suggested that subsection (G), which deals with permits issued by a delegated authority, be changed. Specifically, there is a provision in that subsection which prohibits delegated authorities from issuing permits to themselves. Commenter suggested adding a sentence (APermits issued by a delegated authority for the purpose of instruction in the methods of fire fighting are excepted from the provisions of this rule.@) excepting training fires from this prohibition.

Response #2: Exempting training fires from the permit requirement, generally, makes it unnecessary to add an exception to subsection (G).

Comment #3: One commenter objected to subsection (G), claiming it was unenforceable and would create administrative and practical difficulties. Commenter asked, Aif an agency is not responsible enough to control its own fires and training then why should they be allowed to issue permits to the public?@

Response #3: ADEQ does not intend to prevent a delegated authority from issuing any permits, just permits from themselves to themselves. ADEQ thinks it is appropriate to oversee permits to delegated authorities, both to avoid potential conflicts of interest as well as better track emissions data. It should be noted that a number of commenters think that these permits are issued on a fire-by-fire basis. In fact, open burning permits have a term of up to one year, and can cover multiple burn projects.

Comment #4: One commenter asked if any of the model fire codes, or the National Fire Protection Agency Standards were consulted when drafting these rules.

Response #4: No. ADEQ has reviewed the National Fire Protection Agency Standards and the NFPA 1 Uniform Fire Code, 2003 Edition, to determine their relevance to air quality and whether their consideration might improve the proposed rules. ADEQ found that these documents deal with fire safety, fire-fighting and fire preparedness issues. These areas fall outside the scope of this rule. ADEQ=s fire rules deal with the control of emissions and the tracking of emissions related data, rather than the actual control of fires themselves.

Comment #5: One commenter requested clarification on the difference between subsection (C)(3), fires set for the Apurpose of disease and pest prevention in organized, area-wide control of epidemics or infestations . . .@ which are exempt from permit requirements, and subsection (D)(1)(e) fires set for the Apurpose of weed abatement, the prevention of a fire hazard . . .@ which are subject to permit requirements.

Response #5: Fires described in (C)(3) would be fires authorized by the Director of the Department of Agriculture in an emergency in order to prevent the spread of disease or pest infestation. In such a situation, time constraints may make the normal permitting procedure ineffective. Representatives from the Department of Agriculture were included in the Fire Emissions Work Group. They indicated that they needed this authority so that they might effectively deal with such an emergency. It should be noted that there has been no need, up to the present time, for this authority to be exercised. Fires under (D)(1)(e), however, are not likely to be emergency in nature, and such burners should go through the normal permitting procedure.

Comment #6: Commenter proposed changing (D)(3)(c) so that it reads A[a] requirement that burns be conducted during the following periods, unless otherwise waived or directed by the Director <u>or delegated authority</u> on a specific day basis@. The provision limits fires from one hour after sunrise to 2 hours before sunset.

Response #6: ADEQ thinks it is appropriate that the Director retain authority in this matter. Atmospheric conditions change just before sunset, usually minimizing smoke dispersion. For this reason, most burns should be conducted during the day. There are circumstances where nighttime, or extended daytime, burns might be appropriate, but ADEQ thinks that authority to make that decision should, in general, remain centralized with the Director.

Comment #7: Commenter noted that R18-2-602(D)(3)(f) is in reference to a reporting requirement, and asks if the report form will be available to the delegated authority or will each applicant be responsible for providing this information.

Response #7: The most likely scenario is that the burner will be required by his or her permit to notify the permitting authority of their burn, either on a daily or annual basis. The delegated authority would then take down the pertinent information on the form provided by ADEQ for this purpose, and report that information to ADEQ, under subsection (G)(3), in an annual report to the Director.

Comment #8: Commenter suggested that, in (D)(3)(g) Aa notation should be made that the applicant contact the local fire jurisdiction to determine what local open burning requirements have been established, to obtain a local permit if required, and to follow all local adopted fire code requirements.@

Response #8: ADEQ thinks that this issue is adequately addressed by R18-2-602(I) which states that A[n]othing in this Section is intended to permit any practice which is a violation of any statute, ordinance, rule, or regulation.@

Comment #9: Commenter pointed out that ADEQ=s preamble to the proposed rule was inaccurate. The preamble suggested that a permit exemption for air curtain destructors was considered, under the federal regional haze rule, in order to remove an administrative barrier to certain types of burning. In fact, the regional haze rule requires removal of administrative barriers for *alternatives* to burning.

Response #9: ADEQ has retained and clarified the referenced paragraph in the preamble. The preamble now distinguishes between alternatives to burning and burning with a method that has lower emissions, but notes that removing an administrative barrier to either could be beneficial.

Comment #10: Commenter noted that subsection (D)(1)(a) allows construction burning, with a permit. (A)(4) defines Aconstruction burning@ as including materials from Ademolition or modification of any buildings@ but precludes burning of Aprohibited materials.@ (A)(13) defines Aprohibited materials@ to include a number of common building materials, but that the list is not exhaustive and does not include other potentially harmful materials such as linoleum flooring, lead-painted wood, and composite counter-tops. He suggested adding such materials to (A)(13). Additionally, he suggested requiring a separate permit for the burning of building materials, as does Pinal County. Such a permit requires an on-site inspection before the permit is issued.

Response #10: ADEQ thinks that onsite inspections are an inefficient use of limited resources. However, the list of prohibited materials in R18-2-602(A)(13) can be expanded to include those items that commenter suggested.

Comment #11: Commenter noted that under subsection (D)(3)(g) permittees should know to make daily notifications of burning activity to the Alocal fire-fighting agency,@ or to the State Forester. He thought it unclear whether Alocal fire-fighting agency@ includes private fee-for-service firefighting corporations or is limited to municipal fire departments and local fire districts. Private for-profit services operate outside of jurisdictional limits and it is unclear how Aoperational bounds@ of such services would be defined for the purposes of informing permittees whom to notify.

Response #11: ADEQ will clarify, in the rule, that private fee-for-service fire-fighting corporations are considered Alocal fire-fighting agencies,@ for the purpose of fulfilling notice requirements, when such private services are delegated authorities as defined in R18-2-602(A)(6). In the absence of such a delegated authority, permittees would be required to notify the state forester, as indicated by subsection (D)(3)(g).

Comment #12: Commenter noted that subsection (F) allows the permitting of household waste burning. Commenter thinks that such burning inevitably leads to nuisance and suggested that statutory authority to allow it does not equal legislative mandate, and therefore suggested that subsection (F) be deleted.

Response #12: ADEQ thinks it better to deal with the issue of household waste on an individual basis. Writing household waste entirely out of the rule would not allow for such individual assessment of each such burn. If the burning is likely to cause a nuisance, the application for that burn permit can be denied. Such nuisance is more likely to be an issue in urban counties than it would in rural. Therefore, ADEQ will retain subsection (F) in the rule of statewide application. Those counties with more urban development such as Maricopa, Pima and Pinal, which have independent authority to permit fires, may prohibit such burning if they so choose, as is the case with the Maricopa county rules.

Comment #13: Commenter asserted that 40 CFR 51.308 and 51.309, the Regional Haze rule, refers to prescribed burning, which does not include fire-fighting training. Commenter listed a number of reasons how sections 308 and 309 do not apply to fires set for training purposes and stated that those fires should continue to be exempt from permit requirements.

Response #13: Without addressing the issue of whether or not 40 CFR 51.308 and 309 do apply to fires set for the purpose of conducting fire-fighting training, ADEQ has decided to exempt such fires from the open burning permit requirement, while retaining the notice requirements that would allow ADEQ to track the relevant emissions data.

Comment #14: Commenter stated that the limitations, in subsection (D)(3)(c), set on the hours when permitted burns may be conducted unreasonably limit such fires to daylight hours. They claimed that in order to properly train their fire-fighters to combat fires arising from aircraft incidents, training must be conducted both day and night.

Response #14: Since ADEQ has decided to exempt fires set for training purposes from the permit requirement, subsection (D)(3)(c) no longer applies to such fires.

Comment #15: Commenter listed several practical problems that would make training difficult if they are required to apply for a permit from ADEQ for each training exercise.

Response #15: These issues should be adequately addressed by ADEQ=s decision to continue to exempt training fires from the permit requirement. While ADEQ will retain a notice requirement to allow for the tracking and monitoring of necessary emissions data, it should be noted that this requirement can be filled by the filing of an annual report; it is unnecessary to report on a fire-by-fire basis.

Comment #16: Commenter expressed concern that the requirements of Article 15 relating to Burn Plans, Authorizations, and Accomplishment Forms will be a burdensome addition to his paperwork when conducting his own range management burns on his privately owned land. Commenter was uncertain of what the actual burden was on a private landowner.

Response #16: Under R18-2-1502, the provisions of this Article do not apply to private landowners conducting burns unless they enter into a memorandum of agreement with ADEQ. Private landowners conducting burns would be governed by the provisions of R18-2-602, Unlawful Open Burning. However, when a private landowner conducts a range management burn in cooperation with a State or Federal Land Manager, that Land Manager, not the private landowner, would be covered by the provisions of Article 15, Forest and Range Management Burns.

Comment #17: Commenter was concerned with the language used in R18-2-1503(C)(6) A[b]y area *planned* for wildland fire use, . . . and annual acres *to be* burned . . .@ etc. (emphasis added). Commenter noted that wildland fires cannot, by virtue of their very nature, be planned, and asked if there is more appropriate language that might be used.
Response #17: ADEQ recognizes that wildland fires, or wildfires, cannot be accurately predicted. However, a wildland fire use, as defined in this rule, is a pre-planned event, and a wildland fire use may only take place in an area planned for it. The purpose of R18-2-1503(C)(6) is to get an estimate of the area, fuel types and acreage that may be burned in a wildland fire use incident. ADEQ has clarified some language but kept the phrase Aplanned area.@

Comment #18: Commenter wondered how one should properly coordinate prescribed burning activities on federal land with adjacent private landowners.

Response #18: ADEQ considers this to be an operational issue not addressed in the scope of these rules, but is better dealt with at a practical level between the appropriate Land Manager and the private landowner.

Comment #19: Commenter asked if there is a definition of Anuisance@ for R18-2-602(D)(3)(d)(iii).

Response #19: The definition of Anuisance@ appropriate to this section is to be found in A. R. S. ' 13-2917, Public Nuisance; Abatement; Classification.

Comment #20: Commenter asked whether the reporting requirement of R18-2-602(D)(3)(f) falls on the permit applicant or the delegated authority.

Response # 20: While the specific forms dealing with these requirements are still being designed, the permit applicant would, under R18-2-602(D)(3)(g) notify the local fire-fighting agency or state forester of the burn. That official would, at that time, collect the necessary data to meet the reporting requirement of (D)(3)(f) which would then be reported to the Director or delegated authority in their daily or annual report.

Comment #21: Commenter suggested that it be clarified that fires using air curtain destructors are required to be permitted.

Response #21: Fires using air curtain destructors will be added to R18-2-602(D), Open Outdoor Fires Requiring a Permit, under subsection (D)(1).

Comment #22: Commenter expressed some confusion over whether, under R18-2-602(C)(4) all fires set by the federal government or any of its departments, agencies or agents, etc., are exempt from the permit open outdoor fire permit requirement.

Response #22: Only those fires set by the federal government that would be regulated under Article 15, Forest and Range Management Burns, would be exempt from the requirements of R18-2-602, Unlawful Open Fires. ADEQ will change the language of subsection (C)(4) to better reflect the intention that such fires are to be governed by either the open burning rule, *or* the range management rules.

Comment #23: Commenter was concerned with the inclusion of Awindrows@ in R18-2-602(D)(3)(f)(iii) as an example of the fire types to be included in the permit reporting requirement. He suggested that such fires are dangerously unstable and would like mention of them to be removed from rule.

Response #23: ADEQ has removed Awindrow@ as an example and substituted Apit@ in subsection (D)(3)(f)(iii).

<u>12.</u> **<u>Any other matter prescribed by statute that are applicable to the specific agency or to any other specific rule or class of rules:</u>**

Not applicable

<u>13.</u> **<u>Incorporations by reference and their location in the rules:</u>**

Not applicable

<u>14.</u> **<u>Was this rule previously made as an emergency rule?</u>**

No

<u>15.</u> **<u>The full text of the rules follows:</u>**

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY-

AIR POLLUTION CONTROL

ARTICLE 6. EMISSIONS FROM EXISTING AND NEW NONPOINT SOURCES

Section

R18-2-602.	Unlawful Open Burning

ARTICLE 15. FOREST AND RANGE MANAGEMENT BURNS

Section

R18-2-1501.	Definitions
R18-2-1502.	Applicability
R18-2-1503.	Annual Registration, Program Evaluation and Planning ~~for Prescribed Burns~~
R18-2-1504.	Prescribed Burn Plan ~~Contents~~
R18-2-1505.	Prescribed Burn Requests and Authorization
R18-2-1506.	Smoke Dispersion Evaluation
R18-2-1507.	Prescribed Burn Accomplishment; ~~ADEQ Recordkeeping;~~ Wildfire Reporting
R18-2-1508.	~~Prescribed Natural Fires;~~ Wildland Fire Use: Plan~~;~~, Authorization~~;~~, Monitoring; Interagency Consultation; Status Reporting
R18-2-1509.	Emission Reduction Techniques~~; BMP~~
R18-2-1510.	Smoke Management Techniques
~~R18-2-1510~~ R18-2-1511.	Monitoring
~~R18-2-1511~~ R18-2-1512.	Burner Qualifications
~~R18-2-1512~~ R18-2-1513.	Public Notification and Awareness Program; Regional Coordination
~~R18-2-1514.~~	~~Oversight~~
R18-2-1514.	Surveillance and Enforcement
R18-2-1515.	Forms; Electronic Copies; Information Transfers

ARTICLE 6. EMISSIONS FROM EXISTING AND NEW NONPOINT SOURCES

R18-2-602. Unlawful Open Burning

~~**A.** Notwithstanding the provisions of any other rule in this Chapter, it is unlawful for any person to ignite, cause to be ignited, permit to be ignited, or suffer, allow or maintain any open outdoor fire.~~

~~**B.** "Open outdoor fire," as used in this rule, means any combustion of combustible material of any type outdoors, in the open where the products of combustion are not directed through a flue. "Flue," as used in this rule, means any duct or passage for air, gases or the like, such as a stack or chimney.~~

~~**C.** The following fires are excepted from the provisions of this rule:~~

~~1. Fires used only for cooking of food or for providing warmth for human beings or for recreational purposes or the branding of animals or the use of orchard heaters for the purpose of frost protection in farming or nursery operations.~~

~~2. Any fire set or permitted by any public officer in the performance of official duty, if such fire is set or permission given for the purpose of weed abatement, the prevention of a fire hazard, or instruction in the methods of fighting fires.~~

~~3. Fires set by or permitted by the state entomologist or county agricultural agents of the county for the purpose of disease and pest prevention.~~

~~4. Fires set by or permitted by the federal government or any of its departments, agencies or agents, the state or any of its agencies, departments or political subdivisions, for the purpose of watershed rehabilitation or control through vegetative manipulation.~~

~~**D.** Permission for the setting of any fire given by a public officer in the performance of official duty under subsections (C)(2), (3), or (4) shall be given, in writing, and a copy of such written permission shall be transmitted immediately to the Director of the Department of Environmental Quality and the control officer, if any, of the county, district or region in which such fire is allowed. The setting of any such fire shall be constructed in a manner and at such time as approved by the Director, unless doing so would defeat the purpose of the exemption.~~

~~**E.** The following fires may be excepted from the provisions of this Section when permitted in writing by the Director of the Department of Environmental Quality or the control officer of the county, district or region in which such fire is allowed:~~

~~1. Fires set for the disposal of dangerous materials where there is no safe alternative method of disposal.~~

~~a. "Dangerous material" is any substance or combination of substances which is able or~~

~~likely to inflict bodily harm or property loss unless neutralized, consumed or otherwise disposed of in a controlled and safe manner.~~

~~b.~~ ~~Fires set for the disposal of dangerous materials shall be permitted only when there is no safe alternative method of disposal, and when the burning of such materials does not result in the emission of hazardous or toxic substances either directly or as a product of combustion in amounts which will endanger health or safety.~~

~~2.~~ ~~Open outdoor fires for the disposal of ordinary household trash in an approved waste burner in nonurban areas of less than 100 well spread out dwelling units per square mile where no refuse collection and disposal service is available.~~

~~a.~~ ~~An "approved waste burner" is an incinerator constructed of fire resistant material with a cover or screen which is closed when in use having openings in the sides or top no greater than 1 inch in diameter.~~

~~b.~~ ~~Open burning of the following materials is forbidden: Garbage resulting from the processing, storage, service or consumption of food; asphalt shingles; tar paper; plastic and rubber products (such as waste crankcase oil, transmission oil and oil filters); transformer oils; and hazardous material containers including those that contained inorganic pesticides, lead, cadmium, mercury, or arsenic compounds.~~

~~**F.**~~ ~~The Director of the Department of Environmental Quality or the air pollution control officer, if any, of the county, district, or region may delegate the authority for the issuance of allowable open burning permits to responsible local officers. Such permits shall contain conditions limiting the manner and the time of the setting of such fires as specified in the Arizona Guidelines for Open Burning and shall contain a provision that all burning be extinguished at the discretion of the Director or his authorized representative during periods of inadequate atmospheric smoke dispersion, periods of excessive visibility impairment which could adversely affect public safety, or periods when smoke is blown into populated areas so as to create a public nuisance. Any local officer delegated the authority for issuance of open burning permits shall maintain a copy of all currently effective permits issued including a means of contacting the person authorized by the permit to set an open fire in the event that an order for extinguishing of open burning is issued.~~

~~**G.**~~ ~~Nothing in this rule is intended to permit any practice which is a violation of any statute, ordinance, rule or regulation.~~

A. In addition to the definitions contained in A.R.S. ' 49-501, in this Section:

1. AAgricultural burning@ means burning vegetative materials related to producing and harvesting crops and raising animals for the purpose of marketing for profit, or providing a

livelihood, but does not include burning of household waste or prohibited materials. A person may conduct agricultural burns in fields, piles, ditch banks, fence rows, or canal laterals for purposes such as weed control, waste disposal, disease and pest prevention, or site preparation.

2. AApproved waste burner@ means an incinerator constructed of fire resistant material with a cover or screen that is closed when in use, and has openings in the sides or top no greater than one inch in diameter.

3. AClass I Area@ means any one of the Arizona mandatory federal class I areas defined in A.R.S. ' 49-401.01.

4. AConstruction burning@ means burning wood or vegetative material from land clearing, site preparation, or fabrication, erection, installation, demolition, or modification of any buildings or other land improvements, but does not include burning household waste or prohibited material.

5. ADangerous material@ means any substance or combination of substances that is capable of causing bodily harm or property loss unless neutralized, consumed, or otherwise disposed of in a controlled and safe manner.

6. ADelegated authority@ means any of the following:

   a. A county, city, town, air pollution control district, or fire district that has been delegated authority to issue open burning permits by the Director under A.R.S. ' 49-501(E); or

   b. A private fire protection service provider that has been assigned authority to issue open burning permits by one of the authorities in subsection (A)(6)(a).

7. ADirector@ means the Director of the Department of Environmental Quality, or designee.

8. AEmission reduction techniques@ means methods for controlling emissions from open outdoor fires to minimize the amount of emissions output per unit of area burned.

9. AFlue,@ as used in this Section, means any duct or passage for air or combustion gases, such as a stack or chimney.

10. AHousehold waste@means any solid waste including garbage, rubbish, and sanitary waste from a septic tank that is generated from households including single and multiple family residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas, but does not include construction debris, landscaping rubble, or demolition debris.

11. AIndependent authority to permit fires@ means the authority of a county to permit fires by a rule adopted under Arizona Revised Statutes, Title 49, Chapter 3, Article 3, and includes only Maricopa, Pima, and Pinal counties.

12. AOpen outdoor fire or open burning@ means the combustion of material of any type, outdoors and in the open, where the products of combustion are not directed through a flue. Open outdoor fires include agricultural, residential, prescribed, and construction burning, and fires using air curtain destructors.

13. AProhibited materials@ means nonpaper garbage from the processing, storage, service, or consumption of food; chemically treated wood; lead-painted wood; linoleum flooring, and composite counter-tops; tires; explosives or ammunition; oleanders; asphalt shingles; tar paper; plastic and rubber products, including bottles for household chemicals; plastic grocery and retail bags; waste petroleum products, such as waste crankcase oil, transmission oil, and oil filters; transformer oils; asbestos; batteries; anti-freeze; aerosol spray cans; electrical wire insulation; thermal insulation; polyester products; hazardous waste products such as paints, pesticides, cleaners and solvents, stains and varnishes, and other flammable liquids; plastic pesticide bags and containers; and hazardous material containers including those that contained lead, cadmium, mercury, or arsenic compounds.

14. AResidential burning@ means open burning of vegetative materials conducted by or for the occupants of residential dwellings, but does not include burning household waste or prohibited material.

15. APrescribed burning@ has the same meaning as in R18-2-1501.

B. Unlawful open burning. Notwithstanding any other rule in this Chapter, a person shall not ignite, cause to be ignited, permit to be ignited, allow, or maintain any open outdoor fire in a county without independent authority to permit fires except as provided in A.R.S. ' 49-501 and this Section.

C. Open outdoor fires exempt from a permit. The following fires do not require an open burning permit from the Director or a delegated authority:

1. Fires used only for:

   a. Cooking of food,

   b. Providing warmth for human beings,

   c. Recreational purposes,

   d. Branding of animals,

   e. Orchard heaters for the purpose of frost protection in farming or nursery operations, and

f. The proper disposal of flags under 4 U.S.C. ' 8.

2. Any fire set or permitted by any public officer in the performance of official duty, if the fire is set or permission given for the following purpose:

a. Control of an active wildfire; or

b. Instruction in the method of fighting fires, except that the person setting these fires must comply with the reporting requirements of subsection (D)(3)(f).

3. Fire set by or permitted by the Director of Department of Agriculture for the purpose of disease and pest prevention in an organized, area-wide control of an epidemic or infestation affecting livestock or crops.

4. Prescribed burns set by or assisted by the federal government or any of its departments, agencies, or agents, or the state or any of its agencies, departments, or political subdivisions, regulated under Article 15 of this Chapter.

D. Open outdoor fires requiring a permit.

1. The following open outdoor fires are allowed with an open burning permit from the Director or a delegated authority:

a. Construction burning;

b. Agricultural burning;

c. Residential burning;

d. Prescribed burns conducted on private lands without the assistance of a federal or state land manager as defined under R18-2-1501;

e. Any fire set or permitted by a public officer in the performance of official duty, if the fire is set or permission given for the purpose of weed abatement, or the prevention of a fire hazard, unless the fire is exempt from the permit requirement under subsection (C)(3);

f. Open outdoor fires of dangerous material under subsection (E);

g. Open outdoor fires of household waste under subsection (F); and

h. Open outdoor fires that use an air curtain destructor, as defined in R18-2-101.

2. A person conducting an open outdoor fire in a county without independent authority to permit fires shall obtain a permit from the Director or a delegated authority unless exempted under subsection (C). Permits may be issued for a period not to exceed one year. A person shall obtain a permit by completing an ADEQ-approved application form.

3. Open outdoor fire permits issued under this Section shall include:

a. A list of the materials that the permittee may burn under the permit;

b. A means of contacting the permittee authorized by the permit to set an open fire in the event that an order to extinguish the open outdoor fire is issued by the Director or the delegated authority;

c. A requirement that burns be conducted during the following periods, unless otherwise waived or directed by the Director on a specific day basis:

   i. Year round: ignite fire no earlier than one hour after sunrise; and

   ii. Year round: extinguish fire no later than two hours before sunset.

d. A requirement that the permittee conduct all open burning only during atmospheric conditions that:

   i. Prevent dispersion of smoke into populated areas;

   ii. Prevent visibility impairment on traveled roads or at airports that result in a safety hazard;

   iii. Do not create a public nuisance or adversely affect public safety;

   iv. Do not cause an adverse impact to visibility in a Class I area; and

   v. Do not cause uncontrollable spreading of the fire;

e. A list of the types of emission reduction techniques that the permittee shall use to minimize fire emissions.

f. A reporting requirement that the permittee shall meet by providing the following information in a format provided by the Director for each date open burning occurred, on either a daily basis on the day of the fire, or an annual basis in a report to the Director or delegated authority due on March 31 for the previous calendar year:

   i. The date of each burn;

   ii. The type and quantity of fuel burned for each date open burning occurred;

   iii. The fire type, such as pile or pit, for each date open burning occurred; and

   iv. For each date open burning occurred, the legal location, to the nearest section, or latitude and longitude, to the nearest degree minute, or street address for residential burns.

g. A requirement that the person conducting the open burn notify the local fire-fighting agency or private fire protection service provider, if the service provider is a delegated authority, before burning. If neither is in existence, the person conducting the burn shall notify the state forester.

h. A requirement that the permittee start each open outdoor fire using items that do not cause the production of black smoke;

i. A requirement that the permittee attend the fire at all times until it is completely extinguished;

j. A requirement that the permittee provide fire extinguishing equipment on-site for the duration of the burn;

k. A requirement that the permittee ensure that a burning pit, burning pile, or approved waste burner be at least 50 feet from any structure;

l. A requirement that the permittee have a copy of the burn permit on-site during open burning;

m. A requirement that the permittee not conduct open burning when an air stagnation advisory, as issued by the National Weather Service, is in effect in the area of the burn or during periods when smoke can be expected to accumulate to the extent that it will significantly impair visibility in Class I areas;

n. A requirement that the permittee not conduct open burning when any stage air pollution episode is declared under R18-2-220.

o. A statement that the Director, or any other public officer, may order that the burn be extinguished or prohibit burning during periods of inadequate smoke dispersion, excessive visibility impairment, or extreme fire danger; and

p. A list of the activities prohibited and the criminal penalties provided under A.R.S. ' 13-1706.

4. The Director or a delegated authority shall not issue an open burning permit under this Section:

a. That would allow burning prohibited materials other than under a permit for the burning of dangerous materials;

b. If the applicant has applied for a permit under this Section to burn a dangerous material which is also hazardous waste under 40 CFR 261, but does not have a permit to burn hazardous waste under 40 CFR 264, or is not an interim status facility allowed to burn hazardous waste under 40 CFR 265; or

c. If the burning would occur at a solid waste facility in violation of 40 CFR 258.24 and the Director has not issued a variance under A.R.S. ' 49-763.01.

E. Open outdoor fires of dangerous material. A fire set for the disposal of a dangerous material is allowed by the provisions of this Section, when the material is too dangerous to store and transport, and the Director has issued a permit for the fire. A permit issued under this subsection shall contain all provisions in subsection (D)(3) except for subsections (D)(3)(e) and (D)(3)(f). The Director shall permit fires for the disposal of dangerous materials only when no safe alternative method of disposal exists, and burning the materials does not result in the emission of hazardous or toxic substances either directly or as a product of combustion in amounts that will endanger health or safety.

F. Open outdoor fires of household waste. An open outdoor fire for the disposal of household waste is allowed by provisions of this Section when permitted in writing by the Director or a delegated authority. A permit issued under this subsection shall contain all provisions in subsection (D)(3) except for subsections (D)(3)(e) and (D)(3)(f). The permittee shall conduct open outdoor fires of household waste in an approved waste burner and shall either:

1. Burn household waste generated on-site on farms or ranches of 40 acres or more where no household waste collection or disposal service is available; or
2. Burn household waste generated on-site where no household waste collection and disposal service is available and where the nearest other dwelling unit is at least 500 feet away.

G. Permits issued by a delegated authority. The Director may delegate authority for the issuance of open burning permits to a county, city, town, air pollution control district, or fire district. A delegated authority may not issue a permit for its own open burning activity. The Director shall not delegate authority to issue permits to burn dangerous material under subsection (E). A county, city, town, air pollution control district, or fire district with delegated authority from the Director may assign that authority to one or more private fire protection service providers that perform fire protection services within the county, city, town, air pollution control district, or fire district. A private fire protection provider shall not directly or indirectly condition the issuance of open burning permits on the applicant being a customer. Permits issued under this subsection shall comply with the requirements in subsection (D)(3) and be in a format prescribed by the Director. Each delegated authority shall:

1. Maintain a copy of each permit issued for the previous five years available for inspection by the Director;
2. For each permit currently issued, have a means of contacting the person authorized by the permit to set an open fire if an order to extinguish open burning is issued; and
3. Annually submit to the Director by May 15 a record of daily burn activity, excluding household waste burn permits, on a form provided by the Director for the previous calendar year containing the information required in subsections (D)(3)(e) and (D)(3)(f).

H. The Director shall hold an annual public meeting for interested parties to review operations of the open outdoor fire program and discuss emission reduction techniques.

I. Nothing in this Section is intended to permit any practice that is a violation of any statute, ordinance, rule, or regulation.

ARTICLE 15. FOREST AND RANGE MANAGEMENT BURNS

R18-2-1501. Definitions

In addition to the definitions contained in A.R.S. ' 49-501 and R18-2-101, in this Article:

1. AActivity fuels@ means those fuels created by human activities such as thinning or logging.

~~1.~~2. "ADEQ" means the Department of Environmental Quality.

3. AAnnual emissions goal@ means the annual establishment in cooperation with the F/SLM=s, under R18-2-1503(G), of a planned quantifiable value of emissions reduction from prescribed fires and fuels management activities.

~~2. "BMP" means best management practices as described in R18-2-1509.~~

4. ABurn plan@ means the ADEQ form that includes information on the conditions under which a burn will occur with details of the burn and smoke management prescriptions.

~~3.~~5. "Burn prescription" means, with regard to a burn project, the pre-determined area, ~~intensity of heat, and rate of spread~~ fuel, and weather conditions required to attain planned resource management objectives.

~~4.~~6. "Burn project" means an active or planned prescribed burn, including a ~~prescribed natural fire~~ wildland fire use incident.

~~5. "Class I Area" means a mandatory area designated pursuant to Section 169A of the Clean Air Act Amendments of 1990.~~

~~6.~~7. "Duff" means forest floor material consisting of decomposing needles and other natural materials.

8. AEmission reduction techniques (ERT)@ means methods for controlling emissions from prescribed fires to minimize the amount of emission output per unit of area burned.

~~7.~~9. AFederal land manager (FLM)@ means any department, agency, or agent of the federal government, including the following:

   a. United States Forest Service,

   b. United States Fish and Wildlife Service,

   c. National Park Service,

   d. Bureau of Land Management,

   e. Bureau of Reclamation,

f. Department of Defense,

g. Bureau of Indian Affairs, and

h. ~~United States Soil Conservation Service.~~ Natural Resources Conservation Service.

~~8.~~10. "F/SLM" means a federal land manager or a state land manager.

~~9.~~11. "Local fire management officer" means a person designated by a F/SLM as responsible for fire management in a local district or area.

~~10.~~12. "Mop-up" means the act of extinguishing or removing burning material from a prescribed fire to reduce smoke impacts.

~~11.~~13. "National Wildfire Coordinating Group" means the national inter-agency group of federal and state land managers that shares similar wildfire suppression programs and has established standardized inter-agency training courses and qualifications for fire management positions.

14. ANon-burning alternatives to fire@ means techniques that replace fire for at least five years as a means to treat activity fuels created to achieve a particular land management objective (e.g., reduction of fuel-loading, manipulation of fuels, enhancement of wildlife habitat, and ecosystem restoration). These alternatives are not used in conjunction with fire. Techniques used in conjunction with fire are referred to as emission reduction techniques (ERTs).

~~12.~~15. "Planned resource management objectives" means public interest goals in support of land management agency objectives including silviculture, wildlife habitat management, grazing enhancement, fire hazard reduction, wilderness management, cultural scene maintenance, weed abatement, watershed rehabilitation, vegetative manipulation, and disease and pest prevention.

~~13.~~16. "Prescribed burning" means the controlled application of fire to wildland fuels that are in either a natural or modified state, under certain burn ~~prescription conditions~~ and smoke management prescription conditions that have been specified by the land manager in charge of or assisting the burn, to attain planned resource management objectives. Prescribed burning ~~includes~~ does not include a fire set or permitted by a public officer to provide instruction in fire fighting methods, or construction or residential burning under R18-2-602. ~~A prescribed fire may be ignited either by a trained fire specialist or by natural causes such as lightning.~~

~~14.~~17. "Prescribed fire manager" means a person designated by a F/SLM as responsible for prescribed burning for that land manager.

~~15. "Prescribed natural fire" means a wildland fire that is ignited by natural causes such as lightning rather than by a trained fire specialist, that is subsequently allowed to continue burning using the same controls and for the same planned resource management objectives as prescribed burning.~~

~~16.~~18. "Smoke management prescription" means the predetermined meteorological conditions that affect smoke transport and dispersion under which a burn could occur without adversely affecting public health and welfare.

19. ASmoke management techniques@ (SMT) means management and dispersion practices used during a prescribed burn or wildland fire use incident which affect the direction, duration, height, or density of smoke.

~~17.~~20. "Smoke management unit" means any of ~~11~~ the geographic areas defined by ADEQ whose area is based on primary watershed boundaries and whose ~~outlines are~~ outline is determined by diurnal windflow patterns that allow smoke to follow predictable drainage patterns. A map of the state divided into ~~11~~ the smoke management units is on file with ADEQ.

~~18.~~21. "State land manager (SLM)" means any department, agency, or political subdivision of the state government ~~that is responsible for wildland management~~ including the following:

a. State Land Department,

b. Department of Transportation,

c. Department of Game and Fish, and

d. Parks Department.

~~19.~~22. "Wildfire" means ~~a~~ an unplanned wildland fire subject to appropriate control measures ~~that does not meet resource management objectives and that may threaten life, property, public health, or the ecosystem~~. Wildfires include those incidents where suppression may be limited for safety, economic, or resource concerns.

~~20. "Wildland" means an area in which development is essentially non-existent, except for pipelines, power lines, roads, railroads, or other transportation or conveyance facilities.~~

23. AWildland fire use@ means a wildland fire that is ignited by natural causes, such as lightning, and is managed using the same controls and for the same planned resource management objectives as prescribed burning.

R18-2-1502. Applicability

A. A F/SLM that is conducting or assisting a prescribed burn shall follow the requirements of this Article.

B. A private or municipal burner with whom ADEQ has entered into a memorandum of agreement shall follow the requirements of this Article.

~~B.~~C. The provisions of this Article apply to all areas of the state except Indian Trust lands. All federally-managed lands and all state lands, parks, and forests are under the jurisdiction of ADEQ in matters relating to air pollution from prescribed burning.

~~C.~~D. Notwithstanding subsection ~~(B)~~ (C), ADEQ and any Indian tribe may enter into a memorandum of agreement to implement this Article.

E. ADEQ and any private or municipal prescribed burner may enter into a memorandum of agreement to implement this Article.

R18-2-1503. Annual Registration, Program Evaluation and Planning ~~for Prescribed Burns~~

A. Each F/SLM shall register annually with ADEQ~~,~~ on a form prescribed by ADEQ, all planned burn projects, including areas ~~considered for potential~~ ~~prescribed natural fires~~ planned for wildland fire use~~, for the following year~~.

~~C.~~B. Each planned year extends from ~~August~~ January 1 of the registration year to ~~July~~ December 31 of the same ~~following~~ year. Each F/SLM shall use best efforts to register before ~~August~~ December 31 and no later than January 31 of each year.

~~B.~~C. A F/SLM shall ~~provide~~ include the following information on the registration form:

1. The F/SLM's name, address, and business telephone number;
2. The name, address, and business telephone number of an air quality representative who will provide technical support to ADEQ for decisions regarding prescribed burning. The same air quality representative may be selected by more than one F/SLM ~~or Indian tribe~~;
3. All prescribed burn projects and potential ~~prescribed natural fire~~ wildland fire use areas planned for the next year; ~~and~~
4. Maximum project and annual acres to be burned, maximum daily acres to be burned, fuel types within project area, and planned use of emission reduction techniques to support the annual emissions goal for each prescribed burn project;
5. Planned use of any smoke management techniques for each prescribed burn project;
6. Maximum project and annual acres projected to be burned, maximum daily acres projected to be burned, and a map of the anticipated project area, fuel types and loading within the planned area for an area the F/SLM anticipates for wildland fire use;

~~4.~~7. A list of all burn projects that were completed during the previous year;

8. Project area for treatment, treatment type, fuel types to be treated, and activity fuel loading to support the annual emissions goal for areas to be treated using non-burning alternatives to fire; and
9. The area treated using non-burning alternatives to fire during the previous year including the number of acres, the specific types of alternatives utilized, and the location of these areas.

D. After consultation with the F/SLM, ADEQ may request additional information ~~related to tracking burn projects~~ for registration of prescribed burns and wildland fire use to support regional coordination of smoke management, annual emission goal setting using ERTs, and non-burning alternatives to fire.

E. A F/SLM may amend a registration at any time with a written submission to ADEQ. ~~ADEQ shall approve a new prescribed burn even if the F/SLM has failed to amend a registration if the F/SLM has complied with the other provisions of this Article.~~

F. ADEQ ~~shall accept~~ accepts a facsimile or other electronic method as a means of complying with the deadline for registration. If an electronic means is used ~~a facsimile is submitted~~, the F/SLM shall deliver the original paper registration form to ADEQ for its records. ADEQ shall acknowledge in writing the receipt of each registration. ~~If ADEQ and the F/SLMs jointly develop an electronic filing and reporting system, the original paper form may be waived, and ADEQ shall notify all F/SLMs of this change.~~

~~**G.** No later than 14 days before a F/SLM requests permission to proceed with a registered burn project other than a prescribed natural fire, the F/SLM shall submit a Burn Plan to ADEQ, as described in R18-2-1504. A Burn Plan for a prescribed natural fire shall be submitted as prescribed by R18-2-1508.~~

G. ADEQ shall hold a meeting after January 31 and before April 1 of each year between ADEQ and F/SLM=s to evaluate the program and cooperatively establish the annual emission goal. The annual emission goal shall be developed to minimize prescribed fire emissions to the maximum extent feasible using emission reduction techniques and alternatives to burning subject to economic, technical, and safety feasibility criteria, and consistent with land management objectives.

H. At least once every five years, ADEQ shall request long-term projections of future prescribed fire and wildland fire use activity from the F/SLMs to support planning for visibility impairment and assessment of other air quality concerns by ADEQ.

R18-2-1504. Prescribed Burn Plan ~~Contents~~

~~**A.**~~ Each F/SLM planning a prescribed burn ~~other than a prescribed natural fire,~~ shall complete and submit to ADEQ the "Burn Plan" form supplied by ADEQ no later than 14 days before the date on which the F/SLM requests permission to burn. ADEQ shall consider the information supplied on the Burn Plan Form as binding conditions under which the burn shall be conducted. A Burn Plan shall be maintained by ADEQ until notification from the F/SLM of the completion of the burn project.

Revisions to the Burn Plan for a burn project shall be submitted in writing no later than 14 days before the date on which the F/SLM requests permission to burn. ~~The F/SLM shall provide the following information on the "Burn Plan" form~~ To facilitate the Daily Burn authorization process under R18-2-1505, the F/SLM shall include on the Burn Plan form:

1. An emergency telephone number that is answered 24 hours a day, seven days a week;
2. Burn prescription;
3. Smoke management prescription;
4. The number of acres to be burned, the quantity and type of fuel, type of burn, and the ignition technique to be used;
5. The land management objective or purpose for the burn such as restoration or maintenance of ecological function and indicators of fire resiliency;

~~5.~~6. A map depicting the potential impact of the smoke unless waived either orally or in writing by ADEQ. The potential impact shall be determined by mapping both the daytime and nighttime smoke path and down-drainage flow for 15 miles from the burn site, with smoke-sensitive areas delineated. The map shall use the appropriate scale to show the impacts of the smoke adequately;

~~6.~~7. Modeling of smoke impacts unless waived either orally or in writing by ADEQ, for burns greater than 250 acres per day, or greater than 50 acres per day if the burn is within 15 miles of a Class I Area, an area that is non-attainment for particulates, a carbon monoxide non-attainment area, or other smoke-sensitive area. ~~Air quality modeling for these areas is mandatory unless waived either verbally or in writing by ADEQ.~~ In consultation with the F/SLM, ADEQ shall provide guidelines on modeling;

~~7.~~8. The name of the official submitting the Burn Plan on behalf of the F/SLM; and

~~8.~~9. After consultation with the F/SLM, any other information to support the Burn Plan needed by ADEQ to assist in the Daily Burn authorization process for smoke management purposes or assessment of contribution to visibility impairment of Class I areas.

~~**B.** A Burn Plan shall be submitted for a prescribed natural fire as prescribed by R18-2-1508.~~

R18-2-1505. Prescribed Burn Requests and Authorization

A. Each F/SLM planning a prescribed burn, ~~other than a prescribed natural fire~~, shall complete and submit to ADEQ the "Daily Burn Request" form supplied by ADEQ. The ~~F/SLM shall include the following information on the~~ Daily Burn Request form shall include:

1. The contact information of the F/SLM conducting the burn;

2. Each day of the burn;

~~2.~~3. The area to be burned ~~per~~ on the day for which the Burn Request is submitted, with reference to the Burn Plan, including size, ~~and~~ legal location to the section, and latitude and longitude to the minute;

4. Projected smoke impacts; and

~~3.~~5. Any local conditions or circumstances known to the F/SLM that, if conveyed to ADEQ, could impact the Daily Burn authorization process.

B. After consultation with the F/SLM, ADEQ may request additional information related to the burn, meteorological, smoke dispersion, or air quality conditions to supplement the Daily Burn Request form and to aid in the Daily Burn authorization process. ~~This information may include same day on-site and area meteorological, smoke dispersion, or air quality measurements.~~

C. The F/SLM shall submit the Daily Burn Request form to ADEQ as expeditiously as practicable, but no later than 2 p.m. of the business day preceding the burn. An original form, a facsimile, or an electronic information transfer are acceptable submittals.

D. An F/SLM shall not ignite a prescribed burn without receiving the approval of ADEQ, as follows:

1.~~**D.**~~ ADEQ shall approve, approve with conditions, or disapprove a burn on the same business day as the Burn Request submittal.

2. If ADEQ fails to address a Burn Request by 10 p.m. of the business day on which the request is submitted, the Burn Request is approved by default after the burner makes a good faith effort to contact ADEQ to confirm that the Burn Request was received.

3. ADEQ may communicate its decision by verbal, written, or electronic means. ADEQ shall provide a written or electronic reply if requested by the F/SLM. ~~If ADEQ does not communicate its decision, or a confirmation that the Burn Request was received, by 10 p.m., the burn is deemed approved.~~

~~**E.** Except as provided in subsection (D), an F/SLM shall not ignite a prescribed burn without receiving the approval of ADEQ.~~

~~**F.**~~**E.** If weather conditions cease to conform to those in the smoke management prescription of either the Burn Plan or an Approval with Conditions, the F/SLM shall ~~cease ignitions and~~ take appropriate action to reduce further smoke impacts, ensure safe and appropriate fire control, and notify the public when necessary.~~, unless after~~ After consultation with ADEQ, the smoke management prescription or burn plan may be ~~is~~ modified.

F. The F/SLM shall ensure that there is appropriate signage and notification to protect public safety on transportation corridors including roadways and airports during a prescribed fire.

~~**G.** Burn authorization for prescribed natural fires shall be as prescribed by R18-2-1508.~~

~~**H.** The F/SLM in whose jurisdiction a wildfire occurs shall report all wildfires greater than 100 acres on a daily basis to ADEQ. The F/SLM shall include in the report the location, estimated control date, and estimated incident size of each wildfire. The F/SLM shall provide information on projected smoke and air quality impacts and on estimated control size upon request by ADEQ.~~

R18-2-1506. Smoke Dispersion Evaluation

ADEQ shall approve, approve with conditions, or disapprove a Daily Burn Request submitted ~~pursuant to~~ under R18-2-1505, by using the following factors for each smoke management unit:

1. Analysis of the emissions from burns in progress and residual emissions from previous burns on a day-to-day basis;
2. Analysis of emissions from active ~~prescribed natural fires~~ wildland fire use incidents, and active multiple-day burns, and consideration of potential long-term emissions estimates;
3. Analysis of the emissions from wildfires greater than 100 acres and consideration of their potential long-term growth;
4. Local burn conditions;
5. Burn prescription and smoke management prescription from the applicable Burn Plan;
6. Existing and predicted local air quality;
7. Local and synoptic meteorological conditions;
8. Type and location of areas to be burned;
9. Protection of the national visibility goal for Class I Areas ~~pursuant to~~ under ' 169A(a)(1) of the Act and 40 CFR 51.309; ~~and~~
10. Assessment of duration and intensity of smoke emissions to minimize cumulative impacts;

~~10.~~11. Minimization of smoke impacts in Class I Areas, ~~roads or highways, airports~~, areas that are non-attainment for particulate matter, carbon monoxide non-attainment areas, or other smoke-sensitive areas~~.~~; and

12. Protection of the National Ambient Air Quality Standards.

R18-2-1507. Prescribed Burn Accomplishment; ~~ADEQ Recordkeeping;~~ Wildfire Reporting

A. Each F/SLM conducting a prescribed burn shall complete and submit to ADEQ the "Burn Accomplishment" form supplied by ADEQ. For each burn approval, the F/SLM shall submit a Burn

Accomplishment form to ADEQ by 2 p.m. of the business day following the approved burn. The F/SLM shall include the following information on the Burn Accomplishment form:

1. Any known conditions or circumstances that could impact the Daily Burn decision process;
2. The ~~subsequent~~ date, location, fuel type, fuel loading, and acreage accomplishments;
3. The ~~BMP~~ ERTs and SMTs ~~for emission reduction~~ described in R18-2-1509 and R18-2-1510, respectively, and may include any further ERTs and SMTs that become available, that the F/SLM used to reduce emissions or manage the smoke from the burn.

~~**B.** For each burn approval, the F/SLM shall submit a Burn Accomplishment form to ADEQ by 2 p.m. of the business day following the approved burning.~~

~~C.~~B. The F/SLM shall submit the Burn Accomplishment form as an original form, a facsimile, or an electronic information transfer.

~~D.~~C. ADEQ shall maintain a record of Burn Requests, Burn Approvals/Conditional Approvals/Denials and Burn Accomplishments for ~~5~~ five years.

D. The F/SLM in whose jurisdiction a wildfire occurs shall make available to ADEQ no later than the day after the activity all required information for wildfire incidents that burned more than 100 acres per day in timber or slash fuels or 300 acres per day in brush or grass fuels. For each day of a wildfire incident that exceeds the daily activity threshold, the F/SLM shall provide the location, an estimate of predominant fuel type and quantity consumed, and an estimate of the area blackened that day.

R18-2-1508. ~~Prescribed Natural Fires;~~ Wildland Fire Use: Plan~~;~~, Authorization~~;~~, Monitoring; Inter-agency Consultation; Status Reporting

A. In order for ADEQ to participate in the wildland fire use decision-making process, the ~~A~~ F/SLM shall notify ADEQ as soon as practicable of any ~~potential~~ wildland fire use incident ~~prescribed natural fire when it is~~ projected to attain or attaining a size of 50 acres of timber fuel or 250 acres of brush or grass fuel.

B. For each wildland fire use incident ~~prescribed natural fire~~ that has been declared as such by the F/SLM, the F/SLM shall complete and submit to ADEQ a Wildland Fire Use Burn ~~prescribed natural fire~~ Plan in a format approved by ADEQ in cooperation with the F/SLM. The F/SLM shall submit the Wildland Fire Use Burn ~~prescribed natural fire~~ Plan to ADEQ as soon as practicable but no later than 72 hours after the wildland fire use incident ~~prescribed natural fire~~ is declared or under consideration for such designation ~~1st observed~~. The F/SLM shall include the following information in the

Wildland Fire Use Burn ~~prescribed natural fire~~ Plan:

1. An emergency telephone number that is answered 24 hours a day, seven days a week;
2. Anticipated burn prescription ~~and anticipated emissions~~;
3. Anticipated smoke management prescription;

~~3.~~4. The estimated daily ~~anticipated~~ ~~growth in the~~ number of acres, quantity, and type of fuel to be ~~potentially~~ burned;

~~4.~~5. The anticipated maximum allowable perimeter or size with map;

~~5.~~6. ~~The type or types of fuel involved;~~ Information on the condition of the area to be burned, such as whether it is in maintenance or restoration, its ecological function, and other indicators of fire resiliency;

~~6.~~7. The anticipated duration of the wildland fire use incident ~~prescribed natural fire~~;

~~7.~~8. The anticipated long-range weather trends for the site ~~onsite~~;

~~8.~~9. A map depicting the potential impact of the smoke. The potential impact shall be determined by mapping both the daytime and nighttime smoke path and down-drainage flow for 15 miles from the wildland fire use incident ~~burn site~~, with smoke-sensitive areas delineated. Mapping is mandatory unless waived either orally or in writing by ADEQ. The map shall use the appropriate scale to show the impacts of the smoke adequately; ~~The map shall use the standard agency scale for that F/SLM;~~ and

~~9.~~10. Modeling or monitoring of smoke impacts, if requested by ADEQ after consultation with the F/SLM.

C. ADEQ shall approve or disapprove a Wildland Fire Use Burn ~~prescribed natural fire~~ Plan within ~~3~~ three hours of receipt. ADEQ shall consult directly with the requesting F/SLM before disapproving a Wildland Fire Use Burn ~~prescribed natural fire~~ Plan. If ADEQ fails to address the Wildland Fire Use Burn Plan within the time allotted, the Plan is approved by default under the condition that the F/SLM makes a good faith effort to contact ADEQ to confirm that the Plan was received. ~~If ADEQ fails to respond to the submittal of the prescribed natural fire Plan, approval of the prescribed natural fire may be assumed by the F/SLM.~~ Approval by ADEQ of a Wildland Fire Use Burn ~~prescribed natural fire~~ Plan ~~shall be~~ is binding upon ADEQ for the duration of the wildland fire use incident ~~prescribed natural fire project~~, unless smoke from the incident ~~prescribed natural fire~~ creates a threat to public health or welfare. If a threat to public health or welfare is created, ADEQ shall consult with the F/SLM regarding the situation and ~~the development of~~ develop a joint action plan for reducing further smoke impacts.

D. The F/SLM shall submit a Daily Status Report for each wildland fire use incident ~~prescribed natural~~

~~fire~~ to ADEQ for each day of the burn that the fire burns more than 100 acres in timber or slash fuels or 300 acres in brush or grass fuels ~~perimeter increases~~. The F/SLM shall include a synopsis of smoke behavior, future daily anticipated growth, and location of the activity of the wildland fire use incident ~~prescribed natural fire~~ in the Daily Status Report.

E. The F/SLM shall consult with ADEQ prior to initiating human-made ignition on the wildland fire use incident when greater than 250 acres is anticipated to be burned by the ignition. Emergency human-made ignition on the incident for protection of public or fire-fighter safety does not require consultation with ADEQ regardless of the size of the area to be burned.

F. The F/SLM shall ensure that there is appropriate signage and notification to protect public safety on transportation corridors including roadways and airports during a wildland fire use incident.

R18-2-1509. Emission Reduction Techniques~~; BMP~~

A. Each F/SLM conducting a prescribed burn shall implement as many Emission Reduction Techniques ~~BMP for emission reduction~~ as are feasible subject to economic, technical, and safety feasibility criteria, and land management objectives. ~~for the specific burn and shall include the BMP in the Burn Accomplishment submitted pursuant to R18-2-1507.~~

B. ~~The following measures are considered~~ Emission Reduction Techniques include ~~BMP~~:

1. Reducing biomass to be burned by use of techniques such as yarding or consolidation of unmerchandisable material, multi-product timber sales, or public firewood access, when economically feasible. ~~When allowing public firewood access, provide information on the adverse impacts of using green or wet wood as fuel~~;
~~2. Burning in seasons characterized by meteorological conditions that allow for good smoke dispersion, especially March 15 through September 15;~~
2. Reducing biomass to be burned by fuel exclusion practices such as preventing the fire from consuming dead snags or dead and downed woody material through lining, application of fire-retardant foam, or water;
3. Using mass ignition techniques such as aerial ignition by helicopter to produce high intensity fires of high fuel density areas such as logging slash decks ~~with short duration impacts~~;
~~4. Igniting burns under good-to-excellent ventilation conditions and suspending operations under poor smoke dispersion conditions;~~
~~5. Considering smoke impacts on local community activities and land users;~~
~~6.~~4. Burning only fuels essential ~~fuels~~ to meet resource management objectives;
~~7.~~5. Minimizing ~~duff~~ consumption and smoldering by burning under conditions of high ~~through~~

fuel moisture of duff and litter ~~considerations~~;

6. Minimizing fuel consumption and smoldering by burning under conditions of high fuel moisture of large woody fuels;

~~8.~~7. Minimizing ~~dirt~~ soil content when slash piles are constructed by using brush blades on material-moving equipment and by constructing piles under dry soil conditions or by using hand piling methods;

8. Burning fuels in piles;

~~9. Burning piles when other burns are not feasible, such as when snow or rain is present;~~

9. Using a backing fire in grass fuels;

~~10. Using all opportunities that meet the burn prescription and all burn locations to spread smoke impacts over a broader time period and geographic area;~~

10. Burning fuels with an air curtain destructor, as defined in R18-2-101, operated according to manufacturer specifications and meeting applicable state or local opacity requirements;

~~11. Burning during optimum mid-day dispersion hours, with all ignitions in a burn unit completed by 3 p.m. to prevent trapping smoke in inversions or diurnal windflow patterns;~~

11. Extinguishing or mopping-up of smoldering fuels;

12. ~~Using chunking~~ Chunking of piles and other consolidations of burning material to enhance flaming and fuel consumption, and to minimize smoke production;

~~13. Implementing maintenance burning in a periodic rotation mimicking natural fire cycles to reduce excessive fuel accumulations and subsequent excessive smoke production through smoldering or wildfire;~~

13. Burning before litter fall;

~~14. Using prescribed natural fires and unplanned ignitions; and~~

14. Burning before green-up of fuels;

~~15. Managing smoke impacts as follows:~~

   ~~a. Limiting smoke impacts to roads, highways, and airports to the amounts, frequencies, and durations consistent with any guidance provided by highway and airport personnel;~~

   ~~b. Using appropriate signing if smoke will impact any roadways;~~

   ~~c. Notifying control towers if smoke will intrude in any air traffic control zone;~~

   ~~d. Determining nighttime impacts and taking appropriate precautions; and~~

   ~~e. Contacting appropriate authorities as needed regarding smoke or visibility impacts.~~

15. Burning before recently cut large fuels cure in areas with activity; and

16. Burning just before precipitation to reduce fuel smoldering and consumption.

R18-2-1510. Smoke Management Techniques

A. Each F/SLM conducting a prescribed burn shall implement as many Smoke Management Techniques as are feasible subject to economic, technical, and safety feasibility criteria, and land management objectives.

B. Smoke management techniques include:

1. Burning from March 15 through September 15, when meteorological conditions allow for good smoke dispersion;
2. Igniting burns under good-to-excellent ventilation conditions;
3. Suspending operations under poor smoke dispersion conditions;
4. Considering smoke impacts on local community activities and land users;
5. Burning piles when other burns are not feasible, such as when snow or rain is present;
6. Using mass ignition techniques such as aerial ignition by helicopter to produce high intensity fires with short duration impacts;
7. Using all opportunities that meet the burn prescription and all burn locations to spread smoke impacts over a broader time period and geographic area;
8. Burning during optimum mid-day dispersion hours, with all ignitions in a burn unit completed by 3 p.m. to prevent trapping smoke in inversions or diurnal windflow patterns;
9. Providing information on the adverse impacts of using green or wet wood as fuel when public firewood access is allowed;
10. Implementing maintenance burning in a periodic rotation to shorten prescribed fire duration and to reduce excessive fuel accumulations that could result in excessive smoke production in a wildfire; and
11. Using wildland fire-use strategies to shift smoke into more favorable smoke dispersion seasons.

~~R18-2-1510.~~ R18-2-1511. Monitoring

A. ADEQ may require a F/SLM to monitor ~~weather and~~ air quality before or during a prescribed burn or a ~~excluding~~ wildland fire use incident ~~prescribed natural fires, which are governed by R18-2-1508,~~ if necessary to ~~accurately predict~~ assess smoke impacts. Air quality monitoring may be conducted using both federal and non-federal reference method as well as other techniques.

B. ADEQ may require a F/SLM to monitor weather before or during a prescribed burn or a wildland fire use incident, if necessary to predict or assess smoke impacts. After consultation with the F/SLM, ADEQ may also require the F/SLM to establish burn site or area-representative remote automated weather stations or their equivalent, having telemetry that allows retrieval on a real-time basis by ADEQ. An F/SLM shall give ADEQ notice and an opportunity to comment before making any change to a long-term established remote automated weather station.

~~B.~~C. A F/SLM shall employ the following types of monitoring, unless waived by ADEQ, for burns greater than 250 acres per day, or greater than 50 acres per day if the burn is within 15 miles of a Class I Area, an area that is non-attainment for particulate matter, ~~a~~ carbon monoxide, or ozone ~~non-attainment area~~, or other smoke-sensitive area:

1. Smoke plume measurements, using a format supplied by ADEQ; and

~~1.~~2. The release of pilot balloons (PIBALs) at the burn site to verify needed wind speed, direction, ~~or~~ and stability.~~; and~~

~~2. Smoke plume measurements, using a format supplied by ADEQ.~~

Instead of pilot balloons, a test burn at the burn site may be used for specific prescribed burns on a case-by-case basis as approved by ADEQ, to verify needed wind speed, direction, and stability.

~~C.~~D. ~~A~~ An F/SLM shall make monitoring information required ~~pursuant to~~ under subsection ~~(B)~~(C) available to ADEQ on the business day following the burn ignition.

~~**D.** After consultation with the F/SLM, ADEQ may also require the F/SLM to establish burn site or area-representative remote automated weather stations or their equivalent, having telemetry that allows retrieval on a real-time basis by ADEQ, if necessary to accurately predict smoke impacts.~~

E. The F/SLM shall keep on file for ~~1~~ one year following the burn date any monitoring information required ~~pursuant to~~ under this Section.

~~R18-2-1511.~~ R18-2-1512. Burner Qualifications

A. All ~~burns~~ burn projects shall be conducted by personnel trained in prescribed fire and smoke management techniques ~~to the minimum level~~ as required by the F/SLM in charge of the burn and established by National Wildfire Coordinating Group training qualifications.

B. A Prescribed Fire ~~Manager~~ Boss or other local Fire Management Officer of the F/SLM having jurisdiction over prescribed burns shall have smoke management training obtained through one of the following:

1. Successful completion of a National Wildfire Coordinating Group or F/SLM-equivalent course ~~dedicated to~~ addressing smoke management; or

2. Attendance at an ADEQ-approved smoke management workshop.

~~R18-2-1512.~~ R18-2-1513. Public Notification and Awareness Program; Regional Coordination

A. ~~At the Director's discretion,~~ The Director shall conduct a public education and awareness program ~~may be conducted by ADEQ~~ in cooperation with F/SLMs and other interested parties to inform the general public of the smoke management program described by this Article. ~~If conducted, the~~ The program shall include smoke impacts from prescribed fires and the role of prescribed fire in natural ecosystems.

B. ADEQ shall make annual registration, prescribed burn approval, and wildfire and wildland fire use activity information readily available to the public and to facilitate regional coordination efforts and public notification.

~~R18-2-1514. Oversight~~

~~**A.** An F/SLM planning to make a change to any long-term established remote automated weather station shall give ADEQ notice and an opportunity to comment before making the change.~~

~~**B.** On or before August 15 of each year, each F/SLM shall submit to ADEQ a report generally describing each of the following:~~

~~1. The emissions reductions for each project from the previous year as a result of using BMP. Emissions reductions may be estimated using methods and emission factors developed jointly by ADEQ and F/SLMs;~~

~~2. The smoke management cost estimates for each active project from the previous year including estimates for monitoring, training, applying emission reduction techniques, research, and compliance with the requirements of this Article; and~~

~~3. Any research on or development of innovative techniques for emission reductions.~~

~~R18-2-1513.~~ R18-2-1514. Surveillance and Enforcement

A. An F/SLM conducting a prescribed burn shall permit ADEQ to enter and inspect burn sites unannounced to verify the accuracy of the Daily Burn Request, Burn Plan, or Accomplishment data ~~described pursuant to R18-2-1505~~ as well as matching burn approval with actual conditions, ~~and~~ smoke dispersion, and air quality impacts. On-ground site inspection procedures and aerial surveillance shall be coordinated by ADEQ and the F/SLM for safety purposes.

B. ADEQ may use remote automated weather station data if necessary to verify current and previous meteorological conditions at or near the burn site.

C. ADEQ may audit burn accomplishment data, smoke dispersion measurements, or weather measurements from previously conducted burns, if necessary to verify conformity with, or deviation from, procedures and authorizations approved by ADEQ.

D. Deviation from procedures and authorizations approved by ADEQ constitute a violation of this Article. Violations may require containment or mop-up of any active burns and may also require, in the Director's discretion, a ~~5~~ five-day moratorium on ignitions by the responsible F/SLM. Violations of this Article are also subject to a civil penalty of not more than $10,000 per day per violation ~~pursuant to~~ under A.R.S. ' 49-463.

R18-2-1515. Forms; Electronic Copies; Information Transfers

A. ADEQ shall make available on paper and in electronically-readable format any form required to be developed by ADEQ and completed by a F/SLM.

B. After consultation with ~~the~~ an F/SLM, ADEQ may require ~~each~~ the F/SLM to provide data in a manner that ~~allows for and~~ facilitates electronic transfers of information.

<u>Appendix A-10d. Supporting Documents Related to the Promulgation of Revised Arizona R18-2-602, "Unlawful Open Burning" and Article 15, "Forest and Range Management Burns"</u>

PUBLIC NOTICE

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY NOTICE OF PUBLIC HEARINGS ON PROPOSED REVISIONS TO ARIZONA ADMINISTRATIVE CODE (A.A.C.) R18-2-602, UNLAWFUL OPEN BURNING, ARTICLE 15, FOREST AND RANCE MANAGEMENT BURNS

The Arizona Department of Environmental Quality will hold public hearings to receive comments on proposed revisions to A.A.C. R18-2-602, "Unlawful Open Burning," and Article 15, "Forest and Range Management Burns." The proposed revisions will make the rules conform to EPA regulations for states' Regional Haze SIPs (state implementation plans), as well as improve the rules' clarity, concieseness and understandability.

The public hearings in the proposed revisions to A.A.C. R18-2-602 and to Article 15 will be held in Yuma, Casa Grande, Show Low, and Flagstaff, as follows: Monday, October 20 at 1:30 p.m. at Yuma Department of Public Works, Training Room, 155 W. 14th St., Yuma, AZ 85364; Tuesday, October 21 at 1:30 p.m. at Casa Grande Parks & Recreation Office, Armadillo Room, 440 E. Florence Blvd., Casa Grande, AZ 85222; Wednesday, October 22, 2003 at 1:30 p.m. at Show Low City Hall, Council Chambers, 200 W. Cooley, Show Low, AZ 85901; and Thursday, October 23, 2003, 1:30 p.m. at Flagstaff City-Coconino County Public Library, 300 W. Aspen, Flagstaff, AZ 86001. Interested parties will be given an opportunity at the public hearings to submit relevant comments, data, and views, orally, and in writing. Written comments must be received by 5:00 pm, Friday, October 24, 2003, and should be addressed, faxed, or e-mailed to:

Kevin Force
Air Quality Planning Section
Arizona Department of Environmental Quality, 3415A-3
1110 W. Washington St.
Phoenix, AZ 85007
PHONE: (602) 771-4480; FAX (602) 771-2366
E-mail: kfl@ev.state.az.us

Copies of the proposed rule revisions are available for review beginning Friday, September 19, 2003 at the following location:

Arizona Department of Environmental Quality Library,
First Floor 1110 W. Washington St. Phoenix, AZ 85007
Attn: Lorraine Akey (602) 771-2217

Copies of the proposed rule revisions are also available on the ADEQ website, at: http://www.adeq.state.az.us/about/draftrules.html#open

03537-September 19, 2003

AFFIDAVIT OF PUBLICATION

THE ARIZONA REPUBLIC

STATE OF ARIZONA
COUNTY OF MARICOPA } SS.

Gloria Saldivar, being first duly sworn, upon oath deposes and says: That she is a legal advertising representative of the Arizona Business Gazette, a newspaper of general circulation in the county of Maricopa, State of Arizona, published at Phoenix, Arizona, by Phoenix Newspapers Inc., which also publishes The Arizona Republic, and that the copy hereto attached is a true copy of the advertisement published in the said paper on the dates as indicated.

The Arizona Republic

September 19, 2003

Gloria Saldivar

Sworn to before me this
22ND day of
September A.D. 2003

OFFICIAL SEAL
MARILYN GREENWOOD
NOTARY PUBLIC-ARIZONA
MARICOPA COUNTY
My Comm. Expires May 23, 2007

Marilyn Greenwood
Notary Public

Arizona Daily Star
www.azstarnet.com

Tucson Citizen
www.tucsoncitizen.com

TUCSON'S NEWSPAPERS
www.tucson.com

PUBLIC NOTICE

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Kevin Force, Air Quality Planning Section, Arizona Department of Environmental Quality, 3415A-3, 1110 W. Washington St., Phoenix, AZ 85007, PHONE: (602) 771-4480; FAX: (602) 771-2366, E-mail: kf1@ev.state.az.us

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Publish September 19, 2003
The Arizona Daily Star
Tucson Citizen

STATE OF ARIZONA
COUNTY OF PIMA

Janice Anderson, being first duly sworn, upon oath deposes and says:

That he/she is the agent of TUCSON NEWSPAPERS, publishers of THE ARIZONA DAILY STAR / TUCSON CITIZEN, newspapers of general circulation in the County of Pima, State of Arizona, published at Tucson, Arizona, and that the statement hereto attached is a true representation of the advertisement published in the said paper(s) 1 times on the following days:

Sep 19 2003 in class 918 T-Tucson Classifieds - Daily

Janice Anderson
Agent

Subscribed and sworn to before me this 19th day of September, A.D. 2003

VALERIE S. GONZALES
Notary Public – Arizona
Pima County
Expires 09/30/06

My Commission Expires

Notary Public Valerie S Gonzales

M262205855701

AFFIDAVIT/PROOF OF PUBLICATION

STATE OF ARIZONA

} ss.

County of Coconino

Bobbie Crosby being duly sworn, deposes and says:

That she is the legal clerk of the Arizona Daily Sun

a newspaper published at Flagstaff, Coconino County, Arizona; that the

legal 4948

a copy of which is hereunto attached, was first published in said newspaper in its issue dated the 19 day of September, 2003, and was published in each one issue of said newspaper for one consecutive day the last publication being in the issue dated the 19 day of September, 2003.

Subscribed and sworn to before me this 1st day of Oct, 2003

"OFFICIAL SEAL"
Joeyanne Jaimes
Notary Public-Arizona
Coconino County
My Commission Expires 9/2/2006

Notary Public

My Commission expires 9/2/2006

Legal No. 4948
PUBLIC NOTICE
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY NOTICE OF PUBLIC HEARINGS ON PROPOSED REVISIONS TO ARIZONA ADMINISTRATIVE CODE (A.A.C.) R18-2-602, UNLAWFUL OPEN BURNING, ARTICLE 15, FOREST AND RANGE MANAGEMENT BURNS

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The public hearings on the proposed revisions to A.A.C. R18-2-602 and to Article 15 will be held on Thursday, October 23, 2003, 1:30 p.m. at Flagstaff City-Coconino County Public Library, 300 W. Aspen, Flagstaff, AZ 86001. Interested parties will be given an opportunity at the public hearings to submit relevant comments, data, and views, orally, and in writing. Written comments must be received by 5:00 p.m., Friday, October 24, 2003, should be addressed, faxed, or e-mailed to: Kevin Force
Air Quality Planning Section
Arizona Department of Environmental Quality, 3415A-3
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Publisher's Affidavit of Publication

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STATE OF ARIZONA }
COUNTY OF YUMA }

PUBLIC NOTICE

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY NOTICE OF PUBLIC HEARINGS ON PROPOSED REVISIONS TO ARIZONA ADMINISTRATIVE CODE (A.A.C.) R18-2-602, UNLAWFUL OPEN BURNING, ARTICLE 15, FOREST AND RANGE MANAGEMENT BURNS

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Copies of the proposed rule revisions are also available on the ADEQ website at: http://www.adeq.state.az.us/about/draftrules.html#open
Daily September 19, 2003 #L27209

Julie Moreno or Lee Knapp, having been first duly sworn, deposes and says: that The Sun is a newspaper of general circulation published daily in the City of Yuma, County of Yuma, State of Arizona; that (s)he is the publisher or business manager of said paper; that the

PUBLIC NOTICE

a printed copy of which, as it appeared in said paper, is hereto attached and made a part of this affidavit, was published in The Sun

For ONE issues; that the date of the first publication of said PUBLIC NOTICE

was SEPTEMBER 19 ,2003 and the date of the last publication being SEPTEMBER 19 ,2003 and that the dates when said

PUBLIC NOTICE

was printed and published in said paper were

SEPTEMBER 19, 2003

Lee Knapp

Subscribed and sworn to before me, by the said Julie Moreno or Lee Knapp

22nd day of September, 2003

Virgen P. Perez Notary Public

My commission expires May 10, 2005

VIRGEN P. PEREZ
Notary Public, Yuma Co., AZ
My Comm. Expires May 10, 2005

PLEASE NOTE:

A certified copy of the ad for the fire rule public hearing in the Show Low area paper is not available; however, a copy of the invoice showing that an ad was placed in the area paper is attached.

PRINTERS PUBLISHERS

INVOICE

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White Mountain Independent • Wampum Saver • Mountain Skies • White Mountain Realty Guide
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P.O. Box 1570 • Show Low, Arizona 85902 • (928) 537-5721
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Arizona Dept. of Environmental Quality
1110 West Wasington St., 3415B-3
Phoenix, AZ 85007
ATTN: Lhamo LeMoine

ACCOUNT #50439C-Quote
DATE: September 11, 2003
Legal #:

Equipment to do Fine Printing – Craftsmen who do it Serving Navajo and Apache Counties

QUANTITY	DESCRIPTION	PRICE
	RE: Public Notice	
1 run @ 4.75"	Legal Publication @ $6.91 per column inch (1st insertion)	$ 32.82
~~1 run @ 5"~~	Legal Publication @ $6.00 per column inc(add'l inserts)	$ .00
	Subtotal	$ 32.82
	2% Tax	$ .66
	Total Due	$ 33.48

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ADEQ
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te Affidavits Mailed__________

PAID 9/22/03
CHECK NO. Credit Card
DATE 33.48
LL

NOTICES OF PROPOSED RULEMAKING

Unless exempted by A.R.S. § 41-1005, each agency shall begin the rulemaking process by first submitting to the Secretary of State's Office a Notice of Rulemaking Docket Opening followed by a Notice of Proposed Rulemaking that contains the preamble and the full text of the rules. The Secretary of State's Office publishes each Notice in the next available issue of the *Register* according to the schedule of deadlines for *Register* publication. Under the Administrative Procedure Act (A.R.S. § 41-1001 et seq.), an agency must allow at least 30 days to elapse after the publication of the Notice of Proposed Rulemaking in the *Register* before beginning any proceedings for making, amending, or repealing any rule. (A.R.S. §§ 41-1013 and 41-1022)

a. Proof of at least twenty-four hours of training in interpreting each year that a valid certification is not held or EIPA passing score is not attained, and
b. Documentation of a plan for the individual to meet the required qualifications within three years of employment. If the qualifications are not attained within three years, but progress toward attainment is demonstrated, the plan shall be modified to include an intensive program for up to one year to meet the provisions of subsection (B)(1).

3. An individual employed under the provisions of subsection (2) of this rule must also have the following:
   a. A valid fingerprint clearance card, and
   b. A high school diploma or GED.

C. Compliance with these rules will be reviewed at the same time as a PEA is monitored for compliance with the requirements of the Individuals with Disabilities Education Act (IDEA).

NOTICE OF PROPOSED RULEMAKING

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR POLLUTION CONTROL

PREAMBLE

1. Sections Affected — Rulemaking Action

Sections Affected	Rulemaking Action
R18-2-602	Amend
R18-2-1501	Amend
R18-2-1502	Amend
R18-2-1503	Amend
R18-2-1504	Amend
R18-2-1505	Amend
R18-2-1506	Amend
R18-2-1507	Amend
R18-2-1508	Amend
R18-2-1509	Amend
R18-2-1510	New Section
R18-2-1511	Renumber
R18-2-1511	Amend
R18-2-1512	Renumber
R18-2-1512	Amend
R18-2-1513	Renumber
R18-2-1513	Amend
R18-2-1514	Repeal
R18-2-1514	Renumber
R18-2-1514	Amend
R18-2-1515	Amend

2. The statutory authority for the rulemaking, including both the authorizing statute (general) and the statutes the rules are implementing (specific):

Authorizing statutes: A.R.S. §§ 49-414, 49-414.01, and 49-425

Implementing statute: A.R.S. § 49-501

3. A list of all previous notices appearing in the Register addressing the proposed rules:

Notice of Rulemaking Docket Opening: 9 A.A.R. 3386, August 1, 2003

4. The name and address of agency personnel with whom persons may communicate regarding the rulemaking:

Name: Kevin Force

Address: Arizona Department of Environmental Quality
1110 W. Washington
Phoenix, AZ 85007

Telephone: (602) 771-4480 (This number may be reached in-state by dialing 1-800-234-5677 and requesting the seven digit number.)

Fax: (602) 771-2366

5. An explanation of the rules, including the agency's reasons for initiating the rules:

Summary. This proposed rule would amend Arizona's existing open burning and prescribed burning rules to make them conform to EPA requirements for states' Regional Haze State Implementation Plans. In addition, these amendments make other technical changes, including improvements of the rules' clarity, conciseness, and understandability.

Regional Haze SIP Requirements. The proposed revisions to R18-2-602 and Article 15 will allow the state's Regional Haze SIP that Arizona is required to submit to EPA by December 31, 2003, to meet the approvability test. (40 CFR 51.309(c)) The specific requirements for state regional haze SIPs are found at 40 CFR 51.308 and 51.309.

Under 40 CFR 51.309(d)(6), *Programs Related to Fire*, the plan must provide for:

"(i) Documentation that all Federal, State, and private prescribed fire programs within the State evaluate and address the degree visibility impairment from smoke in their planning and application. In addition the plan must include smoke management programs that include all necessary components including, but not limited to, actions to minimize emissions, evaluation of smoke dispersion, alternatives to fire, public notification, air quality monitoring, surveillance and enforcement, and program evaluation.

(ii) A statewide inventory and emissions tracking system (spatial and temporal) of VOC, NOX, elemental and organic carbon, and fine particle emissions from fire. In reporting and tracking emissions from fire from within the State, States may use information from regional data-gathering and tracking initiatives.

(iii) Identification and removal wherever feasible of any administrative barriers to the use of alternatives to burning in Federal, State, and private prescribed fire programs within the State.

(iv) Enhanced smoke management programs for fire that consider visibility effects, not only health and nuisance objectives, and that are based on the criteria of efficiency, economics, law, emission reduction opportunities, land management objectives, and reduction of visibility impact.

(v) Establishment of annual emission goals for fire, excluding wildfire, that will minimize emission increases from fire to the maximum extent feasible and that are established in cooperation with States, tribes, Federal land management agencies, and private entities."

In early 2002, ADEQ's Regional Haze stakeholders established a Fire Emissions Work Group (FEWG) to discuss visibility issues related to fire emissions and make recommendations to ADEQ for the Regional Haze SIP. Fifteen stakeholders, representing public and private entities in geographically diverse areas of the state, agreed to participate in the work group.

The FEWG held a series of meetings from June 2002 through May 2003 to learn about and discuss options for all categories of burning activities that occur in the state. The draft rules were presented at pubic workshops in Casa Grande, Flagstaff, Phoenix, Show Low, and Yuma from April 10-17, 2003. The extensive meeting schedule was proposed by work group members in order to provide local access to the rulemaking process and obtain early input from sectors of the community who would be most affected by these rules. The current proposed rule is a joint effort of ADEQ and the FEWG based on input received at those public meetings and the decisions of the FEWG.

Structure of open burning authority in Arizona. A.R.S. § 49-425 provides ADEQ with general air quality rule authority, including authority to promulgate rules for open burning permits. It requires the Director to adopt rules determined necessary and feasible "to reduce the release into the atmosphere of air contaminants originating within the territorial limits of the state." A.R.S. § 49-501 adds related authority by excepting from its provisions those open outdoor fires that are permitted by any rule issued pursuant to A.R.S. § 49-425 (see subsections (C)(5) and in (E)) by allowing the director to delegate authority to issue open burn permits to a "county, city, town, or fire district." A.R.S. § 49-414.01(A) sets forth regional haze goals and requires the Director to submit a plan to EPA that addresses "programs related to emissions from fire sources" "as necessary to submit an approvable plan" and authorizes rules necessary for the revisions to the state implementation that address regional haze."

R18-2-602 and a related statute, A.R.S. § 49-501, govern open burning activities under ADEQ's jurisdiction. A.R.S. § 49-501 was last amended in 1997. In 1996, the delegation subsection (E) was added. In 1994, the general permit for household waste was added. Based on the statute and rule, ADEQ published guidelines on open burning in February, 1997.

Proposed Open Burning Revisions

At the public meetings mentioned above, the three frequent topics for comment were: time-of-day burning restrictions in R18-2-602(D)(3), permitting requirements for air curtain destructors, sometimes called air curtain incinerators, and the relationship of the state rule to counties that have independent authority to permit fires.

Compared to the existing rule, this proposed rule contains a number of additional definitions in a separate subsection. ADEQ has proposed definitions for various categories of open burning, such as agricultural, construction, and residential. In addition, there are new definitions for "delegated authority," "independent authority to permit fires," and "prohibited materials." Prohibited materials were previously described in a guidance document. By placing all of the necessary material from the guidelines in the proposed rule, ADEQ intends that this amended R18-2-602 will replace the guidelines as of the effective date of the rule.

The proposed rule also clarifies which open burning activities require open burning permits and those that are exempt from a permit. The proposed rule contains a more complete list of information that is required to be in the permit. This is both for more efficient permit administration, and to comply with various aspects of the regional haze rule.

ADEQ considered exempting certain fires using air curtain destructors from the open burn permit requirement in order to remove an administrative barrier to this type of burning, as required by the Regional Haze Rule (see 40 CFR 51.309(d)(6)(iii)). Air curtain destructors (ACDs) are basically incinerators with high velocity air blown across and into the upper portion of the combustion chamber. This curtain of air traps particulates (smoke) and oxygenates the chamber, resulting in better combustion and less smoke. After reviewing two studies, ADEQ decided that these devices do require oversight and it is appropriate that they be subject to permits under the rule. ADEQ does not view the requirement that ACDs obtain a permit as an administrative barrier. ADEQ also notes that certain air curtain destructors are subject to New Source Performance Standards (see 40 CFR 60, subparts CCCC and DDDD). Studies reviewed by ADEQ relevant to air curtain destructors are listed in item #6 of this preamble.

ADEQ has added language in the proposed rule clarifying that the state rule will not operate in counties with independent authority to permit fires, and has listed the three counties in the definition. This independent authority is derived in part from language in A.R.S. § 49-501(C)(5) specifying that fires permitted pursuant to county rules are excepted from A.R.S. § 49-501. The three counties referenced in the definition all have rules creating permits for open outdoor fires, other than dangerous materials. (see Maricopa County Rule 341; Pima County Rule 17.12.480, et seq.; Pinal County Rule 3-8-700 and 3-8-710.) Pursuant to A.R.S. § 49-501(G) and its current PM10 SIP, Maricopa County prohibits burning of household waste.

The proposed rule also clarifies provisions on burning of dangerous materials and household waste. Finally, new restrictions on permits issued by delegated authorities that minimize the potential for conflict of interest on the part of delegated authorities have been included in proposed subsection (G). First, the proposed rule specifies that a delegated authority may not issue itself open burning permits. Second, the rule proposes to prevent private fire protection providers from conditioning the issuance of open burning permits on the applicant being their customer.

Proposed Prescribed Burning Revisions

State and federal forest and range land make up more than half of the land in Arizona. Despite potential air quality concerns, state and federal land managers (F/SLMs) use fire as a resource management tool on this land for a variety of purposes. Article 15 governs those fires that are set or allowed to burn on these lands in Arizona. The two primary air quality concerns are violations of national ambient air quality standards (NAAQS) for particulates, and visibility impairment. Research indicates that, on average, 90 percent of smoke particles from wildland and prescribed fires are PM10, and 10 percent are PM2.5. Arizona's Prescribed Burning requirements are in Article 15 of the Administrative Code address these air quality concerns, primarily through efforts to ensure the best times for 'burns' and by promoting other techniques to reduce the amount of smoke produced and the effects of that smoke.

A.R.S. § 49-414.01 specifically requires the Director to submit a plan to EPA, and allows ADEQ to promulgate rules addressing programs related to emissions from wildland fire, including prescribed fires and wildfires (see A.R.S. § 49-414.01(A)(7)). The proposed revisions to Article 15 of the Code, which governs the procedures relating to prescribed and wildland fires, will better conform to EPA's regional haze requirements, be more understandable, and facilitate enhanced compliance. Most of the proposed changes to Article 15 directly reflect the mandates of the EPA's regional haze rule requirements, particularly those relating to the collection and recording of burn data, the evaluation of burn programs and setting of annual emission goals. The former structure of the rule remains intact: 1) Annual registration; 2) submittal of a Burn Plan at least 14 days before the burn; 3) a daily Burn Request; and 4) a Burn Accomplishment Form.

Section by Section Explanation of significant proposed changes.

Article 6

R18-2-602	This rule describes the process by which permits may be issued for open burns, and identifies open burning activities which are exempt from the permit requirement.

Article 15

R18-2-1501	This Section lists the definitions applicable to Article 15. In response to the EPA regulation, there are new definitions for "Annual Emissions Goal," and "non-burning alternatives to fire." In addition, "Best Management Practices" has been replaced by "Smoke management techniques" and "Emission reduction techniques," and "Prescribed natural fire" has been replaced by "Wildland fire use."
R18-2-1502	This Section limits the applicability of the rule to state and federal land mangers, while excluding Indian Trust lands. The proposed change clarifies that private burners, such as the Nature Conservancy, may also be subject to the Article.
R18-2-1503	This Section describes the process by which land managers annually register their planned burns with ADEQ. The proposed changes incorporate emission reduction techniques and non-

burning alternatives to fire and facilitate the setting of annual emission goals. A new annual period and other clarifying changes are proposed.

R18-2-1504	This Section requires the details of each burn to be included in the Burn Plan form to be submitted to ADEQ 14 days before requesting permission to ignite. The proposed changes clarify the process and supplement the information related to it.
R18-2-1505	This Section requires land mangers to submit a daily burn request for each day of the burn and describes optional agency response to the request. The proposed changes are primarily clarifying.
R18-2-1506	This Section describes how the agency will determine whether and how much burning to allow. The proposed changes also add clarifying factors not directly related to regional haze.
R18-2-1507	This Section requires land managers to report acreage and fuel types burned, the emission reduction and smoke management techniques used, and requires ADEQ to keep records of this information. A subsection has been added for wildfire reporting to allow those fires' emissions to be entered into the regional haze emission tracking system.
R18-2-1508	This Section describes how land managers shall inform the agency of wildfires and seek permission for wildland burn uses. Clarifications have been proposed based on recent experiences with wildfires.
R18-2-1509	This Section is proposed to replace the former BMP section and describes Emission Reduction Techniques, many of which were listed previously as BMPs. It requires land mangers to use as many as feasible.
R18-2-1510	This Section is also proposed to replace the former BMP section and describes Smoke Management Techniques, some of which were listed previously as BMPs. It requires land managers to use as many as feasible.
R18-2-1511	This Section describes how the agency may require land managers to monitor aspects of their prescribed burns and wildland burn uses. The proposed changes are clarifications and minor changes to weather and air quality monitoring.
R18-2-1512	This Section requires all burn projects to be conducted by personnel trained in prescribed fire and smoke management techniques. The proposed changes are clarifications.
R18-2-1513	This Section directs the agency to conduct burn-related public awareness programs and make burn information available to the public. The proposed changes attempt to promote regional coordination.
R18-2-1514	This Section describes how the agency may inspect, verify, and audit burn information, and actions the agency may take regarding enforcement.
R18-2-1514(former)	In a recent five-year review report, ADEQ stated that it would reevaluate the need for this Section. ADEQ is proposing to delete subsection (B) because the changes in R18-2-1503 provide for a more efficient and effective system. Subsection (A) has been moved to R18-2-1511(B).
R18-2-1515	This Section directs the agency to make its forms and data relating to prescribed burns and wildland burn uses available in an electronic format. The proposed changes are clarifying only.

6. A reference to any study relevant to the rules that the agency reviewed and either proposes to rely on in its evaluation of or justification for the rules or proposes not to rely on in its evaluation of or justification for the rules, where the public may obtain or review each study, all data underlying each study, and any analysis of each study and other supporting material:

The Use of Air Curtain Destructors for Fuel Reduction, Alan R. Shapiro, United States Department of Agriculture, Forest Service Technology and Development Program (September 2002).

Reducing PM2.5 Emissions Through Technology, Evaluations of the Effectiveness of an Air Curtain Incinerator, Ronald A. Scott, Ronald Babbitt, Emily Lincoln, and Wei Min Hao, USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, MT (October 2002)

Studies available for review at the ADEQ Library, 1110 W. Washington, First Floor, Phoenix, AZ 85007.

7. A showing of good cause why the rules are necessary to promote a statewide interest if the rules will diminish a previous grant of authority of a political subdivision of this state:

Not applicable

8. The preliminary summary of the economic, small business, and consumer impact:

A. Rule Identification

The rules amended in this rulemaking are R18-2-602, “Unlawful Open Burning,” and Article 15, “Forest and Range Management Burns,” R18-2-1501 through R18-2-1515.

B. Entities Affected by R18-2-602, “Unlawful Open Burning”

Open burning may be done by many entities for a variety of purposes, such as waste disposal, weed control, site preparation, disease and pest prevention, resource management, training and fire prevention. Unless specifically exempted by this rule, persons setting outdoor fires would have to obtain a permit from ADEQ or a delegated authority, a city or fire district, or one of the three counties with independent authority to issue permits (Maricopa, Pima, Pinal). Persons who might be subject to this proposed rule therefore include: (1) individuals; (2) businesses, such as farms, ranches, orchards, electric generating plants, construction and mines; (3) federal sources, such as military installations; (4) state agencies, such as the Departments of Transportation and Corrections; and, (5) political subdivisions, such as counties, cities, irrigation districts, and fire districts.

ADEQ has delegated authority to issue permits to about 50 fire departments, fire districts and cities or towns located in nine of Arizona’s 15 counties. Authority to issue permits in Graham County is delegated to Graham County Health Department, while Maricopa, Pima and Pinal Counties have independent authority to permit fires. ADEQ has jurisdiction to issue permits in areas outside the delegated authorities’ jurisdiction in these counties. ADEQ typically issues more than 100 open burning permits annually to a wide variety of permittees, most of which are for burns in Gila and Cochise Counties. Permits for burns in La Paz, Yavapai, Santa Cruz, Apache, Greenlee and Coconino Counties are also common.

The following represents a sampling of the level of permits issued by delegated authorities based on the calendar year 2002. The City of Prescott in Yavapai County issued about 200 permits in 2002, of which the majority was for residential burning. The City of Yuma issued 15 open burning permits, mainly for agriculture. Rural Metro Fire Department, which has jurisdiction outside of the municipalities of Somerton and Yuma, typically issues 300-400 residential open burning permits and 50-60 permits for agriculture in Yuma County. The City of Payson in Gila County issued 146 open burning permits for brush and weeds. Bullhead City in Mohave County annually issues 50-70 open burning permits of which the majority is for residential burning. The 384 open burning permits issued by Graham County Health Department in fiscal year 2003 were all for purposes of weed abatement.

C. Potential Impact of R18-2-602

Much of what previously existed as guidelines in 1997 is being incorporated into R18-2-602. Therefore, the baseline for calculating the proposed rule impacts is the current rule requirements, effective in 1990, and these guidelines. The difference between the combined rule provisions and guidelines, and the implementation of the revised R18-2-602 represents the potential impact.

Because this rulemaking proposes only minor changes and incorporates already existing guidance, ADEQ expects the rule to create minimal actual impact, such as the costs associated with minor changes in recordkeeping, documentation, and reporting requirements. ADEQ and delegated authorities will have to maintain copies of effective permits, as well as prepare annual reports for submission to ADEQ. While some of these changes will generate minimal costs, ADEQ expects the overall benefits to exceed those costs. It should also be noted that ADEQ does not charge fees for open burning permits because most permits are issued in a day or two and it would require minimal administrative effort.

D. Entities Affected by Article 15, “Forest and Range Management Burns”

Since ADEQ has jurisdiction, outside tribal lands, over air pollution resulting from prescribed burning, this proposed rule will impact the following federal and state agencies that do burning: (1) Federal Land Managers (FLMs) involved in burning activities, such as U.S. Forest Service, U.S. Fish and Wildlife Service, National Parks Service, Bureau of Land Management, Bureau of Reclamation, Department of Defense; (2) State Land Managers (SLMs), such as Arizona State Land Department, Arizona Department of Transportation, Arizona Department of Game and Fish, and Parks Department. Additionally, there are entities not actually subject to this rule but who may voluntary comply with some or all of the rule provisions, such as the Bureau of Indian Affairs, one of the largest burners in Arizona. Also, private land managers, such as The Nature Conservancy, or individuals, might also need to comply with this rule or request assistance from one of the F/SLMs.

Each year, ADEQ receives more than 1,000 daily burn requests from F/SLMs. For example, in calendar year 2002, about 1,400 requests to burn were received, and slightly more than 104,000 acres were burned, which represents about 56 percent of the total acres approved to burn. This figure is approximately equal to the number of acres burned each year for the past ten years (106,429) on federal, state, and tribal lands. The major fuel types burned in 2002 and their relative proportions include: piled ponderosa pine (22%), non-piled ponderosa pine (21%), and natural ponderosa pine (17%). The remaining 40% of fuel types include: natural shrub, non-piled grass and ponderosa pine, natural grass, natural grass and ponderosa pine, non-piled mixed, and other.

For comparison, in 1999, F/SLMs requested nearly 450,000 acres to burn. Although ADEQ approved close to 80 percent of the requested acreage, the actual number of acres burned was about 200,000. The fuel types burned in 1999 were: broadcast slash (32%), ponderosa pine (22%), grass (20%), slash piles (14%), brush (10%), and pinyon juniper (2%). As shown with these two years, proportions, however, vary from one year to another.

Combining acres burned for 1994 through 1999, shows the percentage of acres burned by F/SLMs agencies: U.S. Forest Service (49%), Bureau of Indian Affairs (30%), National Park Service (7%), Bureau of Land Management (7%), U.S. Fish and Wildlife (6%), Arizona State Land Department (1%), and other (1%).

E. Potential Impact of Article 15

Because this rule involves forest and range management burning by federal and state land managers, private persons, political subdivisions of the state, and small businesses will not bear any direct incremental costs from the proposed rule changes. However, because the proposed rule requires both better tracking of emissions, better management of smoke, and public education and notification, benefits are expected to accrue to the public, particularly to populations living close to the burns. Specifically, there is potential for incremental benefits arising from better planning and implementation of measures which increase burn efficiency, prevent wildfires, improve visibility, and reduce smoke impacts to both the general public and more sensitive segments of the population.

F/SLMs currently pay for two full-time positions to work with ADEQ at an estimated annual value of $120,000 at ADEQ. Office space and equipment are provided by ADEQ. ADEQ currently supports one full-time position for the smoke management program. Although implementing this amended rule may require minimally increased planning and evaluation time, ADEQ does not expect to need additional employees to handle the workload. This increased workload, together with administrative costs associated with making burn information publicly available and conducting public awareness programs, are all that comprise the incremental impact to ADEQ. Thus, ADEQ judges that the costs to the agency are minimal.

The incremental impact of the proposed changes to Article 15 is based on the rule's new requirements, and are expected to result in minimal economic impact to F/SLMs and ADEQ. For example, F/SLMs will have to provide more information about their prescribed burns, including emission reduction techniques and non-burning alternatives. They will also be encouraged to attend annual meetings for program evaluation and the establishment of annual emissions goals, and will be looked to for the development of long-term projections of future prescribed fire and wildland fire use activities. The information provided by F/SLMS will be used by ADEQ to assess visibility impairment and other air quality concerns. Additional compliance costs include those associated with the incorporation of additional emission reduction and smoke management techniques.

Together, these rule changes are expected to improve the state's smoke management program, which could lead to improvements in air quality through reduction and better management of burns. Evidence shows that exposure to criteria pollutants, either to individual pollutants such as particulate matter (PM), or collectively to a variety of pollutants, is associated with increased mortality. The positive correlation is most closely related to ambient air concentrations of PM. Human health effects of PM, for example, include premature mortality, bronchitis, new asthma cases and exacerbated asthma in existing individuals, increased hospital admissions, lower and upper respiratory illness, shortness of breath, respiratory symptoms, restricted activity days, and lost days of work. Other health effects ascribed to exposure to PM include changes in pulmonary function, chronic respiratory diseases (other than chronic bronchitis), morphological changes, neonatal mortality, cancer, altered host defense mechanisms, and non-asthma respiratory emergency room visits. Estimated economic values have been assigned to death and other adverse health effects. For example, a statistical death has been estimated to cost $6.3 million (in year 2000 dollars), chronic bronchitis due to PM costs $260,000 per patient, mortality life years lost is valued at $293,000 per each life year, and work days lost due to PM is worth about $83 per day. (EPA, *The Benefits and Costs of the Clean Air Act 1990-2010*, Office of Air and Radiation, Office of Policy, November 1999, Table 5-1.)

F. Reduction of Impacts to Small Businesses for R18-2-602 and Article 15

These rules create minimal increased compliance costs for ADEQ to administer the open burning and prescribed forestry burning programs. ADEQ considered each of the methods prescribed in A.R.S. § 41-1035 for reducing the impact on small businesses. Likewise, it considered each of the methods prescribed in A.R.S. § 41-1055(B)(5)(c). For example, A.R.S. § 41-1035 requires agencies implementing rules to reduce the impacts on small businesses by using certain methods where legal and feasible. Methods that may be used include the following: (1) exempt them from any or all rule requirements, (2) establish performance standards which could replace more costly design or operational requirements, or (3) institute reduced compliance or reporting requirements.

ADEQ cannot provide additional regulatory relief for small businesses applying for open burning permits. As the agency does not charge fees for open burning permits, ADEQ expects that the proposed R18-2-602's reporting requirement (on forms developed by ADEQ) will create minimal economic impacts to individual persons or small businesses. The rule procedures have been kept as simple and straightforward as possible. Article 15 does not directly impact small businesses as it applies primarily to public entities.

9. The name and address of agency personnel with whom persons may communicate regarding the accuracy of the economic, small business, and consumer impact statement:

Name:	David Lillie, Economist
Address:	ADEQ 1110 W. Washington Phoenix, AZ 85007
Telephone:	(602) 771-4461 (This number may be reached in-state by dialing 1-800-234-5677 and requesting the seven digit number)
Fax:	(602) 771-2366

10. The time, place, and nature of the proceedings for the making, amendment, or repeal of the rules, or if no proceeding is scheduled, where, when, and how persons may request an oral proceeding on the proposed rules:

Time:	October 20, 2003, 1:30 p.m.
Place:	Yuma Public Works, Training Room 155 W. 14th Street Yuma, AZ 85364
Time:	October 21, 2003, 1:30 p.m.
Place:	Casa Grande Parks & Recreation Office, Armadillo Room 440 E. Florence Blvd. Casa Grande, AZ 85222
Time:	October 22, 2003, 1:30 p.m.
Place:	Show Low City Hall, Council Chambers 200 W. Cooley Show Low, AZ 85901
Time:	October 23, 2003, 1:30 p.m.
Place:	Flagstaff City-Coconino County Public Library 300 W. Aspen Flagstaff, AZ 86001
Nature:	Public hearings on proposed rules with opportunity for formal comments on the record. Please call (602) 771-4795 for special accommodations pursuant to the Americans with Disabilities Act.
Close of comment:	October 24, 2003, 5:00 p.m.

11. Any other matters prescribed by statute that are applicable to the specific agency or to any specific rule or class of rules:

Not applicable

12. Incorporations by reference and their location in the rules:

Not applicable

13. The full text of the rules follows:

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY AIR POLLUTION CONTROL

ARTICLE 6. EMISSIONS FROM EXISTING AND NEW NONPOINT SOURCES

Section
R18-2-602. Unlawful Open Burning

ARTICLE 15. FOREST AND RANGE MANAGEMENT BURNS

Section
R18-2-1501. Definitions
R18-2-1502. Applicability
R18-2-1503. Annual Registration, Program Evaluation and Planning ~~for Prescribed Burns~~
R18-2-1504. Prescribed Burn Plan ~~Contents~~
R18-2-1505. Prescribed Burn Requests and Authorization
R18-2-1506. Smoke Dispersion Evaluation
R18-2-1507. Prescribed Burn Accomplishment; ~~ADEQ Recordkeeping;~~ Wildfire Reporting
R18-2-1508. ~~Prescribed Natural Fires;~~ Wildland Fire Use: Plan~~;~~, Authorization~~;~~, Monitoring; Interagency Consultation; Status Reporting
R18-2-1509. Emission Reduction Techniques~~; BMP~~
R18-2-1510. Smoke Management Techniques
~~R18-2-1510.~~ R18-2-1511. Monitoring
~~R18-2-1511.~~ R18-2-1512. Burner Qualifications
~~R18-2-1512.~~ R18-2-1513. Public Notification and Awareness Program; Regional Coordination
~~R18-2-1514. Oversight~~
~~R18-2-1513.~~ R18-2-1514. Surveillance and Enforcement
R18-2-1515. Forms; Electronic Copies; Information Transfers

ARTICLE 6. EMISSIONS FROM EXISTING AND NEW NONPOINT SOURCES

R18-2-602. Unlawful Open Burning

~~**A.** Notwithstanding the provisions of any other rule in this Chapter, it is unlawful for any person to ignite, cause to be ignited, permit to be ignited, or suffer, allow or maintain any open outdoor fire.~~

~~**B.** "Open outdoor fire," as used in this rule, means any combustion of combustible material of any type outdoors, in the open where the products of combustion are not directed through a flue. "Flue," as used in this rule, means any duct or passage for air, gases or the like, such as a stack or chimney.~~

~~**C.** The following fires are excepted from the provisions of this rule:~~

~~1. Fires used only for cooking of food or for providing warmth for human beings or for recreational purposes or the branding of animals or the use of orchard heaters for the purpose of frost protection in farming or nursery operations.~~
~~2. Any fire set or permitted by any public officer in the performance of official duty, if such fire is set or permission given for the purpose of weed abatement, the prevention of a fire hazard, or instruction in the methods of fighting fires.~~
~~3. Fires set by or permitted by the state entomologist or county agricultural agents of the county for the purpose of disease and pest prevention.~~
~~4. Fires set by or permitted by the federal government or any of its departments, agencies or agents, the state or any of its agencies, departments or political subdivisions, for the purpose of watershed rehabilitation or control through vegetative manipulation.~~

~~**D.** Permission for the setting of any fire given by a public officer in the performance of official duty under subsections (C)(2), (3), or (4) shall be given, in writing, and a copy of such written permission shall be transmitted immediately to the Director of the Department of Environmental Quality and the control officer, if any, of the county, district or region in which such fire is allowed. The setting of any such fire shall be constructed in a manner and at such time as approved by the Director, unless doing so would defeat the purpose of the exemption.~~

~~**E.** The following fires may be excepted from the provisions of this Section when permitted in writing by the Director of the Department of Environmental Quality or the control officer of the county, district or region in which such fire is allowed:~~

~~1. Fires set for the disposal of dangerous materials where there is no safe alternative method of disposal.~~
   ~~a. "Dangerous material" is any substance or combination of substances which is able or likely to inflict bodily harm or property loss unless neutralized, consumed or otherwise disposed of in a controlled and safe manner.~~
   ~~b. Fires set for the disposal of dangerous materials shall be permitted only when there is no safe alternative method of disposal, and when the burning of such materials does not result in the emission of hazardous or toxic substances either directly or as a product of combustion in amounts which will endanger health or safety.~~
~~2. Open outdoor fires for the disposal of ordinary household trash in an approved waste burner in nonurban areas of less than 100 well spread out dwelling units per square mile where no refuse collection and disposal service is available.~~
   ~~a. An "approved waste burner" is an incinerator constructed of fire resistant material with a cover or screen which is closed when in use having openings in the sides or top no greater than 1 inch in diameter.~~
   ~~b. Open burning of the following materials is forbidden: Garbage resulting from the processing, storage, service or consumption of food; asphalt shingles; tar paper; plastic and rubber products (such as waste crankcase oil, transmission oil and oil filters); transformer oils; and hazardous material containers including those that contained inorganic pesticides, lead, cadmium, mercury, or arsenic compounds.~~

~~**F.** The Director of the Department of Environmental Quality or the air pollution control officer, if any, of the county, district, or region may delegate the authority for the issuance of allowable open burning permits to responsible local officers. Such permits shall contain conditions limiting the manner and the time of the setting of such fires as specified in the Arizona Guidelines for Open Burning and shall contain a provision that all burning be extinguished at the discretion of the Director or his authorized representative during periods of inadequate atmospheric smoke dispersion, periods of excessive visibility impairment which could adversely affect public safety, or periods when smoke is blown into populated areas so as to create a public nuisance. Any local officer delegated the authority for issuance of open burning permits shall maintain a copy of all currently effective permits issued including a means of contacting the person authorized by the permit to set an open fire in the event that an order for extinguishing of open burning is issued.~~

~~**G.** Nothing in this rule is intended to permit any practice which is a violation of any statute, ordinance, rule or regulation.~~

A. In addition to the definitions contained in A.R.S. § 49-501, in this Section:

1. "Agricultural Burning" means burning of vegetative materials related to the production and harvesting of crops and raising of animals for the purpose of marketing for profit, or providing a livelihood, but not including the burning of household waste or prohibited materials. Burning may be conducted in fields, piles, ditch banks, fence rows or canal laterals for purposes such as weed control, waste disposal, disease and pest prevention, or site preparation.
2. "Approved waste burner" means an incinerator constructed of fire resistant material with a cover or screen which is closed when in use having openings in the sides or top no greater than one inch in diameter.
3. "Class I Area" means any one of the Arizona mandatory federal class I areas defined in A.R.S. § 49-401.01.
4. "Construction burning" means burning of wood or vegetative material from land clearing, site preparation, or fabrication, erection, installation, demolition, or modification of any buildings or other land improvements, but not including the burning of household waste or prohibited materials.
5. "Dangerous material" is any substance or combination of substances that is capable of causing bodily harm or property loss unless neutralized, consumed or otherwise disposed of in a controlled and safe manner.
6. "Delegated authority" means any of the following:
   a. A county, city, town, air pollution control district, or fire district that has been delegated authority to issue open burning permits by the Director under A.R.S. § 49-501(E); or
   b. A private fire protection service provider that has been assigned authority to issue open burning permits by one of the authorities in subsection (a).
7. "Director" means the Director of the Department of Environmental Quality, or his designee.
8. "Emission reduction techniques" are techniques for controlling emissions from open outdoor fires to minimize the amount of emissions output per unit or area burned.
9. "Flue," as used in this subsection, means any duct or passage for air or combustion gases, such as a stack or chimney.
10. "Household waste" means any solid waste including garbage, rubbish and sanitary waste from septic tanks that is generated from households including single and multiple family residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds and day use recreation areas, not including construction debris, landscaping rubble or demolition debris.
11. "Independent authority to permit fires" means the authority of a county to permit fires by a rule adopted pursuant to Arizona Revised Statutes, Title 49, Chapter 3, Article 3. Maricopa, Pima, and Pinal counties have independent authority to permit fires.
12. "Open outdoor fire or open burning" means the combustion of material of any type outdoors, in the open, where the products of combustion are not directed through a flue. Open outdoor fires include agricultural, residential, prescribed and construction burning. Purposes for fires can include prevention of a fire hazard, instruction in the methods of fighting fires, watershed rehabilitation, disease and pest prevention.
13. "Prohibited materials" means nonpaper garbage from the processing, storage, service, or consumption of food; chemically treated wood; tires; explosives or ammunition; oleanders; asphalt shingles; tar paper; plastic and rubber products, including bottles for household chemicals; plastic grocery and retail bags; waste petroleum products, such as waste crankcase oil, transmission oil and oil filters; transformer oils; asbestos; batteries; anti-freeze; aerosol spray cans; electrical wire insulation; thermal insulation; polyester products; hazardous waste products such as paints, pesticides, cleaners and solvents, stains and varnishes and other flammable liquids; plastic pesticide bags and containers; and hazardous material containers including those that contained lead, cadmium, mercury, or arsenic compounds.
14. "Residential burning" means open burning of vegetative materials conducted by or for the occupants of residential dwellings, but not including burning of household waste or prohibited materials.
15. "Prescribed burning" has the same meaning as in R18-2-1501.

B. Unlawful Open Burning. Notwithstanding any other rule in this Chapter, it is unlawful for any person to ignite, cause to be ignited, permit to be ignited, or suffer, allow or maintain any open outdoor fire in a county without independent authority to permit fires except as provided in A.R.S. § 49-501 and this Section.

C. Open Outdoor Fires Exempt From a Permit. The following fires do not require an open burning permit from the Director or a delegated authority:
1. Fires used only for:
   a. Cooking of food;
   b. Providing warmth for human beings;
   c. Recreational purposes;
   d. Branding of animals;
   e. Orchard heaters for the purpose of frost protection in farming or nursery operations; and
   f. The proper disposal of flags under 4 U.S.C. 8.
2. Any fire set or permitted by any public officer in the performance of official duty, if such fire is set or permission given for the purpose of fire control of an active wildfire.
3. Fires set by or permitted by the Director of Department of Agriculture for the purpose of disease and pest prevention in organized, area-wide control of epidemics or infestations affecting livestock or crops.
4. Prescribed burns set by or assisted by the federal government or any of its departments, agencies or agents, the state or any of its agencies, departments or political subdivisions, pursuant to Article 15 of this Chapter.

D. Open Outdoor Fires Requiring a Permit.
1. The following open outdoor fires are allowed with an open burning permit from the Director or a delegated authority:
   a. Construction burning;
   b. Agricultural burning;
   c. Residential burning;
   d. Prescribed burns conducted on private lands without the assistance of a federal or state land manager as defined under R18-2-1501;
   e. Any fire set or permitted by a public officer in the performance of official duty, if such fire is set or permission given for the purpose of weed abatement, the prevention of a fire hazard, or instruction in the methods of fighting fires, unless such fire is exempt from the permit requirement under subsection (C)(3);
   f. Open outdoor fires of dangerous material under subsection (E); and
   g. Open outdoor fires of household waste under subsection (F).
2. A person conducting an open outdoor fire in a county without independent authority to permit fires shall obtain a permit from the Director or a delegated authority unless exempted under subsection (C). Permits may be issued for a period not to exceed one year. A person shall obtain a permit by completing an ADEQ-approved application form.
3. Open outdoor fire permits issued under this Section shall include:
   a. A list of the materials that may be burned under the permit;
   b. A means of contacting the person authorized by the permit to set an open fire in the event that an order to extinguish the open outdoor fire is issued by the Director or the delegated authority;
   c. A requirement that burns be conducted during the following periods, unless otherwise waived or directed by the Director on a specific day basis:
      i. Year round: start ignition no earlier than one hour after sunrise; and
      ii. Year round: fire must be extinguished two hours before sunset.
   d. A requirement that all open burning shall be conducted only during atmospheric conditions which:
      i. Prevent dispersion of smoke into populated areas;
      ii. Prevent visibility impairment on traveled roads or at airports that results in a safety hazard;
      iii. Do not create a public nuisance or adversely affect public safety;
      iv. Do not cause an adverse impact to visibility in a Class I area; and
      v. Do not cause uncontrollable spreading of the fire;
   e. A listing of the types of actions that shall be utilized to minimize fire emissions including any emission reduction techniques;
   f. A reporting requirement that shall be met by providing the following information in a format provided by the Director for each date open burning occurred, on either a daily basis on the day of the fire, or in an annual report to the Director or delegated authority due on March 31 for the previous calendar year:
      i. The date of the burn;
      ii. The type and quantity of fuel burned for each date open burning occurred;
      iii. The fire type, such as pile or windrow, for each date open burning occurred; and
      iv. For each date open burning occurred, the legal location, to the nearest section, or latitude and longitude, to the nearest degree minute, or street address for residential burns.
   g. A requirement that the person conducting the open burn notify the local fire-fighting agency, or if none is in existence, the state forester, prior to commencement of open burning;
   h. A requirement that each open outdoor fire be started using items that do not cause the production of black smoke;
   i. A requirement that the fire shall be attended at all times until it is completely extinguished;
   j. A requirement that fire extinguishing equipment must be on-site for the duration of the burn;

k. A requirement that the burning pit, burning pile, or approved waste burner be at least 50 feet from any structure;
l. A requirement that the burner must have a copy of the burn permit on-site during open burning;
m. A requirement that no open burning shall be conducted when an air stagnation advisory, as issued by the National Weather Service, is in effect in the area of the burn or during periods when smoke can be expected to accumulate to the extent that it will significantly impair visibility in Class I areas;
n. A requirement that no open burning shall be conducted when any stage air pollution episode is declared under R18-2-220.
o. A statement that the Director, or any other public officer may order that the burn be extinguished or prohibit burning during periods of inadequate smoke dispersion, excessive visibility impairment, or during periods of extreme fire danger; and
p. A copy of the activities prohibited and the criminal penalties provided under A.R.S. § 13-1706.

4. The Director or a delegated authority shall not issue an open burning permit under this Section:
   a. That would allow the burning of prohibited materials other than under a permit for the burning of dangerous materials;
   b. If the applicant has applied for a permit under this Section to burn dangerous materials which are also hazardous waste under 40 CFR 261, but does not have a permit for the burning of hazardous waste under 40 CFR 264, or is not an interim status facility allowed to burn hazardous waste under 40 CFR 265; or
   c. If the burning would occur at a solid waste facility in violation of 40 CFR 258.24 and the Director has not issued a variance approval under A.R.S. § 49-763.01(A).

E. Open Outdoor Fires of Dangerous Material. Fires set for the disposal of dangerous materials are allowed by the provisions of this Section, when the materials are too dangerous to store and transport, as permitted in writing by the Director. Permits issued shall contain all provisions in subsection (D)(3) except for subsections (e) and (f). Fires set for the disposal of dangerous materials shall be permitted only when there is no safe alternative method of disposal, and when the burning of such materials does not result in the emission of hazardous or toxic substances either directly or as a product of combustion in amounts that will endanger health or safety.

F. Open Outdoor Fires of Household Waste. Open outdoor fires for the disposal of household waste are allowed by provisions of this Section when permitted in writing by the Director or a delegated authority. Permits issued shall contain all provisions in subsection (D)(3) except for subsections (e) and (f). Open outdoor fires of household waste shall be burned in an approved waste burner and shall either:
1. Burn household waste generated on-site on farms or ranches of 40 acres or more where no household waste collection or disposal service is available; or
2. Burn household waste generated on-site where no household waste collection and disposal service is available and where the nearest other dwelling unit is at least 500 feet away.

G. Permits Issued by a Delegated Authority. The Director may delegate authority for the issuance of open burning permits to a county, city, town, air pollution control district, or fire district. A delegated authority may not permit its own open burning activity. Authority for issuance of permits to burn dangerous material under subsection (E) shall be retained by the Director and not delegated. A county, city, town, air pollution control district, or fire district with delegated authority from the Director may assign that authority to one or more private fire protection service providers that perform fire protection services within the county, city, town, air pollution control district, or fire district. A private fire protection provider shall not directly or indirectly condition the issuance of open burning permits on the applicant being a customer. Permits issued under this subsection shall comply with the requirements in subsection (D)(3) and be in a format prescribed by the Director. Each delegated authority shall:
1. Maintain a copy of each permit issued for the previous five years available for inspection by the Director;
2. For each permit currently issued, have a means of contacting the person authorized by the permit to set an open fire in the event that an order for extinguishing of open burning is issued; and
3. Annually submit to the Director by May 15 a record of daily burn activity, excluding household waste burn permits, on a form provided by the Director for the previous calendar year containing the information required in subsections (D)(3)(e) and (f).

H. The Director shall hold an annual public meeting for interested parties to review operations of the open outdoor fire program and discuss emission reduction techniques.

I. Nothing in this Section is intended to permit any practice which is a violation of any statute, ordinance, rule, or regulation.

ARTICLE 15. FOREST AND RANGE MANAGEMENT BURNS

R18-2-1501. Definitions

In addition to the definitions contained in A.R.S. § 49-501 and R18-2-101, in this Article:
1. "ADEQ" means the Department of Environmental Quality.
2. "Annual Emissions Goal" means the annual establishment in cooperation with the F/SLMs, under R18-2-1503(G), of a planned quantifiable value of emissions reduction from prescribed fires and fuels management activities.

~~2. “BMP” means best management practices as described in R18-2-1509.~~
3. “Burn Plan” means the ADEQ form that includes information on the conditions under which the burn will occur with details of the burn and smoke management prescriptions.
~~3.~~4. “Burn prescription” means, with regard to a burn project, the pre-determined area, ~~intensity of heat, and rate of spread~~ fuel and weather conditions required to attain planned resource management objectives.
~~4.~~5. “Burn project” means an active or planned prescribed burn, including a ~~prescribed natural fire~~ wildland fire use incident.
~~5. “Class I Area” means a mandatory area designated pursuant to Section 169A of the Clean Air Act Amendments of 1990.~~
6. “Duff” means forest floor material consisting of decomposing needles and other natural materials.
7. “Emission reduction techniques (ERT)” means techniques for controlling emissions from prescribed fires to minimize the amount of emission output per unit of area burned.
~~7.~~8. “Federal land manager (FLM)” means any department, agency, or agent of the federal government, including the following:
   a. United States Forest Service,
   b. United States Fish and Wildlife Service,
   c. National Park Service,
   d. Bureau of Land Management,
   e. Bureau of Reclamation,
   f. Department of Defense,
   g. Bureau of Indian Affairs, and
   h. ~~United States Soil Conservation Service.~~ Natural Resources Conservation Services
~~8.~~9. “F/SLM” means a federal land manager or a state land manager.
~~9.~~10. “Local fire management officer” means a person designated by a F/SLM as responsible for fire management in a local district or area.
~~10.~~11. “Mop-up” means the act of extinguishing or removing burning material from a prescribed fire to reduce smoke impacts.
~~11.~~12. “National Wildfire Coordinating Group” means the national inter-agency group of federal and state land managers that shares similar wildfire suppression programs and that has established standardized inter-agency training courses and qualifications for fire management positions.
13. “Non-burning Alternatives to Fire” are techniques that replace fire for at least five years as a means to treat activity fuels created to achieve a particular land management objective (e.g., reduction of fuel-loading, manipulation of fuels, enhancement of wildlife habitat, ecosystem restoration, etc.). These alternatives are not used in conjunction with fire. Techniques used in conjunction with fire are referred to as emission reduction techniques (ERTs).
~~12.~~14. “Planned resource management objectives” means public interest goals in support of land management agency objectives including silviculture, wildlife habitat management, grazing enhancement, fire hazard reduction, wilderness management, cultural scene maintenance, weed abatement, watershed rehabilitation, vegetative manipulation, and disease and pest prevention.
~~13.~~15. “Prescribed burning” means the controlled application of fire to wildland fuels that are in either a natural or modified state, under certain burn prescription conditions and smoke management prescription conditions that have been specified by the land manager in charge of or assisting the burn, to attain planned resource management objectives. Prescribed burning ~~includes~~ does not include a fire set or permitted by a public officer to provide instruction in fire fighting methods, or construction or residential burning under R18-2-602. ~~A prescribed fire may be ignited either by a trained fire specialist or by natural causes such as lightning.~~
~~14.~~16. “Prescribed Fire Manager” means a person designated by a F/SLM as responsible for prescribed burning for that land manager.
~~15. “Prescribed natural fire” means a wildland fire that is ignited by natural causes such as lightning rather than by a trained fire specialist, that is subsequently allowed to continue burning using the same controls and for the same planned resource management objectives as prescribed burning.~~
~~16.~~17. “Smoke management prescription” means the predetermined meteorological conditions that affect smoke transport and dispersion under which a burn could occur without adversely affecting public health and welfare.
18. “Smoke Management Techniques” (SMT) means management and dispersion practices used during a prescribed burn or wildland fire use incident which affect the direction, duration, height or density of smoke.
~~17.~~19. “Smoke management unit” means any of ~~11~~ the geographic areas defined by ADEQ whose area is based on primary watershed boundaries and whose outlines are determined by diurnal windflow patterns that allow smoke to follow predictable drainage patterns. A map of the state divided into ~~11~~ the smoke management units is on file with ADEQ.
~~18.~~20. “State land manager (SLM)” means any department, agency, or political subdivision of the state government ~~that is responsible for wildland management~~ including the following:
   a. State Land Department,

b. Department of Transportation,
c. Department of Game and Fish, and
d. Parks Department.

~~19.~~21. "Wildfire" means ~~a~~ an unplanned wildland fire subject to appropriate control measures ~~that does not meet resource management objectives and that may threaten life, property, public health, or the ecosystem~~. Wildfires include those incidents where suppression may be limited for safety, economic, or resource limitations.

~~20. "Wildland" means an area in which development is essentially non-existent, except for pipelines, power lines, roads, railroads, or other transportation or conveyance facilities.~~

22. "Wildland fire use" means a wildland fire that is ignited by natural causes, such as lightning, that is subsequently managed using the same controls and for the same planned resource management objectives as prescribed burning.

R18-2-1502. Applicability

A. A F/SLM that is conducting or assisting a prescribed burn shall follow the requirements of this Article.

B. A private or municipal burner with whom ADEQ has entered into a memorandum of agreement shall follow the requirements of this Article.

~~B.~~C. The provisions of this Article apply to all areas of the state except Indian Trust lands. All federally-managed lands and all state lands, parks, and forests are under the jurisdiction of ADEQ in matters relating to air pollution from prescribed burning.

~~C.~~D. Notwithstanding subsection (B), ADEQ and any Indian tribe may enter into a memorandum of agreement to implement this Article.

E. ADEQ and any private or municipal prescribed burner may enter into a memorandum of agreement to implement this Article.

R18-2-1503. Annual Registration, Program Evaluation and Planning ~~for Prescribed Burns~~

A. Each F/SLM shall register annually with ADEQ~~,~~ on a form prescribed by ADEQ, all planned burn projects, including areas ~~considered for potential~~ ~~prescribed natural fires~~ planned for wildland fire use~~, for the following year~~.

~~C.~~B. Each planned year extends from ~~August~~ January 1 of the registration year to ~~July~~ December 31 of the same ~~following~~ year. Each F/SLM shall use best efforts to register before ~~August~~ December 31 and no later than January 31 of each year.

~~B.~~C. A F/SLM shall ~~provide~~ include the following information on the registration form:

1. The F/SLM's name, address, and business telephone number;
2. The name, address, and business telephone number of an air quality representative who will provide technical support to ADEQ for decisions regarding prescribed burning. The same air quality representative may be selected by more than one F/SLM ~~or Indian tribe~~;
3. All prescribed burn projects and potential ~~prescribed natural fire~~ wildland fire use areas planned for the next year; ~~and~~
4. By prescribed burn project, maximum project and annual acres to be burned, maximum daily acres to be burned, fuel types within project area and planned use of emission reduction techniques to support the annual emissions goal;
5. By prescribed burn project, planned use of any smoke management techniques;
6. By area planned for wildland fire use, maximum project and annual acres to be burned, maximum daily acres to be burned, and a map of project area, fuel types and loading within the planned area;

~~4.~~7. A list of all burn projects that were completed during the previous year;

8. By area to be treated using non-burning alternatives to fire, project area for treatment, treatment type, fuel types to be treated, activity fuel loading to support the annual emissions goal; and
9. The area treated using non-burning alternatives to fire utilized during the previous year including the number of acres, the specific types of alternatives utilized, and the location of these areas.

D. After consultation with the F/SLM, ADEQ may request additional information ~~related to tracking burn projects~~ for registration of prescribed burns and wildland fire use to support regional coordination of smoke management, annual emission goal setting utilizing ERTs, and non-burning alternatives to fire.

E. A F/SLM may amend a registration at any time with a written submission to ADEQ. ~~ADEQ shall approve a new prescribed burn even if the F/SLM has failed to amend a registration if the F/SLM has complied with the other provisions of this Article.~~

F. ADEQ shall accept a facsimile or other electronic methods as a means of complying with the deadline for registration. If electronic means are used ~~a facsimile is submitted~~, the F/SLM shall deliver the original paper registration form to ADEQ for its records. ADEQ shall acknowledge in writing the receipt of each registration. ~~If ADEQ and the F/SLMs jointly develop an electronic filing and reporting system, the original paper form may be waived, and ADEQ shall notify all F/SLMs of this change.~~

~~G.~~ ~~No later than 14 days before a F/SLM requests permission to proceed with a registered burn project other than a prescribed natural fire, the F/SLM shall submit a Burn Plan to ADEQ, as described in R18-2-1504. A Burn Plan for a prescribed natural fire shall be submitted as prescribed by R18-2-1508.~~

G. ADEQ shall hold an annual meeting after January 31 and prior to April 1 of each year between ADEQ and F/SLMs for program evaluation and to cooperatively establish the annual emission goal. The annual emission goal shall be developed to minimize prescribed fire emissions to the maximum extent feasible using emission reduction techniques and alternatives to burning subject to economic, technical, and safety feasibility criteria, and consistent with land management objectives.

H. At least once every five years, ADEQ shall request long-term projections of future prescribed fire and wildland fire use activity from the F/SLMs to support planning for visibility impairment and assessment of other air quality concerns by ADEQ.

R18-2-1504. Prescribed Burn Plan ~~Contents~~

~~**A.**~~ Each F/SLM planning a prescribed burn, ~~other than a prescribed natural fire~~, shall complete and submit to ADEQ the "Burn Plan" form supplied by ADEQ no later than 14 days before the date on which the F/SLM requests permission to burn. The information supplied on the Burn Plan Form are considered binding conditions under which the burn shall be conducted. Burn Plans shall be maintained by ADEQ until notification from the F/SLM of the completion of the project. Revisions to the Burn Plan for a burn project shall be submitted in writing no later than 14 days before the date on which the F/SLM requests permission to burn. ~~The F/SLM shall provide the following information on the "Burn Plan" form~~ To facilitate the Daily Burn authorization process under R18-2-1505, the F/SLM shall include on the Burn Plan:

1. An emergency telephone number that is answered 24 hours a day;
2. Burn prescription;
3. Smoke management prescription;
4. The number of acres to be burned, the quantity and type of fuel, type of burn, and the ignition technique to be used;
5. The land management objective or purpose for the burn such as restoration or maintenance of ecological function and indicators of fire resiliency;

~~5.~~6. A map depicting the potential impact of the smoke unless waived either verbally or in writing by ADEQ. The potential impact shall be determined by mapping both the daytime and nighttime smoke path and down-drainage flow for 15 miles from the burn site, with smoke-sensitive areas delineated. The map shall use the appropriate scale to show the impacts of the smoke adequately;

~~6.~~7. Modeling of smoke impacts unless waived either verbally or in writing by ADEQ, for burns greater than 250 acres per day, or greater than 50 acres per day if the burn is within 15 miles of a Class I Area, an area that is non-attainment for particulates, a carbon monoxide non-attainment area, or other smoke-sensitive area. ~~Air quality modeling for these areas is mandatory unless waived either verbally or in writing by ADEQ.~~ In consultation with the F/SLM, ADEQ shall provide guidelines on modeling;

~~7.~~8. The name of the official submitting the Burn Plan on behalf of the F/SLM; and

~~8.~~9. After consultation with the F/SLM, any other information to support the Burn Plan needed by ADEQ to assist in the Daily Burn authorization process for smoke management purposes or assessment of contribution to visibility impairment of Class I areas.

~~**B.** A Burn Plan shall be submitted for a prescribed natural fire as prescribed by R18-2-1508.~~

R18-2-1505. Prescribed Burn Requests and Authorization

A. Each F/SLM planning a prescribed burn, ~~other than a prescribed natural fire~~, shall complete and submit to ADEQ the "Daily Burn Request" form supplied by ADEQ. The ~~F/SLM shall include the following information on the~~ Daily Burn Request form shall include:

1. The contact information of the F/SLM conducting the burn;
2. Each day of the burn;

~~2.~~3. The area to be burned ~~per~~ on that day with reference to the Burn Plan, including size, ~~and~~ legal location to the section and latitude/longitude to the minute;

4. Projected smoke impacts;

~~3.~~5. Any local conditions or circumstances known to the F/SLM that, if conveyed to ADEQ, could impact the Daily Burn authorization process.

B. After consultation with the F/SLM, ADEQ may request additional information related to the burn, meteorological, smoke dispersion or air quality conditions to supplement the Daily Burn Request form and to aid in the Daily Burn authorization process. ~~This information may include same day on-site and area meteorological, smoke dispersion, or air quality measurements.~~

C. The F/SLM shall submit the Daily Burn Request form to ADEQ as expeditiously as practicable, but no later than 2:00 p.m. of the business day preceding the burn. An original form, a facsimile, or an electronic information transfer are acceptable submittals.

D. An F/SLM shall not ignite a prescribed burn without receiving the approval of ADEQ, as follows:

~~**D.**~~1. ADEQ shall approve, approve with conditions, or disapprove a burn on the same business day as the Burn Request submittal.

2. If ADEQ fails to address a Burn Request by 10:00 p.m. of the business day on which the request was submitted, the Burn Request is approved by default after the burner makes a good faith effort to contact ADEQ to confirm that the Burn Request was received.
3. ADEQ may communicate its decision by verbal, written, or electronic means. ADEQ shall provide a written or electronic reply if requested by the F/SLM. ~~If ADEQ does not communicate its decision, or a confirmation that the Burn Request was received, by 10 p.m., the burn is deemed approved.~~

~~E.~~ ~~Except as provided in subsection (D), an F/SLM shall not ignite a prescribed burn without receiving the approval of ADEQ.~~

~~F.~~E. If weather conditions cease to conform to those in the smoke management prescription of either the Burn Plan or an Approval with Conditions, the F/SLM shall ~~cease ignitions and~~ take appropriate action to reduce further smoke impacts, ensure safe and appropriate fire control, and notify the public when necessary.~~, unless after~~ After consultation with ADEQ, the smoke management prescription or burn plan may be ~~is~~ modified.

F. The F/SLM is responsible for appropriate signage and notification to protect public safety on transportation corridors including roadways and airports during a prescribed fire.

~~G.~~ ~~Burn authorization for prescribed natural fires shall be as prescribed by R18-2-1508.~~

~~H.~~ ~~The F/SLM in whose jurisdiction a wildfire occurs shall report all wildfires greater than 100 acres on a daily basis to ADEQ. The F/SLM shall include in the report the location, estimated control date, and estimated incident size of each wildfire. The F/SLM shall provide information on projected smoke and air quality impacts and on estimated control size upon request by ADEQ.~~

R18-2-1506. Smoke Dispersion Evaluation

ADEQ shall approve, approve with conditions, or disapprove a Daily Burn Request submitted pursuant to R18-2-1505, by using the following factors for each smoke management unit:

1. Analysis of the emissions from burns in progress and residual emissions from previous burns on a day-to-day basis;
2. Analysis of emissions from active ~~prescribed natural fires~~ wildland fire use incidents, active multiple-day burns, and consideration of potential long-term emissions estimates;
3. Analysis of the emissions from wildfires greater than 100 acres and consideration of their potential long-term growth;
4. Local burn conditions;
5. Burn prescription and smoke management prescription from the applicable Burn Plan;
6. Existing and predicted local air quality;
7. Local and synoptic meteorological conditions;
8. Type and location of areas to be burned;
9. Protection of the national visibility goal for Class I Areas pursuant to § 169A(a)(1) of the Act and 40 CFR 51.309; ~~and~~
10. Assessment of duration and intensity of smoke emissions to minimize cumulative impacts; and

~~10.~~11. Minimization of smoke impacts in Class I Areas, ~~roads or highways, airports,~~ areas that are non-attainment for particulate matter, carbon monoxide non-attainment areas, or other smoke-sensitive areas.

12. Protection of the National Ambient Air Quality Standards.

R18-2-1507. Prescribed Burn Accomplishment; ~~ADEQ Recordkeeping;~~ Wildfire Reporting

A. Each F/SLM conducting a prescribed burn shall complete and submit to ADEQ the “Burn Accomplishment” form supplied by ADEQ. For each burn approval, the F/SLM shall submit a Burn Accomplishment form to ADEQ by 2:00 p.m. of the business day following the approved burning. The F/SLM shall include the following information on the Burn Accomplishment form:

1. Any known conditions or circumstances that could impact the Daily Burn decision process;
2. The ~~subsequent~~ date, location, fuel type, fuel loading and acreage accomplishments;
3. The ~~BMP~~ ERTs and SMTs ~~for emission reduction~~ described in R18-2-1509 and R18-2-1510, respectively, and may include any further ERTs and SMTs that become available, that the F/SLM used to reduce emissions or manage the smoke from the burn.

~~B.~~ ~~For each burn approval, the F/SLM shall submit a Burn Accomplishment form to ADEQ by 2 p.m. of the business day following the approved burning.~~

~~C.~~B. The F/SLM shall submit the Burn Accomplishment form as an original form, a facsimile, or an electronic information transfer.

~~D.~~C. ADEQ shall maintain a record of Burn Requests, Burn Approvals/Conditional Approvals/Denials and Burn Accomplishments for five years.

D. The F/SLM in whose jurisdiction a wildfire occurs shall make available to ADEQ no later than the day after the activity all required information for wildfire incidents that burned more than 100 acres per day in timber or slash fuels or 300 acres per day in brush or grass fuels. For each day of a wildfire incident that exceeded the daily activity threshold, the F/SLM shall provide the location, an estimate of predominant fuel type and quantity consumed, and an estimate of the area blackened that day.

R18-2-1508. ~~Prescribed Natural Fires;~~ Wildland Fire Use: Plan~~;~~, Authorization~~;~~, Monitoring; Inter-agency Consultation; Status Reporting

A. In order for ADEQ to participate in the wildland fire use decision-making process, the ~~A~~ F/SLM shall notify ADEQ as soon as practicable of any ~~potential~~ wildland fire use incident ~~prescribed natural fire when it is~~ projected to attain or attaining a size of 50 acres of timber fuel or 250 acres of brush or grass fuel.

B. For each wildland fire use incident ~~prescribed natural fire~~ that has been declared as such by the F/SLM, the F/SLM shall complete and submit to ADEQ a Wildland Fire Use Burn ~~prescribed natural fire~~ Plan in a format approved by ADEQ in cooperation with the F/SLM. The F/SLM shall submit the Wildland Fire Use Burn ~~prescribed natural fire~~ Plan to ADEQ as soon as practicable but no later than 72 hours after the wildland fire use incident ~~prescribed natural fire~~ is declared or under consideration for such designation ~~1st observed~~. The F/SLM shall include the following information in the Wildland Fire Use Burn ~~prescribed natural fire~~ Plan:

1. An emergency telephone number that is answered 24 hours a day;
2. Anticipated burn prescription ~~and anticipated emissions~~;
3. Anticipated smoke management prescription;

~~3.~~4. The estimated daily ~~anticipated growth in the~~ number of acres, quantity and type of fuel to be ~~potentially~~ burned;

~~4.~~5. The anticipated maximum allowable perimeter or size with map;

~~5.~~6. ~~The type or types of fuel involved;~~ Information on the condition of the area to be burned, such as whether it is in maintenance or restoration, its ecological function or other indicators of fire resiliency;

~~6.~~7. The anticipated duration of the wildland fire use incident ~~prescribed natural fire~~;

~~7.~~8. The anticipated long-range weather trends for the site ~~onsite~~;

~~8.~~9. A map depicting the potential impact of the smoke. The potential impact shall be determined by mapping both the daytime and nighttime smoke path and down-drainage flow for 15 miles from the wildland fire use incident ~~burn site~~, with smoke-sensitive areas delineated. Mapping is mandatory unless waived either verbally or in writing by ADEQ. The map shall use the appropriate scale to show the impacts of the smoke adequately; ~~The map shall use the standard agency scale for that F/SLM;~~ and

~~9.~~10. Modeling or monitoring of smoke impacts, if requested by ADEQ after consultation with the F/SLM.

C. ADEQ shall approve or disapprove a Wildland Fire Use Burn ~~prescribed natural fire~~ Plan within three hours of receipt. ADEQ shall consult directly with the requesting F/SLM before disapproving a Wildland Fire Use Burn ~~prescribed natural fire~~ Plan. If ADEQ fails to address the Wildland Fire Use Burn Plan within the time allotted, the Plan is approved by default under the condition that the F/SLM makes a good faith effort to contact ADEQ to confirm that the Plan was received. ~~If ADEQ fails to respond to the submittal of the~~ Wildland fire use ~~prescribed natural fire Plan, approval of the prescribed natural fire may be assumed by the F/SLM.~~ Approval by ADEQ of a Wildland Fire Use Burn ~~prescribed natural fire~~ Plan shall be binding upon ADEQ for the duration of the wildland fire use incident ~~prescribed natural fire project~~, unless smoke from the incident ~~prescribed natural fire~~ creates a threat to public health or welfare. If a threat to public health or welfare is created, ADEQ shall consult with the F/SLM regarding the situation and ~~the development of~~ develop a joint action plan for reducing further smoke impacts.

D. The F/SLM shall submit a Daily Status Report for each wildland fire use incident ~~prescribed natural fire~~ to ADEQ for each day of the burn that the fire burns more than 100 acres in timber or slash fuels or 300 acres in brush or grass fuels ~~perimeter increases~~. The F/SLM shall include a synopsis of smoke behavior, future daily anticipated growth, and location of the activity of the wildland fire use incident ~~prescribed natural fire~~ in the Daily Status Report.

E. The F/SLM shall consult with ADEQ prior to initiating man-made ignition on the wildland fire use incident when greater than 250 acres is anticipated to be burned by the ignition. Emergency man-made ignition on the incident for protection of public or fire-fighter safety does not require consultation with ADEQ regardless of the size of the area to be burned.

F. The F/SLM is responsible for appropriate signage and notification to protect public safety on transportation corridors including roadways and airports during a wildland fire use incident.

R18-2-1509. Emission Reduction Techniques~~; BMP~~

A. Each F/SLM conducting a prescribed burn shall implement as many Emission Reduction Techniques ~~BMP for emission reduction~~ as are feasible subject to economic, technical and safety feasibility criteria, and land management objectives. ~~for the specific burn and shall include the BMP in the Burn Accomplishment submitted pursuant to R18-2-1507.~~

B. ~~The following measures are considered~~ Emission Reduction Techniques include ~~BMP~~:

1. Reducing biomass to be burned by use of techniques such as yarding or consolidation of unmerchandisable material, multi-product timber sales or public firewood access, when economically feasible~~. When allowing public firewood access, provide information on the adverse impacts of using green or wet wood as fuel~~;

~~2. Burning in seasons characterized by meteorological conditions that allow for good smoke dispersion, especially March 15 through September 15;~~

2. Reducing biomass to be burned by fuel exclusion practices such as preventing the fire from consuming dead snags or dead and downed woody material through lining, application of fire-retardant foam, or water;

3. Using mass ignition techniques such as aerial ignition by helicopter to produce high intensity fires of high fuel density areas such as logging slash decks ~~with short duration impacts~~;
~~4. Igniting burns under good-to-excellent ventilation conditions and suspending operations under poor smoke dispersion conditions;~~
~~5. Considering smoke impacts on local community activities and land users;~~
~~6.~~4. Burning only fuels essential ~~fuels~~ to meet resource management objectives;
~~7.~~5. Minimizing ~~duff~~ consumption and smoldering by burning under conditions of high ~~through~~ fuel moisture of duff and litter ~~considerations~~;
6. Minimizing fuel consumption and smoldering by burning under conditions of high fuel moisture of large woody fuels;
~~8.~~7. Minimizing ~~dirt~~ soil content when slash piles are constructed by using brush blades on material-moving equipment and by constructing piles under dry soil conditions or by using hand piling methods;
8. Burning fuels in piles;
~~9. Burning piles when other burns are not feasible, such as when snow or rain is present;~~
9. Using a backing fire in grass fuels;
~~10. Using all opportunities that meet the burn prescription and all burn locations to spread smoke impacts over a broader time period and geographic area;~~
10. Burning fuels with an air curtain destructor, as defined in R18-2-101, operated pursuant to manufacturer specifications and meeting applicable state or local opacity requirements;
~~11. Burning during optimum mid-day dispersion hours, with all ignitions in a burn unit completed by 3 p.m. to prevent trapping smoke in inversions or diurnal windflow patterns;~~
11. Extinguishing or mopping-up of smoldering fuels;
12. ~~Using chunking~~ Chunking of piles and other consolidations of burning material to enhance flaming, fuel consumption and to minimize smoke production;
~~13. Implementing maintenance burning in a periodic rotation mimicking natural fire cycles to reduce excessive fuel accumulations and subsequent excessive smoke production through smoldering or wildfire;~~
13. Burn before litter fall;
~~14. Using prescribed natural fires and unplanned ignitions; and~~
14. Burn before green-up of fuels;
~~15. Managing smoke impacts as follows:~~
    ~~a. Limiting smoke impacts to roads, highways, and airports to the amounts, frequencies, and durations consistent with any guidance provided by highway and airport personnel;~~
    ~~b. Using appropriate signing if smoke will impact any roadways;~~
    ~~c. Notifying control towers if smoke will intrude in any air traffic control zone;~~
    ~~d. Determining nighttime impacts and taking appropriate precautions; and~~
    ~~e. Contacting appropriate authorities as needed regarding smoke or visibility impacts.~~
15. Burn before recently cut large fuels cure in areas with activity; and
16. Burn just prior to precipitation to reduce fuel smoldering and consumption.

R18-2-1510. Smoke Management Techniques

A. Each F/SLM conducting a prescribed burn shall implement as many Smoke Management Techniques as are feasible subject to economic, technical and safety feasibility criteria, and land management objectives.

B. Smoke Management Techniques include:
1. Burning from March 15 through September 15, when meteorological conditions allow for good smoke dispersion;
2. Igniting burns under good-to-excellent ventilation conditions;
3. Suspending operations under poor smoke dispersion conditions;
4. Considering smoke impacts on local community activities and land users;
5. Burning piles when other burns are not feasible, such as when snow or rain is present;
6. Using mass ignition techniques such as aerial ignition by helicopter to produce high intensity fires with short duration impacts;
7. Using all opportunities that meet the burn prescription and all burn locations to spread smoke impacts over a broader time period and geographic area;
8. Burning during optimum mid-day dispersion hours, with all ignitions in a burn unit completed by 3:00 p.m. to prevent trapping smoke in inversions or diurnal windflow patterns;
9. When allowing public firewood access, provide information on the adverse impacts of using green or wet wood as fuel;
10. Implementing maintenance burning in a periodic rotation to shorten prescribed fire duration and to reduce excessive fuel accumulations which could result in excessive smoke production in a wildfire; and
11. Using wildland fire use strategies to shift smoke into more favorable smoke dispersion seasons.

~~R18-2-1510.~~ R18-2-1511. Monitoring

A. ADEQ may require a F/SLM to monitor ~~weather and~~ air quality before or during a prescribed burn or a ~~excluding~~ wildland fire use incident ~~prescribed natural fires, which are governed by R18-2-1508,~~ if necessary to ~~accurately predict~~ assess smoke impacts. Air quality monitoring may be conducted using both federal and non-federal reference method as well as other techniques.

B. ADEQ may require a F/SLM to monitor weather before or during a prescribed burn or a wildland fire use incident, if necessary to predict or assess smoke impacts. After consultation with the F/SLM, ADEQ may also require the F/SLM to establish burn site or area-representative remote automated weather stations or their equivalent, having telemetry that allows retrieval on a real-time basis by ADEQ. An F/SLM planning to make a change to any long-term established remote automated weather station shall give ADEQ notice and an opportunity to comment before making the change.

~~B.~~C. A F/SLM shall employ the following types of monitoring, unless waived by ADEQ, for burns greater than 250 acres per day, or greater than 50 acres per day if the burn is within 15 miles of a Class I Area, an area that is non-attainment for particulate matter, ~~a~~ carbon monoxide, or ozone ~~non-attainment area~~, or other smoke-sensitive area:

1. Smoke plume measurements, using a format supplied by ADEQ; and

~~1.~~2. The release of pilot balloons (PIBALs) at the burn site to verify needed wind speed, direction, ~~or~~ and stability.~~; and~~

~~2. Smoke plume measurements, using a format supplied by ADEQ.~~

In lieu of pilot balloons, a test burn at the burn site may be used for specific prescribed burns on a case-by-case basis as approved by ADEQ, to verify needed wind speed, direction and stability.

~~C.~~D. ~~A~~ An F/SLM shall make monitoring information required pursuant to subsection ~~(B)~~(C) available to ADEQ on the business day following the burn ignition.

~~**D.** After consultation with the F/SLM, ADEQ may also require the F/SLM to establish burn site or area-representative remote automated weather stations or their equivalent, having telemetry that allows retrieval on a real-time basis by ADEQ, if necessary to accurately predict smoke impacts.~~

E. The F/SLM shall keep on file for one year following the burn date any monitoring information required pursuant to this Section.

~~R18-2-1511.~~ R18-2-1512. Burner Qualifications

A. All ~~burns~~ burn projects shall be conducted by personnel trained in prescribed fire and smoke management techniques ~~to the minimum level~~ as required by the F/SLM in charge of the burn and established by National Wildfire Coordinating Group training qualifications.

B. A Prescribed Fire ~~Manager~~ Boss or other local Fire Management Officer of the F/SLM having jurisdiction over prescribed burns shall have smoke management training obtained through one of the following:

1. Successful completion of a National Wildfire Coordinating Group or F/SLM-equivalent course ~~dedicated to~~ addressing smoke management; or
2. Attendance at an ADEQ-approved smoke management workshop.

~~R18-2-1512.~~ R18-2-1513. Public Notification and Awareness Program; Regional Coordination

A. ~~At the Director's discretion,~~ The Director shall conduct a public education and awareness program ~~may be conducted by ADEQ~~ in cooperation with F/SLMs and other interested parties to inform the general public of the smoke management program described by this Article. ~~If conducted, the~~ The program shall include smoke impacts from prescribed fires and the role of prescribed fire in natural ecosystems.

B. ADEQ shall make annual registration, prescribed burn approval, wildfire and wildland fire use activity information readily available to the public and to facilitate regional coordination efforts and public notification.

~~**R18-2-1514. Oversight**~~

~~**A.** An F/SLM planning to make a change to any long-term established remote automated weather station shall give ADEQ notice and an opportunity to comment before making the change.~~

~~**B.** On or before August 15 of each year, each F/SLM shall submit to ADEQ a report generally describing each of the following:~~

~~1. The emissions reductions for each project from the previous year as a result of using BMP. Emissions reductions may be estimated using methods and emission factors developed jointly by ADEQ and F/SLMs;~~

~~2. The smoke management cost estimates for each active project from the previous year including estimates for monitoring, training, applying emission reduction techniques, research, and compliance with the requirements of this Article; and~~

~~3. Any research on or development of innovative techniques for emission reductions.~~

~~R18-2-1513.~~ R18-2-1514. Surveillance and Enforcement

A. An F/SLM conducting a prescribed burn shall permit ADEQ to enter and inspect burn sites unannounced to verify the accuracy of the Daily Burn Request, Burn Plan, or Accomplishment data ~~described pursuant to R18-2-1505~~ as well as matching burn approval with actual conditions, ~~and~~ smoke dispersion, and air quality impacts. On-ground site inspection procedures and aerial surveillance shall be coordinated by ADEQ and the F/SLM for safety purposes.

B. ADEQ may use remote automated weather station data if necessary to verify current and previous meteorological conditions at or near the burn site.

C. ADEQ may audit burn accomplishment data, smoke dispersion measurements, or weather measurements from previously conducted burns, if necessary to verify conformity with, or deviation from, procedures and authorizations approved by ADEQ.

D. Deviation from procedures and authorizations approved by ADEQ constitute a violation of this Article. Violations may require containment or mop-up of any active burns and may also require, in the Director's discretion, a five-day moratorium on ignitions by the responsible F/SLM. Violations of this Article are also subject to a civil penalty of not more than $10,000 per day per violation pursuant to A.R.S. § 49-463.

R18-2-1515. Forms; Electronic Copies; Information Transfers

A. ADEQ shall make available on paper and in electronically-readable format any form required to be developed by ADEQ and completed by a F/SLM.

B. After consultation with the F/SLM, ADEQ may require each F/SLM to provide data in a manner that ~~allows for and~~ facilitates electronic transfers of information.

Janet Napolitano
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 W. Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

AGENDA

Air Quality Division
Regional Haze State Implementation Plan Development
PUBLIC HEARING/ORAL PROCEEDING
October 20, 2003, 1:30 p.m.
Yuma Public Works Training Room
155 West 14th Street, Yuma, Arizona

Pursuant to [cite 40 CFR § 51.102 for SIP hearings and ARS § 49-425 for air quality rule hearings], notice is hereby given that the above referenced meeting is open to the public.

Welcome and Introductions

Purposes of the Oral Proceeding/Procedures for Making Public Comment

Brief Overview of the Proposed Rule

Question and Answer Period

Oral Comment Period

Adjournment of Oral Proceeding

Comment period ends 5:00 p.m., Friday, October 24, 2003.

Please direct comments and questions to Kevin Force, ADEQ Air Quality Division, at (602) 771-4480 or 1-800-234-5677, Ext. 771-4480.

Order of agenda items is subject to change. For additional information regarding the meeting, please call [NAME], ADEQ Air Quality Division, at (602) 771-[ ] or 1-800-234-5677, Ext. [ ].

Persons with a disability may request a reasonable accommodation such as a sign language interpreter, by contacting Katie Huebner at (602) 771-4794 or 1-800-234-5677, Ext. 4794. Requests should be made as early as possible to allow sufficient time to make the arrangements for the accommodation. This document is available in alternative formats by contacting ADEQ TDD phone number at (602) 771-4829.

Arizona Department of Environmental Quality
Air Quality Division

Please Sign In

SUBJECT **Yuma Public Hearing – Fire Rules** DATE

NAME	ORGANIZATION	PHONE	FAX	E-MAIL

1. **PLEASE NOTE: THE SIGN-IN SHEET FOR THE YUMA HEARING HAS BEEN LOST. HOWEVER, A TRANSCRIPT OF THE YUMA HEARING AND ANY COMMENTS RECEIVED IS INCLUDED IN THIS APPENDIX.**

2.

3.

4.

5.

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE MATTER OF THE PROPOSED REVISIONS TO ARIZONA ADMINISTRATIVE CODE R18-2-602, THE UNLAWFUL OPEN BURNING RULE, AND ARTICLE 15, THE RULES COVERING FOREST AND RANGE MANAGEMENT BURNS.	**PUBLIC HEARING**

At: Yuma, Arizona

Date: October 20, 2003

Filed: NOV - 7 2003

REPORTER'S TRANSCRIPT OF PROCEEDINGS

ARIZONA REPORTING SERVICES, INC.
Court Reporting
Suite Three
2627 North Third Street
Phoenix, Arizona 85004-1103

By: MICHELE E. BALMER, RPR
Certified Court Reporter
Certificate No. 50489

Prepared for:

ADEQ

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE MATTER OF THE PROPOSED REVISIONS TO ARIZONA ADMINISTRATIVE CODE R18-2-602, THE UNLAWFUL OPEN BURNING RULE, AND ARTICLE 15, THE RULES COVERING FOREST AND RANGE MANAGEMENT BURNS.	PUBLIC HEARING

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BE IT REMEMBERED that the above-entitled and numbered matter came on regularly to be heard before the Arizona Department of Environmental Quality, at the Yuma Public Works Training Room, 155 West 14th Street, Yuma, Arizona, commencing at 1:30 p.m. on the 20th day of October, 2003.

BEFORE: SEAN McCABE, HEARING OFFICER

APPEARANCES:

MARK LEWANDOWSKI, SIP and Rulemaking Development Unit Supervisor, Planning Section, on behalf of ADEQ;

EMILY BONANNI, Compliance Officer, Air Quality Compliance Section, on behalf of ADEQ;

GREG FERGUSON, Southwest Arizona Community Liaison, on behalf of ADEQ.

MICHELE E. BALMER
Certified Court Reporter
Certificate No. 50489

HEARING OFFICER McCABE: Good afternoon. Welcome to this hearing of the Arizona Department of Environmental Quality.

The subject of the hearing is proposed revisions to Arizona Administrative Code Rule R18-2-602, the unlawful open burning rule, and Article 15, the rules covering forest and range management burns.

The hearing is now open. The date is Monday, October 20, 2003, and the time is 1:30. The location is the Yuma Public Works Training Room at 155 West 14th Street, Yuma, Arizona, 85364.

My name is Sean McCabe. I'm the Rule Development Manager for the Drinking Water Section of the Water Quality Division of ADEQ, and I've been appointed by the ADEQ Director to conduct this hearing.

The purposes of this hearing are to provide the public an opportunity to, one, hear about the substance of the proposed revisions to the Arizona Administrative Code Rule R18-2-602 and Article 15; and two, to ask questions concerning the proposed rule revisions; and finally, three, to present oral arguments, data, and views concerning the proposed rule revisions in the form of comments on the record.

Other ADEQ Air Quality representatives in attendance today are Mark Lewandowski, State Implementation Plan and Rulemaking Development Unit Supervisor in the Planning Section, Greg Ferguson, and Emily Bonanni?

MS. BONANNI: Yes. Hello.

HEARING OFFICER McCABE: If you plan to make a public comment on the record, the procedure is straight forward. Please complete a speaker slip found at the sign-in table. Where did we have --

MR. LEWANDOWSKI: We don't have a sign-in table. But it's such a small hearing, just let us know.

HEARING OFFICER McCABE: We'll just wing it. I'll just -- we'll just call people in the order that they raise their hands, I guess.

You may also submit written comments to me today in person if you have them, or you may submit comments by mail, e-mail or fax. Please submit any comments by the end of the comment period, 5:00 p.m. on Friday, October 24, 2003. Any written comment must be received no later than October 24, 2003.

Submit your written comments to Kevin Force. And I have business cards here for Kevin on either side if you want to pick them up. Air Quality Planning Section, Arizona Department of Environmental Quality, 1110 West Washington Street, Third Floor, Phoenix, Arizona, 85007. The fax number is (602) 771-2366. And Kevin's e-mail address is force.kevin@ev.state.az.us.

Notice of this hearing was published originally in the Arizona Republic and The Sun on September 19th, 2003. State statutes require that comments made during the formal comment period be considered by ADEQ in their preparation of a final rule, in which the Department responds in writing to written and oral comments made during the formal comment period.

The agenda for this hearing is simple. First, I will ask Mark Lewandowski to provide an overview of the proposed rulemaking. Second, I will conduct a question and answer period. The purpose of the question and answer period is to provide information that might help you in making comments on the rulemaking.

And third, I will conduct the oral comment period. At that time I will call speakers who want to make a comment on the record and you can make your comments.

Please be aware that any comments you make at today's hearing that you want the Department to formally consider must be given either in writing or on the record during the oral comment period of the proceeding.

At this time Mark Lewandowski will give a brief overview of the background concerning Arizona's proposed revisions to R18-2-602 and Article 15.

MR. LEWANDOWSKI: Thank you, Sean. We also forgot to bring -- I forgot to bring sign-in sheets, so I would like to just pass around this sign-in sheet. If you would just put your name and affiliation, chances are we'll be able to track you down in case we need to contact you again or add you to our mailing list for this subject.

Sometimes hearings on rules are called oral proceedings. And oral proceedings is the technical name it's given in the statute, but this is basically a hearing on a proposed rule. And the proposed rule was published in The Register -- which is the official place that it's published -- September 19, 2003. You can also find it on our website if you want to take a closer look at it later on.

The only thing we kind of have to follow very carefully is the close of comment, which, if you look at your agenda, it's shown on there October 24, 2003. And almost all of the data on where to send comments is either on the card. For example, the fax machine is on the card or on the agenda.

These proposed rules -- actually, it's called one proposed rule, but it's a combination of two different areas. One of them is prescribed forestry burning or forest and range management burning, which probably is not as apropos down here in Yuma as the other part which is unlawful open burning.

But we put them in the same rulemaking because they come from the same -- we have the same purpose for them, which is Federal regional haze rules, which has to do with visibility. And in addition, we can save a little money because they're related.

We're actually having four hearings this week. Today's the first hearing in Yuma. Tomorrow in Casa Grande, which we advertised in Tucson and which covers some of the forestry burning down there in the southern half of the state. And on Wednesday we're going to Show Low. And on Thursday -- not all of the same people, but on Thursday DEQ will be in Flagstaff for the last hearing. And then the close of comment is on Friday.

Now, these proposed rules would amend -- when they go final -- Arizona's existing open burning and prescribed burning rules. Open burning is one section. It's 602. And prescribed burning is a whole article, which is Article 15 of about 15 sections.

We want to make them conform -- the reason we started the rulemaking is because we want to make those two rules conform to EPA's requirements for states', that's plural, states' Regional Haze State Implementation Plans or SIPs. All states have to come forward by December 31st of this year and submit to EPA a Regional Haze State Implementation Plan.

Because we opened these rules for that, in addition these proposed amendments make other technical changes, including improvement of the rules' clarity, conciseness, and understandability, which is a separate requirement under state statute.

As I mentioned, these revisions will be included in our state's Regional Haze SIP, which we're required to submit to EPA by December 31st, 2003.

I want to just give you a little background about all of the work that we've done so far. In early 2002, we formed a Fire Emissions Work Group to discuss visibility issues related to fire emissions and make recommendations to us, DEQ, regarding necessary changes to any rules. The current proposed rule is a joint effort of ADEQ and that Fire Emissions Work Group based on input received at those public meetings. And we had a meeting right here in this room probably in April, I think it was, that was one of those public meetings.

The specific requirements for state Regional Haze SIPs can be found in Federal regulations. It's 40 CFR, 51.308 and 51.309.

Basically, they include greater tracking and monitoring of open burning and burn plans. Also, regular evaluation of data, increased collection of data, and the establishment of annual emission goals. Now, the annual emissions goal is in the prescribed forestry burning portion of this proposed rule, and establishment of annual emission goals for fire in cooperation with states, tribes, and Federal land management agencies and private entities.

When I described this rule to, for example, the County Supervisors Association in Phoenix, I called what we did to 602 kind of an overhaul, comparing it to what you might do to an engine. And I described what we did to Article 15, forestry burning, as a tune-up.

In the 602 rule, we added a separate section for definitions, including definitions for various categories of open burning like agricultural, construction and residential.

In addition, based on the comments we had received this spring, we added new definitions for "delegated authority," the phrase "independent authority to permit fires," and "prohibited materials," which came from our guidance document.

The proposed rule on open burning also clarifies which open burning activities will require open burning permits and those that are exempt from a permit. This was another popular topic during our meetings.

It also contains a more complete list of information of what is required to be in the permit. This sort of comes from the EPA regulations. It also helps for more efficient permit administration and to comply with the various aspects of the regional -- with other various aspects of the regional haze rule.

DEQ has added language in the proposed rule clarifying that the state rule will not operate in counties with independent authority to permit fires, and we've listed those three counties in the rule: Maricopa, Pima and Pinal. They already have rules similar to 602 in existence, and the state statute says, therefore, they have independent authority. So those three counties will not be covered by the 602 rule.

Other than dangerous materials, those counties do permit open burning. If they get a request to burn dangerous materials, those three counties will forward that request to ADEQ and we'll handle it in our permit section as if it was an individual permit.

We also considered based on comments and a lot of information from the Fire Emissions Work Group to exempt certain fires that use air curtain destructors, also known as air curtain incinerators, from the open burn permit requirement in order to remove what was called an administrative barrier to this type of burning. And the Federal rule requires us to remove administrative barriers to any kind of burning that might reduce smoke.

However, after reviewing two studies -- and they're listed in the proposed rule -- DEQ management decided that these devices, air curtain destructors, do require oversight and that it is appropriate that they be subject to permits under this rule.

Obviously, it's still subject to comment, and we will invite your comments on the pros and cons of that proposed decision. At the present time, we do not view the requirement that air curtain destructors obtain a permit as a very big administrative barrier.

Now, the proposed revisions to Article 15 of the code, which is forest and range management burns, will better conform to EPA's regional haze requirements and facilitate enhanced compliance. Most of those changes directly reflect the mandates of EPA's original haze rule, particularly relating to collection and recording of burn data, evaluation of burn programs, and, as I mentioned previously, setting annual emission goals.

The former structure of that rule remains intact. There was annual registration of burn plans, submittal of a burn plan at least 14 days before the burn, a daily burn request, which is usually faxed to us, and a burn accomplishment form.

That concludes the comments that I had on the oversight or on the summary of the rule. I just wanted to add a couple of things that weren't included in there.

Our timeline for this rule is that, as I mentioned, we'll have four hearings this week, and October 24th will be close of comment.

We plan to submit the final rulemaking to GERC after we respond to comments, and write that up around November 24th, just before Thanksgiving. We would hope based on that schedule that GERC will approve or consider this rule on January 6th. I think January 6th is a Tuesday, and that would be their monthly meeting. And so we will have that rule on that agenda if all goes well.

However, as I mentioned previously, we have to submit the SIP before the first of the year. So we will submit the SIP with the rule, the not yet approved rule that we submitted to GERC, and EPA will use that as the opening -- for opening consideration.

If we stay on schedule, the rule will be effective approximately 60 days after we file it, which is approximately the beginning of March. I have on this March 9th, 2004.

If anybody is interested in who is on the Fire Emissions Work Group, I have a list of those people here. And so they were partly responsible for what is in this rule.

And I have a list of their meeting times here. They met between August 8, 2002, and May 9, 2003 about 15 times it looks like.

That concludes my summary of the proposed rule. Are there any questions? Oh, actually, I turn it back to you now.

HEARING OFFICER McCABE: Are there any questions?

(No response.)

HEARING OFFICER McCABE: All right. Hearing none -- go ahead.

MR. DUFFY: I got a question in regards to --

MR. LEWANDOWSKI: Sir, would you mind stating your name for the record.

MR. DUFFY: Yeah. Charles Duffy. Fire Chief, Marine Corps Air Station, Yuma.

The last meeting I attended when you were here in Yuma last, there was discussion on who is authorized to issue the burn permit and whether there is local jurisdiction. In our case, the marine base itself was going to be able to issue these permits. I'm not sure if I've got a clear understanding reading through this how that's going to work.

MR. LEWANDOWSKI: Under the 602 rule, there's a section on delegation, which I didn't summarize. And in addition there is a -- well, there's a section on delegation.

And one of the things we put in that is that if your delegated authority -- for example, the Rural/Metro, I think, here is delegated authority from DEQ to issue open burn permits. But we put in there a restriction that a delegated authority could not issue itself permits. And I think that might be an answer to part of your question.

MR. DUFFY: I'm not sure -- I mean, in our case we're looking at two issues. One, we control all burning on the base as far as any welding on up, you know, depending on -- no matter what you're talking about, if you're putting heat to it we control it.

But we have two issues that we're really concerned with. One, of course, is training fires, both for the structural side and the aircraft firefighters. Also, we have in the last year or so purchased a number of acres of farmland citrus that now fall within our boundary.

And the issuing of burn permits is controlled, you know, I mean, usually by us. Where by this, the only thing I'm reading is we have to go to the County or Rural/Metro to do that?

MR. LEWANDOWSKI: I think that's the way the proposed rule currently reads. Now, do you currently get burn permits from anybody?

MR. DUFFY: No. Right now we haven't done anything with that property that --

MR. LEWANDOWSKI: You mean the citrus?

MR. DUFFY: Yeah. That's been purchased.

MR. LEWANDOWSKI: As I understand it, the proposed rule would require the Marine Corps to get a burn permit for those activities that need burn permits from either one of the delegated authorities or DEQ.

MR. DUFFY: Are you delegated?

MR. MEADOWS: Paul Meadows, City of Yuma Fire.

That's what my question was going to be. We've been issuing our own burn permits.

MR. FOSTER: You are delegated.

MR. MEADOWS: So we are -- we will remain delegated?

MR. FOSTER: Yes.

MR. LEWANDOWSKI: However -- go ahead, Greg.

MR. FERGUSON: It's my understanding that Yuma County is the delegated authority for you, and then Yuma County --

MR. FOSTER: Goes to us.

MR. FERGUSON: Goes -- yeah. He's not delegated by --

MR. FOSTER: We're not delegated by -- okay.

COURT REPORTER: I'm sorry. Could you give me your name, please, sir?

MR. FOSTER: Curt Foster. Rural/Metro Fire Department.

MR. FERGUSON: It's my understanding that Yuma County would have approval of Yuma, Rural/Metro, and San Luis? Or is that Somerton?

MS. BONANNI: Somerton.

MR. FERGUSON: One of them. But they all get it from the County, I believe. I think the County is the actual --

MR. FOSTER: Yeah. Even your rule change

states in here that -- it says a private fire protection service provider that has been assigned authority to issue open burn permits by one of the authorities in Subsection A, which is a county, city, town or control district.

MR. LEWANDOWSKI: Right. So I can just clarify a little bit, the statute kind of sets out two different ways that authority can come down to people to issue these permits. And number one is the delegation to another governmental agency. And then the other way is a transfer. They use a different verb other than delegate. I can't think of it at the moment, but the transfer of authority to a private fire protection service provider.

MR. FOSTER: I think ours is listed as a memorandum of understanding. That sounds right.

HEARING OFFICER McCABE: A memorandum of understanding between the fire department and the County?

MR. FOSTER: What's that?

HEARING OFFICER McCABE: It's a memorandum of understanding between the fire department and the County?

MR. FOSTER: Yeah. Yuma County Health Department.

HEARING OFFICER McCABE: And so the ADEQ is not a party to that?

MR. FOSTER: Well, they oversee what the County does, and the recording comes from us to the County to ADEQ. And a number of times we will simply compile our data over a six-month period and send it directly to ADEQ. I think it's Probat? Is that --

MR. LEWANDOWSKI: Yeah. Probat is no longer with us but --

MS. BONANNI: But he was the director of the permit section. Yes. I've seen it.

MR. LEWANDOWSKI: The verb I was looking for in the rule, it's Subsection G is the subsection that discusses delegation, and we repeated the verb from the statute.

But once you're delegated authority, that is the County, city, town, or air pollution control district or a fire district, which is in a sense a governmental unit, once you're delegated that authority, you may assign that authority to one or more private fire protection services.

So when you go outside of the government boundaries, you're no longer delegating authority. You're assigning it. You are reserving some responsibility in a sense.

MR. MEADOWS: Paul Meadows, Yuma Fire.

So the City is delegated as a government agency?

MR. LEWANDOWSKI: I can't speak to that directly because I don't know that there is, in fact, in existence a delegation agreement that goes to that.

MR. FERGUSON: I got a copy. I'll go get it.

MR. LEWANDOWSKI: But Greg is walking with a purposeful manner.

MR. FERGUSON: Yeah. I think I got a copy of it.

MR. LEWANDOWSKI: Oh, okay.

MS. BONANNI: I believe there is an MOU between ADEQ and the City of Yuma Fire Department itself directly.

MR. LEWANDOWSKI: Okay.

MS. BONANNI: You're right. Everything that falls under your area of responsibility you have jurisdiction over to approve or disapprove.

MR. MEADOWS: So our status is not going to change, then, based on these changes.

MS. BONANNI: No.

MR. LEWANDOWSKI: Well, other than this rule prohibits you from issuing an open burn permit to yourself.

MR. MEADOWS: Okay.

MR. FOSTER: You can't burn yourself, Paul.

MS. BONANNI: But it would seem to be the same for the Marine Corps Air Station. If you want to burn on your own land, that you would require -- you're going to have to have someone else to get you the permit, whether it's the City of Yuma, the County, or DEQ itself.

MR. DUFFY: Well, normally it's going to be -- the land backs up to the farmers, so the farmers are going to be requesting the burn permit. Now, except for in the case of training fires and things of that nature. Now, we are talking about ourselves.

MS. BONANNI: Yes, you are. But you can't approve it yourself. Fire training, I believe, still goes back to DEQ itself. You didn't -- you weren't required at one time to get a permit for training exercises. You just had to notify DEQ. I believe now the rule is changing that. That you must apply for a permit.

MR. DUFFY: Right. That is what I was curious about.

MS. BONANNI: I'm really, really sure it does change this time.

HEARING OFFICER McCABE: David.

MR. RODRIGUEZ: David Rodriguez, Marine Corps Station, Environmental Department.

I think what is really concerning us, under the formal rule fire fighting was exempted from the rule. Therefore, we conducted our own fires and we maintain our own records of what we burn.

What we're concerned about now especially is for our crash fire rescue personnel which can't meet the 14-day notice in there and things of that nature. Because we train -- firefighters throughout the United States come to Yuma to train. And that can be on a weekly basis, monthly basis. We could have 10, 20, 30, in any one given day.

This is going to really put a hamper on our training missions because our firefighters got to meet other qualifications through FAA, NAVAIR instructions, and there are three or four different Federal instructions that they have to abide by and keep current.

Each firefighter, I believe -- and don't quote me on this -- but something like three fires a month they have to be able to go out. In addition to that, they have to learn how to fight fires at night, because we don't schedule our aircraft when to crash. So if these guys aren't trained at night how to fight a fire at night, what good is it going to do the first time we have a night crash?

MR. LEWANDOWSKI: Excuse me. You mentioned a 14-day requirement?

MR. RODRIGUEZ: Yes. I read something in here.

MS. BONANNI: I understand the second thing he just said about fire training at night. Right now, I'm not sure if that would be as an individual basis, that would be an individual permit that would -- for that particular purpose you could possibly get a permit. Right now --

COURT REPORTER: I'm sorry. I couldn't hear your last sentence.

MS. BONANNI: Right now, the rules do prohibit training exercises after sundown. And it's possible, whether it's mentioned in the rule or not, they will have to apply for an individual permit on a case-by-case basis to get approval for burning at night at sundown.

MR. LEWANDOWSKI: That's one possibility. But we do need the details surrounding your comment. Again, it's not just DEQ that put this together, but it's this Fire Emissions Work Group.

MR. RODRIGUEZ: Right.

MR. LEWANDOWSKI: And, you know, they were thinking a lot about smoke and monitoring smoke for regional haze purposes.

Before we leave, there was -- the first part of your comment, which was fire. As I recall an early comment from you was that you would use -- somehow you would use propane?

MR. DUFFY: We're looking at going propane.

MR. RODRIGUEZ: We are going propane. We're just purchasing mobile propane fire fighting equipment is going to come, and it's going to be stationed here but used back and forth and bring propane.

MR. LEWANDOWSKI: Would you include some details of that in your comment if you are going to send written comments?

MR. RODRIGUEZ: Yes.

MR. LEWANDOWSKI: Including how these propane might reduce the use of smoke?

MR. RODRIGUEZ: Yes.

MR. LEWANDOWSKI: Or the production of smoke.

MR. RODRIGUEZ: Yes.

HEARING OFFICER McCABE: Mr. Foster.

MR. FOSTER: I think you have it covered in -- it's in your notice of proposed rulemaking number 4 under C. It says: Prescribed burn set by or assisted by the Federal government, or any of its departments, agencies or agents, the state or any of its agents, departments or political subdivisions, do not require a burn permit. It's in your rules.

MR. FERGUSON: Where at?

MR. FOSTER: On page 4075, Section C. Open, outdoor fire exempt from a permit under C, number 4.

MR. LEWANDOWSKI: But the last phrase says: Pursuant to Article 15.

MR. FOSTER: Right.

MR. LEWANDOWSKI: So we're talking about Federal land managers doing prescribed burning in a National Forest.

MR. FOSTER: Right. But this is talking about Federal government, and the Base is Federal.

MR. LEWANDOWSKI: Right.

MR. FOSTER: It's not part of the range or the forest management program.

MR. LEWANDOWSKI: The fires that are exempt from an unlawful open burning permit under 602 are the ones that are set under Article 15 under the second part of this rule. So in other words, there's not dual regulation.

MR. FOSTER: If I were to read this and ask myself, I would say I would not need a permit. If I'm a federal agent on federal property, this says that I don't have to have one.

MR. LEWANDOWSKI: That's not the way it was drafted.

MR. FOSTER: Well, I'm just -- all I'm doing is reading it word for word.

MR. LEWANDOWSKI: I'm only making that comment so that the people here know that the intent was not to exempt the Federal government or any of its departments from open burning permits. But the intent was to exempt it from open burning permits when those activities would be covered under the second part of this rule where they get prescribed burn plans and they register 14 days.

Now, the 14 days you mentioned, that also applies, I know, in the second part of this rule for prescribed forestry burning. But as far as I know, I don't recall where there is a 14-day requirement in 602, which is unlawful open burning.

MS. BONANNI: I have to agree with you. I'm not aware of that at all.

MR. RODRIGUEZ: And that's what we were concerned about. I just read the 14 days in the -- and, again, going back to what you were saying, it refers back to Article 15 when you're talking about the actual AG burning. We're talking about -- our main concern is our firefighters to save lives.

You know, the fire department uses their building for the firefighters that do entries or crash fire recuses using the mock airplanes to demonstrate an aircraft fire. So I think we're talking apples and oranges here in Article 15.

MR. LEWANDOWSKI: Well, we saved money by putting the rules together, but maybe we didn't in the long run because we've got some confusion here.

As I mentioned in the beginning, they're fairly separate in terms of what and who is being -- what is being burned and who is doing the burning. The National Forest Service, Parks Department, the people who manage the forests, they'll burn to prevent or to mitigate future forest fires. And that's covered under Article 15. That's a completely separate program.

Rule 602, which is the rule that I think applies mostly to the Yuma area, covers agriculture burning. It covers burning that is defined by the statutory definition of unlawful open burning. And I think I just would like to read that:

Combustion of material of any type outdoors in the open where the products of combustion don't go through a flue. Open outdoor fires can include agriculture, residential, prescribed and construction burning.

And then it goes on: Further purposes, prevention of a fire hazard, instruction in the method of fighting fires, watershed rehabilitation and disease and pest prevention.

Now, because of the way the rules are legally interpreted, this definition in Article 6 applies in Article 6 and doesn't apply in Article 15. But perhaps we should insert something that open outdoor fires does not include forestry burning under Article 15.

To clarify -- to get back to your comment, as far as Emily and I know, there is no 14-day requirement for open burning that you would conduct on the Marine Corps Air Station.

As I recall -- and Emily is involved more with the issuance of these permits, you can get an annual permit for burning of this type, and they're free. From DEQ they're free.

And so if that would still present you a problem, then we would like to hear about it. Of course, the nighttime burning is a separate issue.

Just so people know, in the rule we replaced the old time of day burn requirements. In other words, I think it used to say 9:00 a.m. -- or it currently says 9:00 a.m. to 3:00 p.m. We now say start ignition no earlier than one hour after sunrise, or that it must be extinguished two hours before sunset.

Now, in terms of special purpose burning like you would do conducting it at night, I would have to go back to the Fire Emissions Work Group and say, what about that? And so that's why -- again, both with the propane, the fire training, and with the nighttime fire training, we would like to see some more details. Maybe we can make some fine-tuning adjustments to this rule.

MR. DUFFY: I'm not sure I'm clear on the permitting process and just specifically talking about training issues here.

If the City of Yuma was going to have a training fire, do they have to turn to Rural/Metro to get a burn permit for that?

MS. BONANNI: Because they have an agreement with DEQ, they turn to DEQ and ask to do a fire training exercise. Because DEQ is going to ask them are they --

MR. DUFFY: If I wanted to run a training fire on the base myself, I would have to turn to one of these two?

MS. BONANNI: See, I thought all training exercises go back to DEQ. It's only if you want to burn the agricultural land you include those.

MR. DUFFY: That's another issue.

MS. BONANNI: It is. But to do fire training, I thought I was understanding the concept was all fire training from the fire departments will have to go to DEQ for approval now. You don't today. But with the new rule, I understand that we're making the change that everyone -- everyone will have to do it.

MR. MEADOWS: Paul Meadows, Yuma Fire.

So can we get, quote, an annual permit for training fires or do we have to schedule -- call you for each time we're going to burn?

MS. BONANNI: I'm going to say -- they haven't actually explained it, but I'm going to say their idea is that they're going to call every time you want to do a training exercise.

MR. MEADOWS: So is there any time limit? I mean, once in a while they find themselves, oh, we got two hours this afternoon. Let's go burn.

MS. BONANNI: Well, the thing is, DEQ has got 24-hour voicemail. So I'm not sure.

MR. MEADOWS: They might be calling at noon and burning at 1:30.

MS. BONANNI: For training. Yeah.

MR. MEADOWS: Is that going to be a problem?

MS. BONANNI: We have not discussed that. So that answer I can't give you today, but it will certainly be worth looking up, is there going to be a time frame.

MR. LEWANDOWSKI: I also have the feeling that there is a limitation about -- in other words, if A delegates to B, and B delegate to C, then B can't get -- or it would seem unusual for B to get a permit to burn from C, whom it delegated authority to in the first place.

Just like the reason we limited people giving permits to themselves is not so much because we have a big history of things going wrong, but because it doesn't look right.

For example, if we elected a president who was a doctor, he or she could probably give themselves a really good physical. But still, government would require that the president get an independent physical even though they could do it themselves. And the same way with the open burn permits. It just -- it's better government for government not to permit itself.

And so if the County delegates to Rural/Metro and the County wanted to burn, I'm not sure that it would be the best thing for Rural/Metro to give a permit to the County.

Although does that happen? When the County burns -- is there anybody from the County here?

MR. FOSTER: I have no idea.

MR. FERGUSON: I don't know what the County would burn.

MR. STANSBURY: Apart from structures where we have -- Monty Stansbury, Yuma County.

Apart from dilapidated structures or structures that are abandoned, normally we'll, I think, try to work with Rural/Metro so they can use in some instances those structures for practice purposes. But that would be the only incident is trying to raze the structures through that means. That's the only --

MR. LEWANDOWSKI: Well, I think there are some areas that we have to clarify here in terms of the timing of permission to burn and how often it needs to be obtained.

HEARING OFFICER McCABE: Everybody realizes that we're still not formally into the formal comment period, so if you want to restate these issues once we have the formal comment.

MR. DUFFY: I think there's also a training issue here. I mean, if you look at Yuma, you look up in the Valley area where you got Phoenix and Mesa and Tempe, if Phoenix is going to put on a training fire for one of their engine companies, are you saying that they got to go to Tempe to get the burn permit? Kind of -- I mean, maybe not.

MR. LEWANDOWSKI: I'm saying that may not seem right. It could be that Phoenix would have to go to the County. It has to go up a level or to the State.

MR. DUFFY: But you see where I'm going with that. Kind of like down here in the Yuma area, you've got two of the fire departments that can issue permits. Us, YPG cannot issue permits. So you're saying almost that I have to go to another fire department to conduct my training.

MR. LEWANDOWSKI: When you have your own -- I understand the --

MR. DUFFY: There's no efficiency there.

MR. LEWANDOWSKI: Yeah. Especially when you have your own fire prevention or your fire extinguishing equipment on the base.

MR. DUFFY: Right.

HEARING OFFICER McCABE: Mr. Foster.

MR. FOSTER: You know, it just seems like we're just -- we just keep beating this thing to death. It seems to me to make this thing neat and clean and efficient is just to have fire trainings be exempt. It was exempt for 20 years.

MS. BONANNI: It was exempt. And I can't tell you why the committee brought it back in.

MR. FOSTER: I don't know. I wasn't here.

MS. BONANNI: No. You weren't there. It was people that are not in your type of work is what brought it in. And unless we went back to the notes, I can't tell you why it was now you have to.

MR. FOSTER: It was just thrown on the table. But it seems to me like all of the mumbo jumbo that's going around with this thing, you should make it exempt and be done with it.

MR. FERGUSON: When we had the meeting here in April, we beat this same subject to death.

MS. BONANNI: I know it came up.

MR. FERGUSON: And we said then, it's exempt. Why are they taking away the exemption?

Because I hope somebody realizes that if every fire department and every fire district and every fire station in Arizona comes to you every time they want a training burn, somebody's going to be overwhelmed. I don't think you -- somebody's not -- it's not registering how many phone calls they're going to get. I mean, I would hate to just do it in Yuma County.

MS. BONANNI: Right. That's true. Like Mark said, it obviously has to be looked at and have a yes or no answer.

MR. LEWANDOWSKI: One of the concerns that was raised by our permitting people was we don't know what things are going to be combusted during training exercises, and we would like to. We would like to know that ahead of time.

MR. FOSTER: Let me give you a heads up. You're never going to know, because you are 214 miles away. Somebody in Yuma is going to call you for a permit to burn or have a training fire, you have no clue. If you're going to do that, if you're to require that, then you better have somebody be doing a physical inspection of that fire prior to ignition.

You can't do it. Trust me. I've been doing this too long. You can't do it. I'm not being negative. I'm just telling you, if you're going to put that type restriction out there, you're going to have to enforce it with a body to do a site inspection prior to ignition.

HEARING OFFICER McCABE: Mr. Stansbury, did you have a comment?

MR. STANSBURY: Monte Stansbury again.

What effect does the rule change have on entertainment value fires such as chimeneas, pit barbecues, pit fires?

MR. LEWANDOWSKI: We don't have a movie exemption. Oh, I see. I followed -- yeah. Entertainment barbecue fires, things like that.

MR. FOSTER: They're exempt.

MR. LEWANDOWSKI: We talked about that. Believe it or not, we did talk about it.

MR. STANSBURY: Some of them get to be exceptionally elaborate and some of them quite large.

MR. MEADOWS: Many of those can be covered by enforcement of the fire code in that jurisdiction. In the City of Yuma, we can limit the size and the materials through the fire code.

MR. STANSBURY: I sure would hope so. People come and ask us questions. We normally refer them to Rural/Metro. But for things such as that, individuals go out on their patio and they want to have a chimenea going for a party for two or three hours. My hope would be that there is some level of exemption or a small reporting requirement, if any at all.

MR. LEWANDOWSKI: Okay.

HEARING OFFICER McCABE: I think we're closing in on the free comment discussion, unless anybody --

MR. FERGUSON: I would just like to say, according to my records, the City of Yuma and the City of Somerton and Yuma County are delegated. And then

Yuma County has re-delegated, subdelegated, something, to Rural/Metro. See there at the bottom of Yuma County? But Somerton and the City of Yuma have a number of different --

MR. RODRIGUEZ: That goes back to who is guarding the chicken coop. You know what I mean? That's what it sounds like.

HEARING OFFICER McCABE: I was thinking one of the reasons they might have put in the restrictions on training burns is you have to have some control over who is going to be doing them and if they're qualified to be doing them.

MR. RODRIGUEZ: But the rules are clear. It says a federal or state official in performance of official duties. I mean, then if you gave the guidelines of what you can burn, what you can't burn, we're fixing something that's not broke.

Now, I know back in '93 when the air station got our first permit, our fire fighting was on our permit. And that's because I didn't know the exemption was there, and I took it off once I found out it was there.

However, under Probat, what I was doing is I was doing a monthly report to the state on the dates we had fires, the times the fires were conducted, and what we burned, how many people we trained and who they were, whether they from here or from New Mexico, wherever, and I sent this in on a monthly basis.

That gave good control until I called the State one more time and asked to get copies, and nobody knew who in the heck I was sending these reports to. Probat didn't know who had them. Nobody in Air Quality knew about the reports. At least three years I've been sending these reports, and nobody knew where they went to.

MR. LEWANDOWSKI: You were ahead of your time.

MR. RODRIGUEZ: That's crazy.

MR. FOSTER: They went the same place mine did.

MR. RODRIGUEZ: Exactly.

MS. BONANNI: Actually, they know your name so they do save yours.

MR. LEWANDOWSKI: Well, now EPA is going to be asking us about the reports that we receive under the Federal regulations.

Thank you so much for all of your intelligent questions. I'm sure glad we came out here to go over this one last time.

MR. MEADOWS: We're not done yet.

MR. LEWANDOWSKI: I know you're not done.

HEARING OFFICER McCABE: Well, if there is no more discussion, I can open up the proceeding for oral comments at this time.

MR. LEWANDOWSKI: By the way, we're going to look at the discussion on the transcript to make sure that we understand your comments as fully as possible. So don't think you have to repeat everything, but if you want to repeat the main points.

HEARING OFFICER McCABE: Mr. Meadows.

MR. MEADOWS: Paul Meadows, Yuma Fire.

I would just like to see a -- my proposal is that fire training be exempted from these rule changes, and the fire training be, you know, federal, state, county, city, or delegated to someone. And delegated might not be the right word since you have a special term.

But in the instance I use, the instance of the County cooperating with Rural/Metro as a private company, they should be exempt from this rule, or at least just an annual permit where you have maybe some standards that are on that annual permit that must be adhered to and they sign that agreement.

Because it just doesn't make sense to -- first of all, the City of Yuma is the State Fire Marshal's representative for Yuma County. I mean, that tells me right there that the State Fire Marshal is not going to be able to support this. Their staff is shrinking. The State is taking money from everyone else. So it sounds like we're setting up a bureaucracy of paper trails that's going to go nowhere, to staffs who can't support it anyway because they're overwhelmed with things that are wrong. And there's nothing wrong with fire training.

So just a proposal to look into that, get that out of here, or make it an annual permit that you fill out annually and with information that ADEQ needs, and that you sign at the bottom that we will adhere to this. And don't worry about it unless something goes wrong. And then -- but I don't see anything going wrong with it because the fire departments of all of the departments in the government I think are probably the -- you know, maybe I'm a little prejudice here, but we're the most good faith department you're going to find. Thank you.

MR. LEWANDOWSKI: Anybody else?

MR. RODRIGUEZ: David Rodriguez again.

I just want to reemphasize the issue on the times for the burns and the need to be authorized to burn at night, at least for the Marine Corps firefighters. For safety, it's a big issue. Again, we don't schedule the airplanes when they're going to crash. And when they crash at night, they've got to be able to fight it at night.

MR. FOSTER: But also keep in mind that if there's rule changes made where fire fighting fires are not required to be permitted, you don't worry about it.

MS. BONANNI: True.

MR. FOSTER: Because it's only those fires that are permitted that have to abide by the rules. Non-permitted fires do not. That goes out the window.

MR. MEADOWS: If you put in an annual thing, there should be something in there that allows and takes into consideration nighttime fire training.

MS. BONANNI: I'm going to say what we'll need to check out is if it's strictly an emissions reason why the fire department is being asked to now get permission for every training exercise, perhaps what Paul was saying may satisfy that requirement.

If we get an annual report from each fire department saying I've had this many training exercises and conducted these days, the duration of the fire training took so many hours, that might answer the question if it's strictly from an emissions question.

If it is what materials you're burning -- back on another statement -- no, that won't answer that question. But that's probably the best proposal.

MR. MEADOWS: Paul Meadows again. Under your annual, you could say these types of fuels are permitted. These types of fuels are not.

MR. RODRIGUEZ: Exactly.

MR. MEADOWS: Are burn permits issued now? I mean, this isn't rocket science.

MS. BONANNI: If that's what the concern is, that might be perfect. We don't know until we ask the committee.

MR. RODRIGUEZ: And we have our own SOPs. The fire department when they do their tower burns, all they burn is wood. There's no plastics. No wood with any kind of paint or shellac is allowed to be burned. We have policies in place already.

Right now -- well, we're not burning JP anymore, but at that time we were only allowed to burn virgin JP.

MR. LEWANDOWSKI: And what is JP?

MR. RODRIGUEZ: JP-5 jet fuel. It can't be contaminated with anything. If you're going to burn it, it's got to be virgin material.

So the policies are in place. The state is going to know that we're burning by an annual report.

MR. MEADOWS: Paul Meadows again, Yuma Fire.

We are guided by the National Fire Protection

Association. They have a standard for fire training. And a department that doesn't go by that standard has just opened themselves up for a bunch of trouble well beyond what we're talking about here. But the NFPA -- I don't remember the number right now -- covers all of the safety and that type of stuff.

So, again, I would like to reiterate, we are self-regulated. And what good does it do the taxpayer to have us creating other regulating bodies when money is the big issue anyway? Just a for instance, the State is in trouble. We all know that. And we've picked up a lot of their responsibility as the jurisdiction having authority, and I think this falls under that jurisdiction having authority.

MR. RODRIGUEZ: David Rodriguez again.

I think maybe one thing that we could do is probably go out and see what the community is doing. I mean, I think we will probably be surprised.

On the air station, we're probably as strict or more strict than anyone else around. If a firefighter wants to burn, they have to tell us, my department, Marie Stewart here, 24 hours ahead of time that they're going to have a training burn. If they fail to do that and they call us, we say, sorry, you can't burn. You got to wait for the next day. Then they're not allowed to burn until we make the phone call, get the 800 number and we call them back. Okay. It's a good day to burn. You're good to go.

We've got our policies in place. Maybe we need to find out what everybody is doing.

MR. LEWANDOWSKI: We would be happy to receive that policy if you wish to send it to us.

MR. RODRIGUEZ: You have a lot of work to do.

MR. FOSTER: They call that delegating, don't they?

HEARING OFFICER McCABE: All right. If there are no further comments --

MR. FOSTER: Well, I have a comment, but it's not the same issue. Different issue.

HEARING OFFICER McCABE: Okay.

MR. FOSTER: Under Section D, lower F, number 3, it says the type of fires such as pile or windrow. We need to get rid of that word "windrow." It needs to disappear quickly.

MR. LEWANDOWSKI: Could you suggest an alternative?

MR. FOSTER: Take it out completely. Piles.

MR. LEWANDOWSKI: Okay.

MR. FOSTER: Since the introduction of the air current destructor, the piles of citrus and other debris that are being burned are set up in piles and the air current destructor handles that very well.

When you get into windrows that are 300 or 400 feet long, you have no control over anything.

MR. LEWANDOWSKI: Well, I thought you were suggesting getting rid of it because it no longer happens, but what you're saying is that that might happen and that it's not as safe?

MR. FOSTER: That's very unpredictable.

MR. LEWANDOWSKI: So we would want to know, if it was a windrow -- unless your suggestion is that we should prohibit windrow.

MR. FOSTER: Prohibit windrows. If you leave it in there, somebody is going to see it and they're going to do windrows because it's cheaper to push it into windrows than piles. You have no fire control measures in a windrow, you have no emissions controls in a windrow, and you don't have time in a windrow.

I guess you could replace it, if you wanted to fill the space in, with a pit. Piles or a pit.

MR. LEWANDOWSKI: Thank you.

HEARING OFFICER McCABE: Any other comment?

(No response.)

HEARING OFFICER McCABE: Okay. This concludes the oral comment period of the proceeding. We encourage everyone to submit written comments on the proposed rulemaking. Please remember that all of the comments must be received no later than 5:00 p.m. this Friday, October 24th.

And we thank you all for attending and thank you for all of your suggestions.

MR. MEADOWS: Just one last question. Since we made these proposals during the oral comment period, do we have to resubmit them or are they on the record for action?

HEARING OFFICER McCABE: They're on the record. I don't know if you want to be any more specific in the written comment or not.

MR. LEWANDOWSKI: The oral comments are as good or sometimes better as the written.

HEARING OFFICER McCABE: Thank you.

(The Public Hearing concluded at 2:30 p.m.)

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, MICHELE E. BALMER, Certified Court Reporter No. 50489 for the State of Arizona, do hereby certify that the foregoing printed pages constitute a full, true and accurate transcript of the proceedings had in the foregoing matter, all done to the best of my skill and ability.

WITNESS my hand this 1st day of November, 2003.

MICHELE E. BALMER
Certified Court Reporter
Certificate No. 50489

Arizona Department of Environmental Quality
Air Quality Division

Public Hearing Presiding Officer Certification

I, Sean McCabe, the designated Presiding Officer, do hereby certify that the public hearing held by the Arizona Department of Environmental Quality was conducted on October 20, 2003, at the Yuma Public Works Office, Yuma, Arizona, in accordance with public notice requirements by publication in Arizona Administrative Register and other locations beginning September 19, 2003. Furthermore, I do hereby certify that the public hearing was recorded from the opening of the public record through concluding remarks and adjournment, and the transcript provided contains a full, true, and correct record of the above-referenced public hearing.

Dated this 4th day of December, 2003.

Sean P McCabe
Sean McCabe

State of Arizona)
) ss.
County of Maricopa)

Subscribed and sworn to before me by Sean McCabe this 4th day of December, 2003

DENEE N. WOODARD
Notary Public - Arizona
Maricopa County
Expires 12/30/05

Denee N. Woodard

Notary Public

My commission expires: 12/30/05

Janet Napolitano
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 W. Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

AGENDA

Air Quality Division
Regional Haze State Implementation Plan Development
PUBLIC HEARING/ORAL PROCEEDING
October 21, 2003, 1:30 p.m.
Casa Grande Parks & Recreation Office, Armadillo Room
404 East Florence Boulevard, Casa Grande, Arizona

Pursuant to [cite 40 CFR § 51.102 for SIP hearings and ARS § 49-425 for air quality rule hearings], notice is hereby given that the above referenced meeting is open to the public.

Welcome and Introductions

Purposes of the Oral Proceeding/Procedures for Making Public Comment

Brief Overview of the Proposed Rule

Question and Answer Period

Oral Comment Period

Adjournment of Oral Proceeding

Comment period ends 5:00 p.m., Friday, October 24, 2003.

Please direct comments and questions to Kevin Force, ADEQ Air Quality Division, at (602) 771-4480 or 1-800-234-5677, Ext. 771-4480.

Order of agenda items is subject to change. For additional information regarding the meeting, please call [NAME], ADEQ Air Quality Division, at (602) 771-[ ] or 1-800-234-5677, Ext. [ ].

Persons with a disability may request a reasonable accommodation such as a sign language interpreter, by contacting Katie Huebner at (602) 771-4794 or 1-800-234-5677, Ext. 4794. Requests should be made as early as possible to allow sufficient time to make the arrangements for the accommodation. This document is available in alternative formats by contacting ADEQ TDD phone number at (602) 771-4829.

Arizona Department of Environmental Quality
Air Quality Division

Please Sign In

SUBJECT ADEQ R18-2-602, ART 15 REVISIONS DATE 10/21/03

CASA GRANDE

	NAME	ORGANIZATION	PHONE	FAX	E-MAIL
1.	Larry Hawke	PDEQ	520 740 3337		
2.	Don Gabrielson	Pinal Air Q	520 866 6929		
3.	Ed Minch	AZ Dept of Agric.	(602) 542-0954		
4.	Kale Walch	PCAQCD	520 866 6960		
5.					
6.					
7.					
8.					

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE MATTER OF THE PROPOSED REVISIONS TO ARIZONA ADMINISTRATIVE CODE R18-2-602, THE UNLAWFUL OPEN BURNING RULE, AND ARTICLE 15, THE RULES COVERING FOREST AND RANGE MANAGEMENT BURNS.	**PUBLIC HEARING**

At: Casa Grande, Arizona

Date: October 21, 2003

Filed: NOV - 7 2003

REPORTER'S TRANSCRIPT OF PROCEEDINGS

ARIZONA REPORTING SERVICE, INC.
Court Reporting
Suite Three
2627 North Third Street
Phoenix, Arizona 85004-1126

By: KATHRYN A. BLACKWELDER
Certified Court Reporter
Certificate No. 50666

Prepared for:

ADEQ

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

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BE IT REMEMBERED that the above-entitled and numbered matter came on regularly to be heard before the Arizona Department of Environmental Quality, at the Casa Grande Parks & Recreation Office Armadillo Room, 404 East Florence Boulevard, Casa Grande, Arizona, commencing at 1:30 p.m. on the 21st day of October, 2003.

BEFORE: SHUDEISH MAHADEV, HEARING OFFICER

APPEARANCES:

MARK LEWANDOWSKI, SIP and Rulemaking Development Unit Supervisor, Planning Section, on behalf of ADEQ;

KEVIN FORCE, Rule Writer, Planning Section, on behalf of ADEQ.

KATHRYN A. BLACKWELDER
Certified Court Reporter
Certificate No. 50666

HEARING OFFICER MAHADEV: Good afternoon. Welcome to this Arizona Department of Environmental Quality hearing.

The subject of this hearing is proposed revisions to Arizona Administrative Code R18-2-602, the unlawful open burning rule, and Article 15, the rules covering forest and range management burns.

The hearing is now open. The date is Tuesday, October 21st, 2003, and the time is 1:38 p.m. The location is the Armadillo Room of the Casa Grande Parks and Recreation Office at the following address, 404 East Florence Boulevard, Casa Grande, Arizona 85222.

My name is Shudeish Mahadev. I'm an Environmental Engineering Specialist for the Permits Section of the Air Quality Division at ADEQ, and I have been appointed by the ADEQ Director to conduct this hearing.

The purposes of this hearing are to provide the public an opportunity to, one, hear about the substance of the proposed revisions to the Arizona Administrative Code Rule 18-2-602 and Article 15; two, ask questions concerning the proposed rule revisions; and present oral arguments, data, and views concerning the proposed rule revisions, in the form of comments on the record.

Other ADEQ Air Quality representatives in attendance today are Mark Lewandowski, SIP and Rulemaking Development Unit Supervisor for the Planning Section; Kevin Force, Rule Writer from the Planning Section.

If you plan to make a public comment on the record, the procedure is straightforward. Please complete a speaker slip found at the sign-in table and hand your slip to me. Using speaker slips allows everyone an opportunity to be heard and allows us to match the name on the official record with the comments.

You may also submit written comments to me today in person, or you may submit comments by mail, e-mail, or fax. Please submit comments by the end of the comment period, 5:00 p.m. on Friday, October 24, 2003. Any written comment must be received no later than October 24, 2003.

Submit your written comments to Kevin Force, Air Quality Planning Section, Arizona Department of Environmental Quality, 1110 West Washington Street, Third Floor, Phoenix, Arizona 85007. His fax is 602-771-2366 and his e-mail is force.kevin@ev.state.az.us.

Notice of this hearing was published in The Arizona Republic and The Arizona Daily Star on September 19, 2003.

State statutes require that comments made during the formal comment period be considered by ADEQ in the preparation of a final rule, in which the Department responds in writing to written and oral comments made during the formal comment period.

The agenda for this hearing is simple. First, I will ask Mark Lewandowski to provide an overview of the proposed rulemaking.

Second, I will conduct a question and answer period. The purpose of the question and answer period is to provide information that may help you in making comments on the rulemaking.

Third, I will conduct an oral comment period. At that time, I will call speakers in the order in which I have received their speaker slips.

Please be aware that any comments you make at today's hearing that you want the Department to formally consider must be given either in writing or on the record during the oral comment period of this proceeding.

At this time Mark Lewandowski will give a brief overview of the background concerning ADEQ's proposed revisions to A.A.C. Rule 18-2-602 and Article 15.

MR. LEWANDOWSKI: Thank you. These proposed rules would amend Arizona's existing open burning and prescribed burning rules to make them conform to EPA requirements for states' Regional Haze State Implementation Plans, or SIPS. In addition, these amendments make other technical changes, including improvements of the rules' clarity, conciseness, and understandability.

We're going to include revisions to 602 and Article 15 in the state's Regional Haze SIP, which we are required to submit to EPA by December 31st, 2003. And, in fact, that's an EPA requirement, an EPA deadline. We planned a lot for these two rules. In 2002 we formed a Fire Emissions Work Group to discuss visibility issues related to the fire emissions and made recommendations to ADEQ regarding necessary changes to the rules. The current proposed rule is a joint effort of ADEQ and the Fire Emissions Work Group based on input received at those public meetings and the decisions of them.

The specific requirements for state regional haze SIPs are found in the Code of Federal Regulations at Title 40, CFR 51.308 and 51.309. Most notably they include greater tracking and monitoring of open burning and burn plans, regular evaluation of data, and the establishment of annual emission goals for fire in cooperation with States, tribes, Federal land management, and private entities.

With regard to the changes to R18-2-602, the Unlawful Open Burning Rule, we kind of overhauled that section. We added a new subsection that contains just definitions. We added definitions for various categories of open burning like agricultural, construction, residential. We added definitions for "delegated authority" and the phrase "independent authority to permit fires" and "prohibited materials." Prohibited materials was previously described but not defined in a guidance document.

The proposed rule also clarifies which open burning activities require open burning permits under the rule and those that are exempt from that permit. It contains a more complete list of information required to be in the permit. This is because of the various requirements of the Regional Haze Rule, but in the petition it promotes more efficient permit administration.

We also added language in the body of the rule clarifying that the state rule will not operate in counties with independent authority to permit fires. And in the definition we have listed these three counties, Maricopa, Pinal, and Pima. Those three counties all have rules creating permits for open outdoor fires other than dangerous materials, which as I understand it are normally referred to ADEQ for processing.

ADEQ considered exempting certain fires that use air curtain destructors from the open burn permit requirement in order to remove an administrative barrier to this type of burning, as referenced by the Regional Haze Rule. However, after reviewing two studies, ADEQ decided that these devices do require oversight and it is appropriate that they be subject to permits under the rule. In addition, ADEQ does not view the requirement that ACDs obtain a permit as an administrative barrier.

The other part of this rule has to do with Article 15 of the Code, the Code being Title 18, Chapter 2 of the Arizona Administrative Code. The title of that article is Forest and Range Management Burns, and it will better conform to EPA's regional haze requirements. We're trying to make it more understandable and facilitate enhanced compliance. Unlike the overhaul of 602, this rule merely needed a tune-up.

The former structure of the rule remains intact; that is, there is an annual registration, a submittal of a Burn Plan at least 14 days before the burn, a daily Burn Request, and a Burn Accomplishment Form that is sent to ADEQ after the burn.

The rule has been strengthened to aid in the collection and the recording of the burn data, the evaluation of the burn programs, and the setting of annual emission goals, which is specifically required under the Regional Haze Rule.

Finally, I'd like to mention that we did send the Article 15 rule to EPA for comments early in the process, and they did send us back the comments and we did our best to respond to them. But we will be sending it to them again in the near future.

That concludes the overview.

HEARING OFFICER MAHADEV: Thanks, Mark Lewandowski, for providing us the overview. We'll next move to the question and answer period.

Are there any questions? Please introduce yourself.

MR. GABRIELSON: I'm not sure what the process is. Is this a free form question and answer period?

HEARING OFFICER MAHADEV: Yeah. Initially, we'll do the free form question and answer period, and the formal period will start after this.

MR. HAWK: Larry Hawk from the County DEQ.

Mark, on the air curtain destructors, I want to be clear on this, that air curtain destructor use is considered open outdoor burning for purposes of 602, thus, it needs a permit? Is that what you're saying?

MR. LEWANDOWSKI: That's correct.

MR. HAWK: Now, where is that in the rule? I can't find it right now.

MR. LEWANDOWSKI: It's not specifically in the rule. It would have -- Had they been exempt from a permit, it would have showed up in the list of activities that are exempt from the permit. They're absent from that list because we consider them an open outdoor fire.

MR. HAWK: Why do we consider them an open outdoor fire under the rule? I understand they're not specifically exempted, therefore, the presumption is that they're going to be included because they're not exempted. And I could argue that because they're not exempted doesn't necessarily mean they are included if they don't fit the definition or the inclusionary language. Where is it in the inclusionary language that would include an air curtain destructor in 602?

MR. GABRIELSON: A12.

MR. HAWK: They're not --

MR. LEWANDOWSKI: I'd appreciate any help from the audience.

MR. GABRIELSON: A12 defines open outdoor fire, which basically states --

MR. HAWK: And I'm not taking a position here or advocating for a position, except I just want to be clear, as far as the rule is concerned, that if an air curtain destructor requires a permit, that it's clear that it requires a permit in 602.

MR. LEWANDOWSKI: Your question is, where is the inclusionary language. I'm not sure there is inclusionary language. I'm not sure the phrase air curtain destructor is used in the rule.

MR. HAWK: In the definitions under A2, there's a definition of an approved waste burner, meaning an incinerator, blah, blah, blah. This is where we get back to 601, which is not under consideration here. If an air curtain destructor is considered an incinerator, or is an incinerator under the definition of incinerator, and therefore is an approved waste burner, does that matter insofar as having air curtain destructors included within the rule?

In other words, our earlier conversation, I'm unclear -- you know, when we started talking about the section 601 that's not here -- I can't remember what 601 said. But it would seem to me if we want air curtain destructors -- I'm not sure that open outdoor fire or open burning under the definition under 12 necessarily would include an air curtain destructor.

MR. LEWANDOWSKI: That sounds reasonable to me. I see your point. And if we wanted to make extra sure that we were -- people were clear that we are including air curtain destructors, now that the phrase doesn't appear in the rule, we might want to mention the phrase air curtain destructors, for example, under an open outdoor fire.

MR. HAWK: And what was the thing in 601 -- What does 601 say again?

MR. FORCE: 601 says, "For purposes of this Article, any source of air contaminants which, due to lack of an identifiable emission point or plume, cannot be considered a point source, shall be classified as a nonpoint source. In applying this criteria, such items as air curtain destructors ... shall be considered to have identifiable plumes."

MR. HAWK: That makes them a point source.

MR. LEWANDOWSKI: No. That makes them a nonpoint, doesn't it? Air curtain destructors have identifiable plumes.

MR. HAWK: Therefore, they are a point source under 601? Okay. That was our problem -- or, the issue.

So if an air curtain destructor is considered, by virtue of its plume, to be a point source as we read 601, then an air curtain destructor would not be within the purview of 602, because this is a nonpoint source. Isn't that what our issue was?

MR. GABRIELSON: Wouldn't that trigger a permit requirement under 49-426?

MR. LEWANDOWSKI: It might.

MR. HAWK: The thing is, if we want to permit air curtain destructors, for good reason, then we do need to -- don't we need to address that other rule?

MR. LEWANDOWSKI: Well, it's too late now. We're not going to have time to go back and open that one up. So the position that we're adopting -- unless we can come up with a better one -- is that whether an air curtain destructor is a point or nonpoint source is irrelevant to the 602 Rule.

602 happens to be a rule concerning open outdoor fires, but it happens to be in an article

entitled nonpoint sources. But I don't think that that means that every phrase in 602 only applies to nonpoint sources.

MR. HAWK: That's interesting. I think that's something we need to look at.

But in any event, if we don't have a definition, if we're going to try to fit the air curtain destructor into this definition under A12, I think that's weak. And especially when you look at the subject matter here is nonpoint sources. It's not nonpoint and point sources; it's not nonpoint sources except for -- do you know what I mean -- air curtain destructors.

Because, I'll tell you, if I own an air curtain destructor or I want to use one and I don't want to get a permit, I'm going to be looking for loopholes in the rules, and it would seem to me that there's one here. And that's all we're concerned about, are people who are looking to avoid the permitting process. We're not looking for people, you know --

MR. LEWANDOWSKI: Right.

MR. HAWK: People who don't care or think they ought to be permitted, those people aren't going to show up.

MR. GABRIELSON: I have a copy of 601 in front of me. And to the extent that 601 defines an air curtain destructor as a source of an identifiable plume, therefore making it a point source, then at least initially it would be subject to a permit requirement under 426.

And it sounds like the question is, are you intending, with 602, to exempt them from the permit requirement that seemingly arises under 601? Clearly the intent at this point doesn't appear to be to exempt them altogether.

MR. LEWANDOWSKI: That's something that we could, perhaps, discuss in a response to comments. My initial and formal response would be, we have not expressed such an intent. The 601 identification of an air curtain destructor having an identifiable plume means that it's presumed to not be a nonpoint source. Double negative, but that's logically -- or, exactly what it says, not a nonpoint source because it has an identifiable plume.

There's some problems here that we're going to have to kind of just work through. It may be weak to put it in A12, but it maybe that that's what we're going to have to do.

MR. HAWK: For purposes of this rule, though, forgetting about 601 and going straight to 602, you believe if 601 did not exist that air curtain destructors would be within 602 because what?

MR. LEWANDOWSKI: Because they fall under the definition of an open outdoor fire.

MR. HAWK: An open outdoor fire or open burning under A12? That's our basis?

MR. LEWANDOWSKI: Right.

MR. GABRIELSON: Rather than try to identify the statutory basis for inclusion, could you just include a blurb in the preamble that explains that it is not the intent of these provisions to exempt them from a permit requirement? And leave the phrase permit requirement open-ended so that you're not trying to resolve point source versus open burning permit requirement, you're just saying we're not trying to exempt it and make that part of it clear. And as to which category they fall in, that's a question for another day.

MR. LEWANDOWSKI: Well, you say rather than, we could also do it in addition to the blurb. In other words, we could discuss in the preamble and in the rule, perhaps, how we consider them to be open outdoor fires and subject to 602, in addition to saying that we're not intending to exempt them from a permit requirement.

MR. GABRIELSON: But to the extent you're saying that they're subject to an open burning permit to 602, you're necessarily implying that they're not subject to a point source permit requirement.

MR. LEWANDOWSKI: I wouldn't put the word necessarily in there. I mean, that could be somebody's conclusion, but I don't think it would be necessarily a conclusion you would have to draw.

MR. HAWK: Under 601, assuming air curtain destructors are point sources and you're citing 426, have air curtain destructors been permitted as point sources by ADEQ previously?

MR. LEWANDOWSKI: I don't know that they have.

MR. HAWK: I think they haven't.

MR. GABRIELSON: Looking at this from a pragmatic perspective, I don't know what air curtain destructors are used for in the contemplation of the Fire Management Task Force in clearing the slash up in the forest, whatever it may be. But on the floor of the desert where things are developing and you've got substantial commercial vegetation that's been growing, be it orchards or vineyards or other vegetation, an initial step in the development process involves the wholesale clearing of all of that and building a lot of fires. And to the extent that you've got big fires that are occurring in immediate proximity to developed areas, it's the kind of activity that really calls out for some sort of on-the-ground or close-in-hand supervision.

And it's my impression that, generally speaking, ADEQ's open burning permit contemplates a pretty hands-off kind of a permitting transaction, when you come in, get a no-cost permit, and go out and do what you're going to do and there's no inspection, there's no on-the-ground management by an administrative authority as to what's going on. And as a practical matter, wholesale land clearing does call for some level of supervision so you don't wind up with substantial nuisance impacts with respect to development that may be immediately next door to the areas being cleared.

MR. LEWANDOWSKI: Do you see ADEQ's rule affecting Pinal County inasmuch as that you would be encouraged to follow up with what we did?

MR. GABRIELSON: Larry raised this earlier, and there's really two considerations that come into play. 49-479 says that we have to be at least as stringent as. 49-112 says if we're going to be more stringent than, we need to come up with some sort of identifiable local risk to public health, is basically the standard.

To the extent that you have an existing set of rules or an existing ordinance in place that is arguably as stringent as, you don't really need to do anything as a result.

On the other hand, inevitably you will need to change that ordinance or set of rules -- something will change in the requirement. And at that point, it's a legitimate question to ask, do you need to either drop down to what I'll call the lowest common denominator defined by ADEQ's rule, or in the alternative, do you need to be able to articulate an immediate risk of public health?

And if I'm talking about nuisance level impacts as being the real issue, 49-112 won't allow for a nuisance level impact to be justification for more stringent rules. However, it wouldn't be an issue. 112 calls for articulation of a risk to health, and that's not always going to be easy to do.

MR. LEWANDOWSKI: So we have a lot of questions and not a whole lot of answers in the air curtain destructor area.

MR. GABRIELSON: I would really broaden the discussion beyond just air curtain destructors because, at least from the perspective of Pinal County, the real question is wholesale land clearing. And whether you're clearing land on a wholesale basis by just piling it up in 20-foot piles and burning it or you're using an air curtain destructor, it's basically the same issue in either case. You've got a lot of burning occurring that could be in an immediate proximity to developed areas. And to what extent that would require more handing and management --

MR. LEWANDOWSKI: Okay. We're going to have to take a lot of this under consideration. And I thank you for your bringing it to our attention, both today and in the past.

HEARING OFFICER MAHADEV: For the gentleman who just walked in --

MR. WALCH: I'm Kale Walch with Pinal County Air Quality.

HEARING OFFICER MAHADEV: -- we're just in the process of doing an informal question and answer. If you want to make a formal comment, you can fill out a speaker slip and bring it to me. We'll be doing that right after this.

MR. GABRIELSON: I guess I would ask that you take a look at page 4068 of the publication of the register and the reference there to the Regional Haze Rule as possibly a justification for exempting air curtain destructors. I'm not sure that that does reconcile with the language of the Regional Haze Rule, because this is not -- air curtain destructors aren't an alternative to burning, air curtain destructors are just a different form of burning.

MR. LEWANDOWSKI: Okay. Comment noted.

MR. GABRIELSON: On which note, I will leave air curtain destructors alone for the rest of the day. I promise.

Taking a look at 18-2-602.A.4 and D.1(a), they respectively define construction burning, and D.1(a) allows construction burning.

MR. LEWANDOWSKI: I can't turn the pages quite that fast.

MR. GABRIELSON: A.14 is really the crux of the comment here, because it allows for the burning of demolition materials. And in Pinal County we have a special category for burning demolition materials.

Burning demolition materials raises asbestos-related issues, and it's been our experience that it takes some direct oversight to get people to understand what they can and cannot burn. It's obviously to their advantage to just pile things up in a pile and burn them, because it's a lot cheaper than hauling anything to the landfill and it's also a lot cheaper than going through and sorting the material out.

So if you take a look at A.13, it defines prohibited materials. And my point is, that many times it has taken our going out and visiting directly with the person who is going to conduct the burning to get them to sort out the things that shouldn't be burned.

So, again, without some sort of meaningful oversight, I question what level of compliance you're going to get with the stated objective of excluding prohibited materials. Again, there's a strong economic motivation on the part of somebody who's going to burn a building after they knock it down to just burn it all and be done with it. So that's a comment with regard to A.4.

Turning to 18-2-602.D.3, the reporting requirement --

MR. HAWK: What page are you on?

MR. GABRIELSON: 4075. Why don't I go through these just in a question and answer format, and I'll try to put this on paper and get it to you rather than trying to transcribe my rambling on the fly.

MR. LEWANDOWSKI: Did you say D.3?

MR. GABRIELSON: I'm looking at D.3(f).

I understand that from the perspective of regional haze modeling, one of the many holes in the emission inventory structure was having a better understanding of short term temporal and spacial distribution of fire emissions, if you will. So the objective was to come up with better data.

On the other hand, I also work in accounting where we've been issuing thousands of burning permits per year. And I work for a group of supervisors, which include Jimmie Kerr, in particular, who is the supervisor for District Three.

MR. LEWANDOWSKI: Can you spell his last name?

MR. GABRIELSON: K-e-r-r.

He's made clear that he doesn't want to see Pinal County get acidified at this point.

So we had initially come up with a proposed rule that tracks ADEQ's rule, or at least I thought it was. And what we were actually proposing to require was a daily report with respect to burning activity, when did it occur, and what did you burn.

And I thought about that and I thought about Mr. Kerr's concern about not unduly imposing upon the citizenry. And then I took a look at ADEQ's rule, and in (f) it seems to say that, as an acceptable alternative, you can either provide a daily report of what you've done or send in an annual report.

I guess I'd like to ask the ADEQ, is submission of an annual report by the person with the burn permit an acceptable level of reporting?

Because from a practical perspective, that's a lot less onerous burden to impose on people who buy a lot of burn permits that are requiring that they get a month-long or six-month or however long the burn permit is and call us every day. I recognize the quality of the data that you get back if you had them call every day. On the other hand, if your proposed rule allows for an annual report, in all candidness, that's what I would propose to do at the County level.

MR. LEWANDOWSKI: My recollection is that the Fire Emissions Work Group did talk a lot about that and did think that an annual report was an acceptable alternative.

MR. GABRIELSON: Okay. That one was a question.

The next one is a comment, and I'm on page 4076, paragraph F.2. It's my understanding that the legislature amended the A.R.S. 49-501(f) to allow the issuance of a general permit to allow burning household waste for people engaged in farming or ranching on 40 acres or more.

HEARING OFFICER MAHADEV: This is an informal comment, right?

MR. GABRIELSON: Sure. Right.

To the extent that that's permissive, I realize one could infer a mandate from the legislature in affording ADEQ that authority. But as one that lives out in still a relatively rural area of the state of Arizona, I can unequivocally say people burning garbage is really an obnoxious thing.

And I realize in F.2 you have an admonition that you have to be at least 500 feet away from an adjoining dwelling. But based on personal observation, I can tell you that the stench of burning garbage can carry for miles. You get a nice burning condition, and it's obnoxious. And the legislature may have said you can do it, but from my perspective I respectfully submit it's not a good idea to do even if you have the authority to do it.

MR. LEWANDOWSKI: There's, perhaps, a point of clarification. F.1 and F.2 are in the alternative, so I believe the 500 feet requirements would not apply for household waste generated on farms or ranches.

MR. GABRIELSON: That would appear to be the case. And if you look at the F.1, there's nothing to preclude you from parking all your garbage in one corner of your 40 acres and lighting it off next to your neighbor's house. Which, again, from a public nuisance perspective or a public policy perspective doesn't really seem like the kind of image I would like to project from the state of Arizona, that it is a third-world country because it's okay to have a burn barrel in your backyard and burn garbage. That one was a comment.

I'm not clear on any of this, how will this be enforced and what are the relevant penalties? And given that this was going to be a minimal administrative burden, how will it be enforced and what will the penalties be?

MR. LEWANDOWSKI: I don't recall, either, any specific penalties or enforceability provisions in 602 itself.

MR. MINCH: Isn't there a $25 fine?

MR. GABRIELSON: Well, actually, what 49-501.I says is that any violation of this section shall be punishable by a fine not to exceed $25.

But in terms of the administrative burden, the assumption is that this isn't going to be any administrative burden to do all of this. Then I guess my question is, does that mean you're not contemplating enforcing any of it?

MR. LEWANDOWSKI: Absolutely not.

MR. GABRIELSON: Is that for the record? That's not what you're contemplating or you're not contemplating enforcing it?

MR. LEWANDOWSKI: That's not what we're contemplating.

MR. HAWK: On that household waste, this doesn't indicate to me that the household waste that is permissible has to be your household waste. So I could be burning household waste for someone else or for neighbors.

MR. LEWANDOWSKI: I think that's why we put in the phrase on site.

MR. HAWK: On site where? Of the household or of where it's burned, is that the idea?

MR. LEWANDOWSKI: If the waste is generated on the farms or ranches, on site, that would be F.1. And F.2 seems to imply, although it's not as clear, at the site of the household.

MR. HAWK: And household waste -- There's a definition of household waste; then there's a definition of prohibited material which includes a lot of household waste, except that it's prohibited materials.

How does the definition of prohibited materials -- Where in the rule do I hear about prohibited materials, such that -- For instance, plastic retail and grocery bags are prohibited materials, but common household garbage consists of that. How would I -- If I know what the rule says, how would I know to take my plastic household-generated waste, take the plastic bags out because they're prohibited materials? Other than being defined as prohibited materials, where does prohibited materials apply in the rule?

MR. LEWANDOWSKI: One logical place where it could have been -- and I don't see it -- is in the definition of household waste.

MR. HAWK: That's what I would suggest, is that household waste excludes prohibited materials.

MR. LEWANDOWSKI: Another place it could be -- and I'm going to check now -- is in subsection F. I don't see it there either.

MR. GABRIELSON: On the other hand, if you define household waste to exclude prohibited materials which includes nonpaper garbage, plastic and rubber products including bottles, plastic grocery and retail bags, aerosol spray cans --

MR. LEWANDOWSKI: Things that are normally household waste.

MR. GABRIELSON: There's not a lot left in your garbage can by the time you get through emptying those things out.

MR. HAWK: In order to do it, you've got to use an air curtain destructor.

We're supposed to use an approved waste burner. An approved waste burner is not necessarily an air curtain destructor, but the incinerator -- that is an incinerator. This waste -- The approved waste burner, it says, means an incinerator, and I think incinerator is defined somewhere else.

MR. LEWANDOWSKI: Yeah. It's defined in Article 1 of the State.

MR. HAWK: And that includes an air curtain destructor, I think.

MR. LEWANDOWSKI: Yeah, but that wouldn't necessarily mean that this is one. Approved waste burner is an incinerator and an air curtain destructor is an incinerator, but that doesn't mean -- there's just different classes of an incinerator.

MR. GABRIELSON: Historically an approved waste burner was a 55-gallon barrel with a screen laid across the top and holes punched in the bottom. That was what the definition of an approved waste burner was.

MR. LEWANDOWSKI: And it still is.

I mean, if you think the definition would be improved by instead of saying an incinerator saying -- just saying a device constructed of fire resistant material. I'm not sure if there's any specific conflict between --

MR. FORCE: "Incinerator means any equipment, machine, device, contrivance, or other article, and all the pertinences thereof, used for combustion of refuse, salvage materials, or any other combustible material, except fossil fuels, for the purpose of reducing the volume of the material."

MR. LEWANDOWSKI: It sounds like a broad definition. Doesn't require a plume -- doesn't require an identifiable plume. An incinerator kind of means a burning device.

MR. HAWK: Does that approved waste burner have a plume?

MR. LEWANDOWSKI: I don't think we need to decide that, do we?

MR. HAWK: Because that would make it a point source.

MR. LEWANDOWSKI: Well, would it be a point source? I'm not sure we'd have to decide that, because the legislature seems to have given a specific niche to the household waste. It falls under what the legislature terms a general permit, I think.

MR. GABRIELSON: To the extent that the allowance from the legislature was to adopt a general permit, does this rule do that?

MR. LEWANDOWSKI: My hunch, without having analyzed that precisely, is that it continues the general permit that was previously adopted in 602. So yes, this rule does do that. It doesn't create a general permit; it continues the general permit.

MR. GABRIELSON: So there is an existing general permit?

MR. LEWANDOWSKI: Not in the sense of the Title 5 general permits. I think it means a broader definition of a general permit.

MR. GABRIELSON: But is there a document that has been issued that says, "General permit for open burning in accord with 49-501.F"?

MR. LEWANDOWSKI: I'm not aware that there is one, and it could be that the rule is a general permit.

MR. GABRIELSON: But to the common understanding, the rule isn't the general permit.

MR. LEWANDOWSKI: I've heard the phrase

permit by rule.

MR. GABRIELSON: I've heard the phrase too.

MR. LEWANDOWSKI: So in terms of general understanding, there might be some people that do understand that.

MR. GABRIELSON: But then this isn't giving blanket permission, this is requiring individual permits, isn't it? This isn't a permit by rule, this is saying to --

MR. LEWANDOWSKI: I simply noted -- and I'm going to check it right now -- that 49-501, I thought, used the phrase general permit.

MR. FORCE: "The general permit shall include the following."

MR. GABRIELSON: Right. 602.D.1 allows for residential burning, and F allows open outdoor fires -- F still requires permits, but I guess between D and F they're basically providing authority to issue these permits.

MR. LEWANDOWSKI: I was still turning pages.

MR. GABRIELSON: D.1(c) requires a permit for residential burning, and F allows for burning of household waste when permitted in writing by the Director. And the permits issued shall contain in the -- So F really seems to be another species of burning as defined in D.1 for a type of permit.

MR. LEWANDOWSKI: However, residential burning does not include burning of household waste, according to this definition.

MR. GABRIELSON: True. Okay. So F would really seem to be more properly scheduled as another paragraph under D.1.

MR. LEWANDOWSKI: Other than the fact that this legislature has given it special status in the statute, we thought we needed to give it special status in the rule.

MR. GABRIELSON: I guess my comment was really just editorial in nature anyway.

The other question I had that I haven't noted here, I don't see anywhere in here where it defines the term -- Oh, I see. In D.2, "Permits may be issued for a period not to exceed one year."

MR. LEWANDOWSKI: Right. Some people get annual burn permits because they do a lot of burning. And, for example, you pay for an annual permit. Whereas other people burn once and they don't want to pay the $90 for the annual, so the shorter term is offered there.

MR. GABRIELSON: And I guess, just as another comment, in D.3(g) there's a requirement that anybody that lights a fire needs to notify either the local fire fighting agency or the State Forester.

Again, I realize that DEQ has historically issued on the order of 100 burn permits a year, more or less. We've been issuing thousands in Pinal County. And I just wonder, to the extent that this rule seems to be substantially expanding the universe of people who will be getting a permit from ADEQ, is the State Forester prepared to get thousands of phone calls about fires being lit?

MR. LEWANDOWSKI: The State Forester did attend the Fire Emissions Work Group and was asked a question very similar to that, and he sounded ready to me. Although, I'm not sure he believed that there was going to be thousands.

MR. MINCH: I think Curt said something to the effect that there's a lot of land, area wise, and a big area of the state that is not under any fire district. So he had to do something for them.

MR. LEWANDOWSKI: Ed Minch, M-i-n-c-h.

MR. HAWK: What is the point of that provision? That just seems unnecessary. It's another thing that somebody has to do, and for what public purpose? They've gone and they've gotten the permit --

MR. LEWANDOWSKI: Are you taking

unnecessary on the State Forester's part or the notification period?

MR. HAWK: The notification period. They're getting a permit, and what is having the fire chief know that somebody is doing household burning or whatever, what does that got to do with anything?

MR. LEWANDOWSKI: As I recall, one of the things was that if somebody complains and calls up the fire department, that way the fire department knows ahead of time that it is an authorized burn or that it is not. In other words, they can tell the concerned citizen, we know about it, and they can be ready.

For example, if all the trucks are out at some other place, they can at least start planning. As I recall, in the Fire Emissions Work Group, and, of course, the fire departments were there, but they thought they needed to have notice that that was going to happen.

MR. MINCH: They didn't want to see the smoke and then send their crew out there to find out it was somebody who had a burn permit.

MR. HAWK: So you want to make sure your house doesn't catch on fire next to a permitted burn, because they're going to say, "No problem. They've got a burn permit." And then your house burns down because nobody showed.

MR. GABRIELSON: The two issues that I've heard are the waste of resources phenomenon where they don't want to go running out to fires that are legit. And the other one is, in issuing the thousands of burning permits -- I'm in the air quality regulatory business, and I think the face of our burn permit has the illusion of the fact that if you don't properly manage this fire, you may be subject to all sorts of civil consequences if you burn your house down or your neighbor's house down or Central Arizona down.

But I've taken a hands-off position about being in the fire safety business, because I'm not. And to use the Apache Junction Fire District as an example, there they actually require that the permits be countersigned by the fire district. And they have the authority, as the fire marshal, to ban burning. Whether I permit it or not, they can ban it. When you bring the permit in to get it countersigned, they put a big X through all of the burning permit conditions and they staple their own sheet on that says here's what you can do.

So from a fire safety perspective, fire supression organizations have a legitimate interest in watching what's going on. Whether the State Forester is meaningfully equipped to do that on a statewide basis or not, I'm not so sure.

MR. LEWANDOWSKI: Well, we'll check with them.

MR. GABRIELSON: Back to the one year. One year seems like a long time.

MR. LEWANDOWSKI: As I recall, a lot of permits have been issued for one year, and part of it is just momentum. That's just the way we've done it. DEQ doesn't charge for its permits. I'm not sure if we want to start issuing a shorter permit --

MR. GABRIELSON: On the other hand, if the underlying motivation is to flush out the emission inventory with regard to open burning activity for purposes of coming up with a better picture of what you need for the Regional Haze Rule, I seriously doubt whether a one-year permit and an annual report is going to get you anything approaching meaningful information.

MR. LEWANDOWSKI: As we discussed this rule, we continually looked to a couple people at DEQ in terms of, now do we have enough information collected from this new rule to satisfy EPA. And they said yes. So we're going to probably rely on their judgment.

In Yuma we got comments on not being able to -- delegated authority not to being able to issue its own permit, or permit to itself. There was some dissatisfaction up there. Any thoughts about that?

MR. HAWK: My personal view is that there's no reason -- I don't understand why that's the case. In Yuma isn't it the fire district that's issuing the permits? It's not the fire district, it's Rural/Metro that's issuing permits.

MR. GABRIELSON: Can they do that now, fire districts?

MR. LEWANDOWSKI: The private fire protection service provider can be assigned -- The phrase doesn't delegate it, but they're assigned delegated authority by a government unit to issue open burn permits.

MR. HAWK: I think one of the things that maybe we were concerned about, from a County perspective, is if you have -- where we are, the air quality control district can have a concern about air quality in the region having jurisdictions issuing burn permits, where that's not what their focus is. That there may be opportunities where people can burn under pretexts, maybe, as a fire fighting exercise when maybe you're clearing ranch land. And having the control on that, sort of that disinterested third party maybe.

MR. GABRIELSON: That situation shouldn't arise. I mean, to the extent that in Title 49 allows the delegation to a fire supression organization, a fire district -- a Title 48 fire district could issue burn permits under the Uniform Fire Code. Because the Uniform Fire Code specifically provides for issuing burn permits. To get a permit under Title 48 and to still get a burn permit under Title 49, you may need two burn permits.

MR. HAWK: What about if I were a Title 48 permitter, I would think that my Title 48 permit would be sufficient and let somebody complain about it.

MR. GABRIELSON: You'd be wrong.

MR. LEWANDOWSKI: This is a surprisingly complex area to do a rule. I've done rules in air quality control for 25 years now, and you have to encompass so many different needs and factors. So I'm confident that we're going to end up with a better rule.

MR. WALCH: Who can delegate it to the fire district? Does it have to be ADEQ or the local fire district? Is there anybody else other than those two that can delegate it?

MR. LEWANDOWSKI: It's specified right in the statute.

MR. HAWK: ADEQ delegates -- Excuse me. We wouldn't delegate our delegated authority to the fire district. We wouldn't have to, but we could.

MR. LEWANDOWSKI: You wouldn't have to, but you could.

MR. HAWK: Like a subdelegation?

MR. LEWANDOWSKI: They call it an assignment. For some reason they use the phrase assign. A private person can't, perhaps, receive delegation, but they can be assigned.

MR. GABRIELSON: I think 501.E says the Director may delegate. I don't see any reason why a County would have an interest in delegating, at least speaking for Pinal County.

MR. HAWK: We can -- A County that has been delegated the authority may assign the issuance of these permits to a private fire protection service provider that performs -- may assign the issuance of these permits. What does that mean?

MR. GABRIELSON: That's looking to a County that has delegated authority. And I think the premise of this rule proposal is that Pinal, Pima, and Maricopa County have statutory authority. And we're not going to get a delegation of authority under this rule. We've got statutory authority.

So if ADEQ delegates authority to Yavapai County, Yavapai County could then continue to delegate on down the chain. But I don't read this to say that Pima County could delegate under that, unless you want to go to ADEQ and get a delegation in the first place. It's renounced the statutory authority to delegated authority.

MR. FORCE: I don't think you could do that. If you have independent statutory authority --

MR. GABRIELSON: Well, that's at least the position that we've taken. And that's all predicated on Mark's initial comment about 49-501 is an interesting statute, that if you hold it up to the light and turn it just right, you can understand it.

MR. FORCE: If you have independent statutory authority, then you would have been granted also the power also to delegate authority.

MR. GABRIELSON: Sounds good to me.

MR. HAWK: Specific authority.

MR. LEWANDOWSKI: The original question, Larry, was what does that mean. Actually, that statute goes on and on and on. To me, assigned means the same as delegated, but the receiver is a private entity rather than a government entity.

MR. HAWK: And they're doing certain things. I wanted to read more of that.

In the delegation agreements, ADEQ uses terms

-- uses the term subdelegation, I believe, as I recall.

MR. LEWANDOWSKI: Any more questions?

MR. GABRIELSON: Nope. Not here.

HEARING OFFICER MAHADEV: Let's proceed now to the oral comments. Mr. Don Gabrielson from Pinal County will now make his comment.

MR. GABRIELSON: I will defer my comments and provide them in writing.

HEARING OFFICER MAHADEV: Is there anybody else who wants to make any comments?

There's no further oral comments, so I'm going to close the oral comment period of this proceeding.

I encourage everyone to submit written comments on the proposed rulemaking. Please remember that all comments must be received no later than 5:00 p.m. on Friday, October 24th, 2003.

Thank you all for attending. The time is now 2:40, and I'll close this proceeding.

(The public hearing concluded at 2:40 p.m.)

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, KATHRYN A. BLACKWELDER, Certified Court Reporter No. 50666 for the State of Arizona, do hereby certify that the foregoing printed pages constitute a full, true and accurate transcript of the proceedings had in the foregoing matter, all done to the best of my skill and ability.

WITNESS my hand this 5th day of November, 2003.

KATHRYN A. BLACKWELDER
Certified Court Reporter
Certificate No. 50666

Arizona Department of Environmental Quality
Air Quality Division

Public Hearing Presiding Officer Certification

I, Shudeish Mahadev, the designated Presiding Officer, do hereby certify that the public hearing held by the Arizona Department of Environmental Quality was conducted on October 21, 2003, at the Casa Grande Parks and Recreation Office, Casa Grande, Arizona, in accordance with public notice requirements by publication in Arizona Administrative Register and other locations beginning September 19, 2003. Furthermore, I do hereby certify that the public hearing was recorded from the opening of the public record through concluding remarks and adjournment, and the transcript provided contains a full, true, and correct record of the above-referenced public hearing.

Dated this 4th day of December, 2003.

Shudeish Mahadev
Shudeish Mahadev

State of Arizona)
) ss.
County of Maricopa)

Subscribed and sworn to before me by Shudeish Mahadev this 4th day of December, 2003

DENEE N. WOODARD
Notary Public - Arizona
Maricopa County
Expires 12/30/05

Denee N. Woodard

Notary Public

My commission expires: 12/30/05

Janet Napolitano
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 W. Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

AGENDA

Air Quality Division
Regional Haze State Implementation Plan Development
PUBLIC HEARING/ORAL PROCEEDING
October 22, 2003, 1:30 p.m.
Show Low City Hall, Council Chambers
200 West Cooley, Show Low, Arizona

Pursuant to [cite 40 CFR § 51.102 for SIP hearings and ARS § 49-425 for air quality rule hearings], notice is hereby given that the above referenced meeting is open to the public.

Welcome and Introductions

Purposes of the Oral Proceeding/Procedures for Making Public Comment

Brief Overview of the Proposed Rule

Question and Answer Period

Oral Comment Period

Adjournment of Oral Proceeding

Comment period ends 5:00 p.m., Friday, October 24, 2003.

Please direct comments and questions to Kevin Force, ADEQ Air Quality Division, at (602) 771-4480 or 1-800-234-5677, Ext. 771-4480.

Order of agenda items is subject to change. For additional information regarding the meeting, please call [NAME], ADEQ Air Quality Division, at (602) 771-[ ] or 1-800-234-5677, Ext. [ ].

Persons with a disability may request a reasonable accommodation such as a sign language interpreter, by contacting Katie Huebner at (602) 771-4794 or 1-800-234-5677, Ext. 4794. Requests should be made as early as possible to allow sufficient time to make the arrangements for the accommodation. This document is available in alternative formats by contacting ADEQ TDD phone number at (602) 771-4829.

Arizona Department of Environmental Quality
Air Quality Division

Please Sign In

SUBJECT R18-2-602 APP 15 Revisions, ADEQ

DATE 10/22/03
SHOWLOW

	NAME	ORGANIZATION	PHONE	FAX	E-MAIL
1.	George M Patterson	City of Show Low	928-532-4103		
2.	FRED MOLLENHAUER	ABITIBI CONS.	928 536 9462	928 536 9447	FRED_MOLLENHAUER@ABICON.COM
3.	Karen Mayall	self	—	—	pamayall@[illegible]
4.	STEPHEN OWENS	TUCSON ELECTRIC	928 337 7335		SOWENS@TEP.COM
5.	Merry Pitts	White Mtn Apache Tribe	928-338-1665	928-338-1907	
6.	Paul Esswein	Town of Pinetop-Lakeside	928-368-8883	928-368-8528	pesswein@ci.pinetop-lakeside.az.us
7.	Amy Pulsifer	Tucson Electric	928-337-7429		
8.	JACK E. BABB	SHOW LOW FD	(928) 537-5100	(928) 537-7634	jbabb@showlowfire.org

9.	Byron James	ADEQ	(928)337-3565	bfj@ev.state.az.us.
10.	Ed Mudder	City of Show Low	928 532-4041	emudder@ci.show-low.az.us
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ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE MATTER OF THE PROPOSED REVISIONS TO ARIZONA ADMINISTRATIVE CODE R18-2-602, THE UNLAWFUL OPEN BURNING RULE, AND ARTICLE 15, THE RULES COVERING FOREST AND RANGE MANAGEMENT BURNS.	**PUBLIC HEARING**

At: Show Low, Arizona

Date: October 22, 2003

Filed: NOV - 7 2003

REPORTER'S TRANSCRIPT OF PROCEEDINGS

ARIZONA REPORTING SERVICE, INC.
Court Reporting
Suite Three
2627 North Third Street
Phoenix, Arizona 85004-1126

By: KATHRYN A. BLACKWELDER
Certified Court Reporter
Certificate No. 50666

Prepared for:

ADEQ

CERTIFIED COPY
(When in red)

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE MATTER OF THE PROPOSED REVISIONS TO ARIZONA ADMINISTRATIVE CODE R18-2-602, THE UNLAWFUL OPEN BURNING RULE, AND ARTICLE 15, THE RULES COVERING FOREST AND RANGE MANAGEMENT BURNS.) PUBLIC HEARING

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Prepared for:
ADEQ

BE IT REMEMBERED that the above-entitled and numbered matter came on regularly to be heard before the Arizona Department of Environmental Quality, at the Show Low City Hall, Council Chambers, 200 West Cooley, Show Low, Arizona, commencing at 1:30 p.m. on the 22nd day of October, 2003.

BEFORE: BRUCE FRIEDL, HEARING OFFICER

APPEARANCES:

THERESA PELLA, Air Planning Section Manager, on behalf of ADEQ;

KEVIN FORCE, Rule Writer, Planning Section, on behalf of ADEQ.

KATHRYN A. BLACKWELDER
Certified Court Reporter
Certificate No. 50666

HEARING OFFICER FRIEDL: Good afternoon, and welcome to this Arizona Department of Environmental Quality hearing.

The subject of this hearing is proposed revisions to Arizona Administrative Code R18-2-602, the "Unlawful Open Burning Rule," and Article 15, the rules covering "Forest and Range Management Burns." The hearing is now open.

The date is Wednesday, October 22nd, 2003, and the time is 1:35 p.m. The location is the Council Chambers of the Show Low City Hall at 200 West Cooley, Show Low, Arizona 85901.

My name is Bruce Friedl. I'm an Environmental Programs Specialist for the Planning Section of the Air Quality Division at ADEQ, and I have been appointed by the ADEQ Director to conduct this hearing.

The purposes of this hearing are to provide the public an opportunity, one, to hear about the substance of the proposed revisions to the Arizona Administrative Code R18-2-602 and Article 15; two, to ask questions concerning the proposed rule revisions; and three, to present oral arguments, data, and views concerning the proposed rule revisions, in the form of comments on the record.

Other ADEQ Air Quality representatives in attendance today are Theresa Pella to my left, Air Quality Planning Section Manager, and Kevin Force, Rule Writer, Planning Section. And in the back of the room Byron James, Community Liaison in the ADEQ Northern Regional Office. Also present is our court reporter, Kathryn Blackwelder.

If you plan to make a public comment on the record, the procedure is straightforward. Please complete a speaker slip found at the sign-in table and hand your slip to me. Using speaker slips allows everyone the opportunity to be heard and allows us to match the name on the official record with the comments.

You may also submit written comments to me today in person, or you may submit comments by mail, e-mail, or fax. Please submit comments by the end of the comment period, 5:00 p.m. on Friday, October 24th, 2003. Any written comment must be received no later than October 24th, 2003. Submit your written comments to Kevin Force, K-e-v-i-n F-o-r-c-e, Air Quality Planning Section, Arizona Department of Environmental Quality, 1110 West Washington Street, Third Floor, Phoenix, Arizona 85007. Or by fax at 602-771-2366. You can e-mail to force.kevin@ev.state.az.us.

Notice of this hearing was published in The Arizona Republic and The White Mountain Independent on September 19th, 2003.

State statutes require that comments made during the formal comment period be considered by ADEQ in the preparation of a final rule, in which the Department responds in writing to written and oral comments made during the formal comment period.

The agenda for this hearing is simple. First, I will ask Theresa Pella to provide an overview of the proposed rulemaking.

Second, I will conduct a question and answer period. The purpose of the question and answer period is to provide information that may help you in making comments on the rulemaking.

Third, I will conduct an oral comment period. At that time, I will call speakers in the order in which I have received their speaker slips.

Please be aware that any comments that you want the Department to formally consider must be given either in writing or on the record during the oral comment period of this proceeding.

At this time Theresa Pella will give a brief overview of the background concerning ADEQ's proposed revisions to A.A.C. R18-2-602 and Article 15.

MS. PELLA: Thank you. And again, welcome, everybody. Thank you for coming and taking time out of your day to attend this public hearing.

These proposed rules would amend Arizona's existing open burning and prescribed burning rules to make them conform to EPA requirements for states' Regional Haze State Implementation Plans, otherwise known as SIPs. In addition, these amendments make other technical changes, including improvements to the rules' clarity, conciseness, and understandability.

The revisions to R18-2-602, which is our Unlawful Open Burning Rule section of the regulation, and Article 15, which is the Smoke and Range Management Rule, will be included in the state's Regional Haze SIP, which ADEQ is required to submit to EPA by December 31st of 2003.

In early 2002, ADEQ formed a Fire Emissions Work Group to discuss visibility issues related to fire emissions and make recommendations to ADEQ regarding necessary changes to the rules. The current proposed rule, that you have in front of you, is a joint effort of ADEQ and the Fire Emissions Work Group based on input received at not only the Work Group meetings, but also a series of public meetings that we held throughout the state earlier this year. I believe it was in April. So what we've got in front of us is a result of those meetings and the Work Group's efforts.

The specific requirements for state Regional Haze SIPs can be found at Title 40, Code of Federal Regulations Chapter 51.308 and 51.309. They include, most notably, greater tracking and monitoring requirements of open burning and burn plans, regular evaluation of such data that comes from burning, and the establishment of annual emission goals under the Smoke and Range Management Rules in cooperation with States, tribes, Federal land management agencies, and private entities that do prescribed burns.

Changes to R18-2-602, again, the Unlawful Open Burning Rule of our rules, are not extensive. However, we did -- you'll notice we did kind of strike out the entire rule as it exists and kind of did a new underlying rule. And we basically did that mostly for improving the understandability and the flow of the rule. So even though you see a completely stricken version, it doesn't mean that the content and the substance of the rule was changed that much from the original version.

This proposed rule contains some additional definitions that have been added in a separate subsection, including definitions for various categories of open burning, such as agricultural, construction, and residential. In addition, there are new definitions for "delegated authority," "independent authority to permit fires," and "prohibited materials."

The proposed rule revisions also clarify which open burning activities require open burning permits and those that are exempt from having to obtain a permit. It also contains a more complete list of information that's required to be in the permit itself. This is both for more efficient permit administration from ADEQ's side and to comply with the various aspects of the Regional Haze Rule as it is contained in 40 CFR 51.309.

ADEQ has also added in the language in the proposed rule revisions clarifying that the state rule is not applicable in counties with independent authority to permit fires. And there are three counties in Arizona of which that is the case, and those three counties are Maricopa, Pima, and Pinal Counties, that are also identified in that particular definition. The three counties referenced all have their own rules that have permit -- require permits for open outdoor fires, other than dangerous materials.

ADEQ considered exempting certain fires under which air curtain destructors are used from the open burning permit requirement in order to remove what's considered an administrative barrier to this type of burning, as is contained in the Regional Haze Rule. However, after reviewing two studies and getting input from the Work Group and also the public meetings that we had, ADEQ decided that the air curtain destructors do require some oversight, and so it's appropriate that they be permitted, as well as other open burning activities. So ADEQ does not view this requirement, that air curtain destructors obtain a permit, as an administrative barrier, though, to operation of such.

Moving on to Article 15, the Smoke and Range Management portion of our rule. The proposed revisions to this article are such that ADEQ is trying to better conform to, again, the Federal Regional Haze Rule requirements to make the article more understandable, and to facilitate enhanced compliance by those organizations that do prescribed burns.

Most of the proposed changes to the article directly reflect the mandates in the federal rule, particularly those relating to the collection and recording of burn data from such burns, the evaluation of burn programs, and the setting of annual emission goals. The former structure of the rule remains intact. You've got the annual registration which the organization needs to submit to DEQ, the submittal of a Burn Plan At least 14 days before any burn begins, and a daily Burn Request that is also submitted to DEQ, and a Burn Accomplishment Form, which is submitted after the fire to gather information related to how many acres were burned and that sort of stuff. So again, Article 15 relates to prescribed burns, and R18-2-602 relates to the Unlawful Open Burning Rule.

This concludes the overview of the proposed rulemaking.

HEARING OFFICER FRIEDL: Next, we'll move to the question and answer period.

Does anybody have any questions on the rule revisions? Would you state your name for the record, please?

MR. ESSWEIN: My name is Paul Esswein and I'm from Pine Top/Lakeside.

I have a question on the open burning permit section, paragraph D3 --

MR. FORCE: Paragraph what?

MR. ESSWEIN: It's paragraph D3.d.3. The question I have is, is there a definition of nuisance in the rule anywhere?

MS. PELLA: No, there probably isn't. Nuisance is one of those words that according to --

well, sometimes we go by Webster's. If there's a clear definition in Webster's that a reasonable person would understand, then we don't do a special definition in our rules. And in this instance, we've considered nuisance to be one of those words.

Do you think that it should be?

MR. ESSWEIN: I think it should be defined or have some standard for defining it.

MS. PELLA: Okay. Would you repeat that during the oral comment period?

MR. ESSWEIN: Yes.

I have another question on the next paragraph, it's D3.e, and it indicates that there's a reporting requirement for all open burning permits.

I'm just curious as to how, on residential burns, that information is going to be collected and how the material that's burned is measured?

MR. FORCE: You're talking about 3.f?

MR. ESSWEIN: It's f. I'm sorry.

MR. FORCE: For residential burns, that is going to be difficult. We're sort of trusting the permitted person. There's a notification requirement that they notify the fire department. If there's no fire district in their area, they are to notify the State Forester so that someone is aware of the fact that a burn is taking place. I don't think that the fire departments, in that situation, will be able to forward that information to us. It's up to the actual burner.

MS. PELLA: There is -- Right. That's where the delegated authority is going to come into place. And I think this is actually a comment that was raised at one of the previous meetings. We had a public hearing in Yuma on Monday and in Casa Grande yesterday, and I think there was a similar question that came up. So again, it will be something that we'll be considering and looking at again as we go back to the final rulemaking stage.

MR. JAMES: I was on the Fire Emissions Work Group that helped to draft the rules and so forth, and one of the ways in which -- We needed to meet the Federal Regional Haze criteria so that our State implementation plan could be improved. And one of the things we needed to do was have some sort of feedback, because we had no idea how much open burning actually took place. So to meet the regional haze requirements we had to have something like that in there.

And the goal of the Fire Emissions Work Group, even though there needs to be a feedback requirement, is to make it as simple as possible. And in the development of the program, there would be ways to try to make that simple, either through a phone call, a message with ADEQ on a toll-free phone number, where you could just say, "Hey, I burned today, this is how much I burned," and leave it at that and make it very simple. And it would actually say on the permit form how to accomplish that.

MS. PELLA: Right. Yeah. That's one of the options that we've been considering.

MR. MOLENHAUR: I have a question here on the unlawful burning. They list the hours that you can burn, one hour after sunrise to two hours before sunset. I'm from Abbott Tibbey Consolidated. We have an open burn permit. We've tried to get these hours, and DEQ says, "You can't have them. You can only burn different periods of the year at different times of the day." And right now they have, like, from 10:00 in the morning to 2:00 in the afternoon.

Well, up here you have problems with winds blowing, in the morning it's fairly calm. We're 15 miles out of town. And they tell me, "Well, we do the model in Yuma, so these are the hours you have."

If this is basically the same regulations that exist now, why are these hours allowed in this and not at the present time?

MS. PELLA: You mean we're extending the hours in our proposal? I'm trying to find -- I think we did.

MR. MOLENHAUR: It's 602.D3.c.

MS. PELLA: Right. This is another thing that came up during our public meetings, was the fact that different parts of the state, the environment isn't the same. So, yeah, here under D3.c, for year-round it's one hour after sunrise or two hours before sunset.

MR. MOLENHAUR: Yes.

MS. PELLA: Is that posing a problem?

MR. MOLENHAUR: No. I mean, that's beneficial. It's not in the current regs, yet they tell us we can't have this time right now.

MS. PELLA: Well, look at it as an improvement. Those current regs were written in 197- --

MR. MOLENHAUR: There is nothing that restricts the time at the present time.

MS. PELLA: But I think it's up to the discretion of DEQ right now, correct?

MR. MOLENHAUR: Well, every year we get a new permit. Every year we've gone back to -- well, they bounce between Phoenix and Flagstaff -- and we say, "We'd like the extended hours that we had last year." And every year up until this year they've said okay.

This year they say, "No. It's in the regulations. You can't have it." And yet I can't find it by reading anything.

MR. JAMES: At the present time, the hours of burning are in the ADEQ guidelines. And one of the goals of the Fire Emissions Work Group was to put those guidelines into rule so that we apply them consistently. And you're right, the way it's written in the rule allows a longer time period than what the guidelines currently specify.

MS. PELLA: We're actually trying -- This is one of the ways where we could make it easier for the regulating community as well as us.

MR. FORCE: The rules try to incorporate all those guidelines so that there's only one source for the authority in this case.

MR. MOLENHAUR: Well, that may or may not be good. It depends on if you're in the middle of Phoenix or if you're 15 miles from town when you're doing your open burning.

MS. PELLA: They don't do open burning in Phoenix.

MR. MOLENHAUR: But, I mean, if you're in the middle of town or if you're 15 miles from town, to say one thing fits all, that's why I could see why they would have discretion on doing things. But why you can't get that at the present time --

MS. PELLA: As I indicated, the current regs are very old.

HEARING OFFICER FRIEDL: Are there any other questions?

Next we'll move on to the oral comment period. And the first speaker slip is Mr. Jack Babb.

MR. BABB: Maybe I should have asked during the question and answer period, but I tried to get this off the Internet and wasn't able to download it, for whatever reason. So I've just been able to glance at it just now.

A little confusion has come up. Currently, State permits are issued for a specific length of time. Is there going to be a change to that?

MR. FORCE: Are you asking regarding the Open Burning Rule?

MR. BABB: Yes, sir.

MR. FORCE: I think that there's a limitation -- a term limit of one year for the open burning permits.

MR. BABB: Because I read in here something that a daily request has to be made. Is that --

MR. FORCE: Those are for prescribed burn plans. The daily burn request is for a prescribed burn plan for wildland fire use. For an open burning permit, the term limit is one year.

MR. BABB: Well, to the prescribed burn limits, ADEQ is looking to request or require a daily burn plan?

MR. FORCE: Well, first, there's a burn plan that's required to be filed with ADEQ no later than 14 days before the proposed planned burn. Then when you get to the actual burn activities, you submit a daily burn request to ADEQ with the pertinent information that's listed in the rule.

Now, the request in this case is really more of a formality. As Byron was saying, we're trying to gather information for the purposes of satisfying the Federal Regional Haze Rules. It's more of a question -- We need the data about the burn, what is being burned, how much is being burned.

MS. PELLA: They actually do a daily call-in now. The Federal Land Managers, when they do prescribed burns, they're calling in daily to ADEQ now.

MR. BABB: So that would remain?

MS. PELLA: That would remain. What we would be asking for is a little bit more information that -- we will make a concerted effort to gather information related to what's being burned, how many acres, that type of stuff, in order to fulfill our federal tracking requirements.

MR. BABB: You may want to consider changing that to a final report after the burn.

MS. PELLA: There is --

MR. FORCE: There is a final report.

MR. BABB: Because to come in daily with the areas changing and topography and climate and so forth, it may be difficult for the range managers or fire operations officers to go in and say, this is how much we plan on burning, this is the types of fuels, and so forth. It may be reduced drastically because we get a rain in all of a sudden, or because of a change in topography and fuels, it may explode on you. Still remaining within the confines of their prescription, but it may burn more than what they anticipated for that burn period.

MS. PELLA: Right. I'm trying to find the exact spot in Article 15 where it requires a kind of end-of-the-project type report.

MR. FORCE: It's the burn accomplishment report.

MS. PELLA: What section?

MR. FORCE: That is 1507.

MS. PELLA: It's in there, but your point is very well taken.

MR. BABB: And you did say permits would be allowed for up to one year?

MR. FORCE: For open burning.

MR. BABB: One of the things that we look at, from the fire department standpoint, is anybody with an adopted code has got specific regulations to open burning, permitting, and so forth. But then again, the fire department also uses the same code to administer open burning training such as wildland training for one day. And for us to go in and try to get a permit on an event-by-event basis may be difficult, whereas if we obtained the permit for one year for a general area rather than a specific location, that would be more beneficial overall.

MS. PELLA: We received that exact comment at one of the other public hearings.

MR. FORCE: About training.

MS. PELLA: I don't know what you guys -- how you dealt with it in Yuma.

We'll make sure that when we do our final analysis of the rule that we especially list out that particular item and our response to it.

MR. BABB: Okay. Thank you.

HEARING OFFICER FRIEDL: I believe the gentleman in the back, Mr. Paul Esswein, had something.

MR. ESSWEIN: I would like to suggest that the Department consider adding a definition for the word nuisance under the open burning section of the rule and provide some standard for how that is applied.

MS. PELLA: Okay.

HEARING OFFICER FRIEDL: Thank you.

Does anybody else want to make a comment on the record?

This concludes the oral comment period of this proceeding.

I encourage everyone to submit written comments on the proposed rulemaking. Please remember that all comments must be received no later than 5:00 p.m. on Friday, October 24th, 2003.

Thank you for attending. The time is now 2:03, and I now close this oral proceeding.

(The public hearing concluded at 2:03 p.m.)

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, KATHRYN A. BLACKWELDER, Certified Court Reporter No. 50666 for the State of Arizona, do hereby certify that the foregoing printed pages constitute a full, true and accurate transcript of the proceedings had in the foregoing matter, all done to the best of my skill and ability.

WITNESS my hand this 5th day of November, 2003.

KATHRYN A. BLACKWELDER
Certified Court Reporter
Certificate No. 50666

Arizona Department of Environmental Quality
Air Quality Division

Public Hearing Presiding Officer Certification

I, Bruce Friedl, the designated Presiding Officer, do hereby certify that the public hearing held by the Arizona Department of Environmental Quality was conducted on October 22, 2003, at the Show Low City Hall Council Chambers, Show Low, Arizona, in accordance with public notice requirements by publication in Arizona Administrative Register and other locations beginning September 19, 2003. Furthermore, I do hereby certify that the public hearing was recorded from the opening of the public record through concluding remarks and adjournment, and the transcript provided contains a full, true, and correct record of the above-referenced public hearing.

Dated this 3 day of December 2003.

[NAME OF PRESIDING OFFICER]
Bruce Joseph Friedl

State of Arizona)
) ss.
County of Maricopa)

Subscribed and sworn to before me by Bruce Joseph Friedl this 3Rd day of December, 2003

RENEE N. WOODARD
Notary Public - Arizona
Maricopa County
Expires 12/30/05

Renee N. Woodard
Notary Public

My commission expires: 12/30/05

Janet Napolitano
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 W. Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

AGENDA

Air Quality Division
Regional Haze State Implementation Plan Development
PUBLIC HEARING/ORAL PROCEEDING
October 23, 2003, 1:30 p.m.
Flagstaff City-Coconino County Public Library
300 West Aspen, Flagstaff, Arizona

Pursuant to [cite 40 CFR § 51.102 for SIP hearings and ARS § 49-425 for air quality rule hearings], notice is hereby given that the above referenced meeting is open to the public.

Welcome and Introductions

Purposes of the Oral Proceeding/Procedures for Making Public Comment

Brief Overview of the Proposed Rule

Question and Answer Period

Oral Comment Period

Adjournment of Oral Proceeding

Comment period ends 5:00 p.m., Friday, October 24, 2003.

Please direct comments and questions to Kevin Force, ADEQ Air Quality Division, at (602) 771-4480 or 1-800-234-5677, Ext. 771-4480.

Order of agenda items is subject to change. For additional information regarding the meeting, please call [NAME], ADEQ Air Quality Division, at (602) 771-[ ] or 1-800-234-5677, Ext. [ ].

Persons with a disability may request a reasonable accommodation such as a sign language interpreter, by contacting Katie Huebner at (602) 771-4794 or 1-800-234-5677, Ext. 4794. Requests should be made as early as possible to allow sufficient time to make the arrangements for the accommodation. This document is available in alternative formats by contacting ADEQ TDD phone number at (602) 771-4829.

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE MATTER OF THE PROPOSED REVISIONS TO ARIZONA ADMINISTRATIVE CODE R18-2-602, THE UNLAWFUL OPEN BURNING RULE, AND ARTICLE 15, THE RULES COVERING FOREST AND RANGE MANAGEMENT BURNS.	**PUBLIC HEARING**

At: Flagstaff, Arizona

Date: October 23, 2003

Filed: NOV - 7 2003

REPORTER'S TRANSCRIPT OF PROCEEDINGS

ARIZONA REPORTING SERVICE, INC.
Court Reporting
Suite Three
2627 North Third Street
Phoenix, Arizona 85004-1126

By: KATHRYN A. BLACKWELDER
Certified Court Reporter
Certificate No. 50666

Prepared for:

ADEQ

CERTIFIED COPY
(When in red)

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

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BE IT REMEMBERED that the above-entitled and numbered matter came on regularly to be heard before the Arizona Department of Environmental Quality, at the Flagstaff City-Coconino County Public Library, 300 West Aspen, Flagstaff, Arizona, commencing at 1:30 p.m. on the 23rd day of October, 2003.

BEFORE: BRUCE FRIEDL, HEARING OFFICER

APPEARANCES:

THERESA PELLA, Air Planning Section Manager, on behalf of ADEQ;

KEVIN FORCE, Rule Writer, Planning Section, on behalf of ADEQ.

KATHRYN A. BLACKWELDER
Certified Court Reporter
Certificate No. 50666

HEARING OFFICER FRIEDL: Good afternoon. Welcome to this Arizona Department of Environmental Quality hearing.

The subject of this hearing is proposed revisions to Arizona Administrative Code R18-2-602, the "Unlawful Open Burning Rule," and Article 15, the rules covering "Forest and Range Management Burns." The hearing is now open.

The date is Thursday, October 23rd, 2003, and the time is 1:36 p.m. The location is the Flagstaff-Coconino County Public Library at 300 West Aspen, Flagstaff, Arizona 86001.

My name is Bruce Friedl and I'm an Environmental Programs Specialist for the Planning Section of the Air Quality Division at ADEQ, and I have been appointed by the ADEQ Director to conduct this hearing.

The purposes of this hearing are to provide the public an opportunity to hear about the substance of the proposed revisions to the Arizona Administrative Code R18-2-602 and Article 15; two, to ask questions concerning the proposed rule revisions; and three, to present oral arguments, data, and views concerning the proposed rule revisions in the form of comments on the record.

Other ADEQ Air Quality representatives in attendance today are Theresa Pella, Air Quality Planning Section Manager, and Kevin Force, Rule Writer, Planning Section. Also present is our court reporter, Kathryn Blackwelder.

If you plan to make a public comment on the record, the procedure is straightforward. Please complete a speaker slip found at the sign-in table and hand your slip to me. Using speaker slips allows everyone an opportunity to be heard and allows us to match the name on the official record with the comments.

You may also submit written comments to me today in person, or you may submit comments by mail, e-mail, or fax. Please submit comments by the end of the comment period, 5:00 p.m. on Friday, October 24th, 2003. Any written comment must be received no later than October 24th, 2003.

Submit your written comments to Kevin Force, K-e-v-i-n F-o-r-c-e, Air Quality Planning Section, Arizona Department of Environmental Quality, 1110 West Washington Street, Third Floor, Phoenix, Arizona 85007. The fax number is 602-771-2366. You can e-mail written comments to force.kevin@ev.state.az.us.

Notice of this hearing was published in The

Arizona Republic and The Arizona Daily Sun on September 19, 2003.

State statutes require that comments made during the formal comment period be considered by ADEQ in the preparation of a final rule, in which the Department responds in writing to written and oral comments made during the formal comment period.

The agenda for this hearing is simple. First, I will ask Theresa Pella to provide an overview of the proposed rulemaking.

Second, I will conduct a question and answer period. The purpose of the question and answer period is to provide information that may help you in making comments on the rulemaking.

Third, I will conduct an oral comment period. At that time, I will call speakers in the order in which I have received their speaker slips.

Please be aware that any comments you make at today's hearing that you want the Department to formally consider must be given either in writing or on the record during the oral comment period of this proceeding.

At this time, Theresa Pella will give a brief overview of the background concerning the ADEQ's proposed revisions to A.A.C. R18-2-602 and Article 15.

MS. PELLA: Thank you, and welcome. For those of you who are here, thank you for joining us this afternoon and taking time out of your busy schedules.

These proposed rules would amend Arizona's existing open burning rule R18-2-602, Unlawful Open Burning, and the prescribed burning rules under Article 15, which are also known as the Smoke and Range Management Fire Rules, to make the rules conform to EPA's requirements for states' Regional Haze State Implementation Plans, or SIPs, as we call them. In addition, these amendments make other technical changes, including improving the rules' clarity, conciseness, and understandability.

The revisions to R18-2-602 and Article 15 will be included in the state's Regional Haze SIP, which ADEQ is required to submit to EPA by December 31st, 2003.

In early 2002, ADEQ formed a Fire Emissions Work Group to discuss visibility issues related to fire emissions and make recommendations to ADEQ regarding necessary changes to the rules. The current proposed rule is a joint effort of ADEQ and the Fire Emissions Work Group, based on input received from the Work Group meetings and public meetings that were held earlier this year in Yuma, Casa Grande, Show Low, and Flagstaff.

The specific requirements for state Regional Haze SIPs can be found at Title 40, Code of Federal Regulations Sections 51.308 and 51.309 and include, most notably, more complete tracking and monitoring of open burning and burn plans, periodic review of the data collected by DEQ, and the establishment of annual emission goals for fire, in cooperation with States, tribes, Federal land management agencies, and private entities. It should be noted that Arizona Department of Environmental Quality does not have jurisdiction on tribal land, but the tribes have been participating. But they would need to adopt their separate rules.

Changes to R18-2-602, the Unlawful Open Burning Rule, are not extensive, although the current rule has been completely stricken. The intent of the revisions was to write the rule in a more clear manner that's easier to follow than the current rule. And so what we've done is added a definitions subsection and included definitions for various categories of open burning, such as agricultural, construction, and residential. In addition, there are new definitions for "delegated authority," "independent authority to permit fires," and "prohibited materials."

The proposed rule revisions also clarifies which open burning activities require open burning permits and those activities that are exempt from a permit. It also contains a more complete list of information that is required to be in the permit. This is both for more efficient permit administration by the DEQ and its delegated authority and to comply with various aspects of the Regional Haze Rule.

ADEQ has also added language in the proposed rule clarifying that the state rule is not -- will not operate in counties with independent authority to permit fires, and has listed those three counties, which are Maricopa, Pima, and Pinal. Those three counties all have their own rules that allow for permitting for open outdoor fires, other than danger materials.

ADEQ considered exempting fires using air curtain destructors from the open burning permit requirement in 602 in order to remove an administrative barrier to this type of burning. The identification of administrative barriers and what are alternatives is required in the Federal Regional Haze Rule under 40 CFR 51.309(d)(6)(iii). However, after reviewing two studies and public meetings that we had, ADEQ decided that the air curtain destructors do require oversight and it is appropriate that they be subject to permits. So they are included as having to obtain a permit under this proposed rule. ADEQ does not view the requirement that air curtain destructors obtain a permit as an administrative barrier.

To comply to the federal rule, the proposed revisions to Article 15 of Title 18, Chapter 2, the Forest and Range Management Burns Article, is made to -- or, the changes are made to better conform to EPA's regional haze requirements to again, hopefully, be more understandable to both the community and the regulators and to facilitate enhanced compliance with the rule.

Most of the proposed changes to Article 15 directly reflect the mandates of the federal rule, particularly those relating to the collection and recording of burn data, the evaluation of burn programs, and the establishment of annual emission goals. The former structure of the rule remains intact. That is, there's an annual registration by those who burn, there's a submittal of a Burn Plan that needs to be submitted to ADEQ at least 14 days before a burn, there's a daily Burn Request that the burner will submit to ADEQ, and there's a Burn Accomplishment Form at the end of the project that's submitted to ADEQ.

The Article 15 rule applies primarily to federal and state land managers, as those are the ones within the state of Arizona that do prescribed burns. However, there may be some private burners that Article 15 may also apply to. And as I indicated earlier, Article 15 does not apply to burns that are completed on tribal lands.

HEARING OFFICER FRIEDL: Thank you. Next we'll move to the question and answer period.

Does anybody have any questions on the rule revisions?

MR. MACAULEY: I'm a private landowner, I have a ranch, and I'm doing -- we've been doing burns for 60 years.

MS. PELLA: Uh-huh.

MR. MACAULEY: You talk about increasing my paperwork burden, this makes it exponential. I'll spend more time doing paperwork than I will burning.

MS. PELLA: What's the process you have to do now? And Article 15 would apply to you?

MR. MACAULEY: If I'm going to burn, you know, I'd like to burn 2,800 acres next year.

MS. PELLA: And you do that in connection with the federal land managers? Do you work with them?

MR. MACAULEY: No. My ranch is strictly private estate. I do the State land in conjunction with the State Land Department.

But when you're talking about trying to manage -- The fence that's not there, we put on the designation of who owns what land. I try to manage both sides of the fence the same way, as far as livestock is concerned and as far as wildlife is concerned. To get rid of the overstore, you need to burn. That's part of the fire regimen that's been around here for centuries.

But to do 2,800 acres requires to be burning at your property for three weeks or longer, if you can't get it to run.

MS. PELLA: Right.

MR. MACAULEY: So you're talking about doing something every single day at the end of the burn day --

MS. PELLA: No. Just at the beginning of the day. The daily burning request is generally -- the process is similar as it happens today. There's a daily phone call to ADEQ that says this is what I'm planning on burning today.

We're still working out the details of the implementation of it, but there will be forms that ADEQ is creating that the burners can use. They'll submit an initial one of those saying, for example, I'd like to burn 2,800 acres, and here's the time line that I'm thinking of doing it. And then you can submit that whenever you think you're ready to, and then the 14-day --

MR. MACAULEY: Last time we tried to do the same 2,800 acres, we got about 20 acres burned and got rained off. The thing is, the weather up here changes very rapidly and can change from day to day.

MR. FORCE: Do you work in conjunction with the State Land Manager?

MR. MACAULEY: I try to unless I'm doing it strictly on private property.

Historically, I'd get a burn permit in May and it would work until the end of October and we'd burn all summer long.

MS. PELLA: And you'd burn all summer without having to do a 14-day burn --

MR. MACAULEY: The only individuals I'd call would be the Forest Service and let them know, I'd call the volunteer fire departments and the local law enforcement and go burn.

MS. PELLA: Right. And I believe you might want to -- We can include that as an official comment, that we need to take that into consideration for private burning. I don't think much would change for you.

MR. MACAULEY: Other than filing all the paperwork. To date, I fill out a burn application, and they generally fax it to me, and that was the last bit of paperwork I did.

MS. PELLA: And what did you do when the project was done?

MR. MACAULEY: Nothing.

MS. PELLA: Nothing. Okay.

So the purpose of the rule changes here is -- the main purpose of why we're asking for a completed form of how many acres were burned, what type of fuel, et cetera, is that under the federal rule requirements we need to report to the EPA, from our standpoint, some estimate of emissions that were created from burns.

And so what we were trying to do with this rule is to figure out what's the least cap of resistance for the burners to give that information to ADEQ so that we can comply with our federal requirements. And so having an accomplishment form, when all is said and done, was one of the easiest ways that we thought would be least resistant.

But we'll take it as a formal comment that you think it's going to be cumbersome.

MR. MACAULEY: How am I supposed to tell you how many tons of fuel --

MS. PELLA: You don't.

MR. MACAULEY: I mean, that's directly proportionate to how dense the trees are on the acre.

MS. PELLA: Right. But you know how many acres you burned?

MR. MACAULEY: Right.

MS. PELLA: And you kind of know the fuel type, you know mostly what type of vegetation it was.

MR. MACAULEY: Are you talking about woody or grass or --

MS. PELLA: Right.

MR. MACAULEY: The whole idea is to increase the ground cover of the grasses, is what you're trying to accomplish.

MS. PELLA: Right. And what we're trying to do -- and we create the forms themselves that you guys fill out -- is, again, trying to make it as easy for you guys to fill out as possible. It might be some kind of thing where you just circle some things, where you don't even have to write out in longhand the information. But that's the general onus of it, is we're trying to figure out how we can comply with the federal rule requirement.

MR. MACAULEY: So what you're trying to do on private lands -- If you can start a fire here and have it run through an area and take the standing as well as what you've cut and let dry or you bushed or cabled, you could get a lot more bang for your buck. Because it's expensive to go out there and physically cut down the trees. And if you run into the green and take the green, the whole idea is to get it to run to cover hundreds of thousands of acres at a time.

MS. PELLA: Right. No one is arguing that prescribed --

MR. MACAULEY: What's going to happen, though, is you're not going -- If that happens, you're not going to have a daily estimate of how many acres have been burned, unless you go out there and walk it or measure it or take some sort of activity to clarify. And if the fire is burning, you're going to try to let it run, and it may go beyond the scope of the fire plan. But as long as it stays within the boundary of the ranch, that's what you're trying to accomplish.

MS. PELLA: Right. I totally agree with you. And if the situation is the prime time -- you want to burn as much as you can, right? And there's nothing -- If the conditions are right, it's not limiting what you can burn in a daily situation. I mean, you report in the morning, you call in the morning and you say this is what we're estimating we're going to burn. And when your project is done, that's your accomplishment form. Am I capturing that right, Carl, as you recall it?

MR. BOWMAN: As I recall, yeah.

MS. PELLA: I mean, we don't want you having to call DEQ twice a day or the State Land Manager, or however it's set up who your particular person is. We're not trying to get you to have to do that at all.

MR. MACAULEY: I just think -- Just trying to find the time to fill out all the paperwork and comply with all the rules and regulations, it is becoming cumbersome.

MS. PELLA: Okay. We will take that as a formal comment and make sure we put something in our response and summary.

HEARING OFFICER FRIEDL: Are there any other questions?

MR. LETZ: I had a question.

It's been a while since I've read the proposed rules, but in one of the initial drafts there were some requirements to provide annual estimates on the number of papers that would be burned in the wildland burn use strategy.

MS. PELLA: Not for wildland fires, prescribed burns. ADEQ is committed to holding an annual meeting with State and Federal Land Managers and other interested parties to discuss annual emission goals. But you can't estimate wildland fires.

MR. LETZ: That was exactly my comment.

MS. PELLA: Wild fires are lightening strikes --

MR. LETZ: Well, so is it --

MS. PELLA: Wildland is lightening strikes that get burned. So once you classify your terms into a wildland fire, the Land Manager -- Federal Land Manager is watching it and knows where they want the wildland fire to go.

MR. FORCE: I think the provision he's asking about is still in there. Wildland fire use is a wild fire that we -- They're asking us to project how much a wildland fire use is going to be on the annual registration form.

MS. PELLA: Okay.

MR. FORCE: And I'm wondering about that one myself. Carl, do you remember --

MR. BOWMAN: I think our comments were along the lines -- if I remember the comments we sent in, it was the area of, in our case, the park that was suitable for wildland fire use.

MR. FORCE: Maybe we should clarify that

language a little bit.

MR. BOWMAN: Since it's a wild fire, instead of putting this out, we're going to manage it. You don't really know if it's going to start, if it's going to grow. We've had some this year that have gotten to about a tenth of an acre, and we've gotten another one that's gotten to 8,000. So it's really hard.

MS. PELLA: Okay. Are you Craig?

MR. LETZ: Yes.

MS. PELLA: He's with the ADEQ Northern Regional Office. We'll put that down as a formal comment.

MR. LETZ: I'm Craig Letz with the Grand Canyon National Park.

HEARING OFFICER FRIEDL: The gentleman who spoke first, if we could get you to fill out a speaker slip just so we can match your name to the comment on the official record?

MS. PELLA: Good point, Craig.

HEARING OFFICER FRIEDL: Any other questions?

MS. PELLA: Carl, do you have anything you want to add?

MR. BOWMAN: No. I'm woefully unprepared.

MR. MACAULEY: My name is Mike MaCauley. Besides being a rancher, I'm also the chairman of the

Natural Resource Conservation District. The concern I have with fires -- I mean, when we go out and set a fire, the idea is -- the reality is, we can't -- unless you do a great deal of pretreatment to have that fire stay within a defined physical boundary, you're not going to have control unless you have a lot of water available. And the ability to transport a lot of water, because there's -- in my part of the world there's no live water, there's no wells, there's no streams. So you end up having to haul the water, which is very expensive, to try to put out a fire or fight a fire in that type of situation.

The idea of managing a fire, if you really want to manage a fire, there's certain things you have to do. And one of them is pretreat the boundaries, and that gets exceedingly cost prohibitive. If I had the Government money like the Forest Service does, the pay for that sort of thing, yeah, I could do that. But from a private standpoint, that's not feasible.

MS. PELLA: We'll also take that down as a formal comment, that there's some concern about the cost when it's related to private land.

MR. MACAULEY: One of the issues I also said, when we're talking about doing some sort of interface treatment, is the private landowner. How do you coordinate with the private landowner what you're doing on the federal lands? And that has become a stumbling point, because the monies are not there unless the private landowner is willing to ante up.

So when you're treating an area and you have islands that you can't treat because it's cost-prohibitive, you're, in a sense, defeating your own purpose because you cannot treat the entire area the same. So you're leaving pockets of areas where you can have wild fires grow or become a problem and then spread in other areas that may have been treated or beyond.

HEARING OFFICER FRIEDL: Does anybody else have any questions or formal comments that they would like ADEQ to consider?

This concludes the question and answer and the formal comment period.

We encourage everyone to submit written comments on the proposed rulemaking. And please remember that all comments must be received no later than 5:00 p.m. on Friday, October 24th, 2003.

Thank you for attending. The time is now 2:04 p.m., and I now close this oral proceeding.

(The public hearing concluded at 2:04 p.m.)

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, KATHRYN A. BLACKWELDER, Certified Court Reporter No. 50666 for the State of Arizona, do hereby certify that the foregoing printed pages constitute a full, true and accurate transcript of the proceedings had in the foregoing matter, all done to the best of my skill and ability.

WITNESS my hand this 5th day of November, 2003.

KATHRYN A. BLACKWELDER
Certified Court Reporter
Certificate No. 50666

Arizona Department of Environmental Quality
Air Quality Division

Public Hearing Presiding Officer Certification

I, Bruce Friedl, the designated Presiding Officer, do hereby certify that the public hearing held by the Arizona Department of Environmental Quality was conducted on October 23, 2003, at the Flagstaff City-Coconino County Public Library, Flagstaff, Arizona, in accordance with public notice requirements by publication in Arizona Administrative Register and other locations beginning September 19, 2003. Furthermore, I do hereby certify that the public hearing was recorded from the opening of the public record through concluding remarks and adjournment, and the transcript provided contains a full, true, and correct record of the above-referenced public hearing.

Dated this 3 day of December 2003.

[NAME OF PRESIDING OFFICER]
Bruce Joseph Friedl

State of Arizona)
) ss.
County of Maricopa)

Subscribed and sworn to before me by Bruce Joseph Friedl this 3RD day of December, 2003

DENEE N. WOODARD
Notary Public - Arizona
Maricopa County
Expires 12/30/05

Denee N. Woodard
Notary Public

My commission expires: 12/30/05

Show Low Fire Department
60 N. 6th Street
Show Low, Arizona 85901-5007
Phone (928) 537-5100 – Fax (928) 532-7634
slfd@citlink.net

22 October 2003

R. Kevin Force
Environmental Rules Specialist
Air Quality Division
Arizona Department of Environmental Quality
1110 W. Washington Street, 3415A-3
Phoenix, Arizona 85007-2955

RE: R18-2-602 – Proposed Rule Changes

Kevin:

After attending the meeting held in Show Low on the 22nd I am sending you this letter with questions and comments regarding the proposed rule changes.

1. When the proposed changes were written were any of the various model fire codes or the National Fire Protection Agency (NFPA) nationally recognized standards, more specifically NFPA 1, Uniform Fire Code, and NFPA 403, Live Fire Training Evolutions?
2. What is the difference between:
   a. C.3. – "… purpose of disease and pest prevention in organized, area-wide control of epidemics or infestations …" and
   b. D.1.e. – "… purpose of weed abatement, the prevention of a fire hazard, …"?

   Both have a purpose for protecting the public from harmful effects. I believe that both subsections, as written, should be exempt from permits, but must follow nationally recognized standards while conducted.
3. In item D.3.c. – I propose the addition of "… by the Director <u>or delegated authority</u> on a …".
4. Item D.3.f. states that a report is required. Is a report form available for the independent / delegated authority or is each applicant responsible to provide this information?
5. In item D.3.g. a notation should be made that the applicant contact the local fire jurisdiction to determine what local open burning requirements have been established, to obtain a local permit if required, and to follow all local adopted fire code requirements.

Regarding R18-2-1501 I ask if NFPA 1403, Wildland Fire Management, was reviewed to assure training of wildland firefighters was considered?

I look forward to receiving a response from you. If I can provide any assistance please feel free to contact me.

Respectfully,

Jack E. Babb
Asst. Chief / Fire Marshal

CC: File

81167

fax

Quartzsite Fire Department

P.O. 1889
#70 Tyson Drive

Quartzsite, AZ. 85346

BUS 928-927-6556
FAX 928-927-4277

Date: 10-23-03

To: G. Force

Firm: ADEQ

Fax #: 602 771 2366

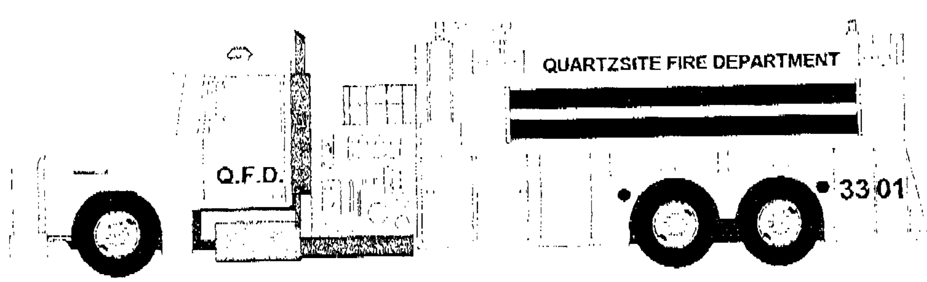
Phone #:

From: Jim Brownell

Subject: New Rules

Pages: ______ INCLUDING THIS PAGE

Note:



2/1/67

k. A requirement that the burning pit, burning pile, or approved waste burner be at least 50 feet from any structure;
l. A requirement that the burner must have a copy of the burn permit on-site during open burning;
m. A requirement that no open burning shall be conducted when an air stagnation advisory, as issued by the National Weather Service, is in effect in the area of the burn or during periods when smoke can be expected to accumulate to the extent that it will significantly impair visibility in Class I areas;
n. A requirement that no open burning shall be conducted when any stage air pollution episode is declared under R18-2-220.
o. A statement that the Director, or any other public officer may order that the burn be extinguished or prohibit burning during periods of inadequate smoke dispersion, excessive visibility impairment, or during periods of extreme fire danger; and
p. A copy of the activities prohibited and the criminal penalties provided under A.R.S. § 13-1706.

4. The Director or a delegated authority shall not issue an open burning permit under this Section:
   a. That would allow the burning of prohibited materials other than under a permit for the burning of dangerous materials;
   b. If the applicant has applied for a permit under this Section to burn dangerous materials which are also hazardous waste under 40 CFR 261, but does not have a permit for the burning of hazardous waste under 40 CFR 264, or is not an interim status facility allowed to burn hazardous waste under 40 CFR 265; or
   c. If the burning would occur at a solid waste facility in violation of 40 CFR 258.24 and the Director has not issued a variance approval under A.R.S. § 49-763.01(A).

E. Open Outdoor Fires of Dangerous Material. Fires set for the disposal of dangerous materials are allowed by the provisions of this Section, when the materials are too dangerous to store and transport, as permitted in writing by the Director. Permits issued shall contain all provisions in subsection (D)(3) except for subsections (e) and (f). Fires set for the disposal of dangerous materials shall be permitted only when there is no safe alternative method of disposal, and when the burning of such materials does not result in the emission of hazardous or toxic substances either directly or as a product of combustion in amounts that will endanger health or safety.

F. Open Outdoor Fires of Household Waste. Open outdoor fires for the disposal of household waste are allowed by provisions of this Section when permitted in writing by the Director or a delegated authority. Permits issued shall contain all provisions in subsection (D)(3) except for subsections (e) and (f). Open outdoor fires of household waste shall be burned in an approved waste burner and shall either:
   1. Burn household waste generated on-site on farms or ranches of 40 acres or more where no household waste collection or disposal service is available; or
   2. Burn household waste generated on-site where no household waste collection and disposal service is available and where the nearest other dwelling unit is at least 500 feet away.

G. Permits Issued by a Delegated Authority. The Director may delegate authority for the issuance of open burning permits to a county, city, town, air pollution control district, or fire district. A delegated authority may not permit its own open burning activity. Authority for issuance of permits to burn dangerous material under subsection (E) shall be retained by the Director and not delegated. A county, city, town, air pollution control district, or fire district with delegated authority from the Director may assign that authority to one or more private fire protection service providers that perform fire protection services within the county, city, town, air pollution control district, or fire district. A private fire protection provider shall not directly or indirectly condition the issuance of open burning permits on the applicant being a customer. Permits issued under this subsection shall comply with the requirements in subsection (D)(3) and be in a format prescribed by the Director. Each delegated authority shall:
   1. Maintain a copy of each permit issued for the previous five years available for inspection by the Director;
   2. For each permit currently issued, have a means of contacting the person authorized by the permit to set an open fire in the event that an order for extinguishing of open burning is issued; and
   3. Annually submit to the Director by May 15 a record of daily burn activity, excluding household waste burn permits, on a form provided by the Director for the previous calendar year containing the information required in subsections (D)(3)(e) and (f).

H. The Director shall hold an annual public meeting for interested parties to review operations of the open outdoor fire program and discuss emission reduction techniques.

I. Nothing in this Section is intended to permit any practice which is a violation of any statute, ordinance, rule, or regulation.

ARTICLE 15. FOREST AND RANGE MANAGEMENT BURNS

R18-2-1501. Definitions

In addition to the definitions contained in A.R.S. § 49-501 and R18-2-101, in this Article:
1. "ADEQ" means the Department of Environmental Quality.
2. "Annual Emissions Goal" means the annual establishment in cooperation with the F/SLMs, under R18-2-1503(G), of a planned quantifiable value of emissions reduction from prescribed fires and fuels management activities.

8/167

Burn Permit :

Quartzsite Fire District
P.O. Box 1889 (928) 927-6556
Quartzsite, Arizona 85346

Items in red box are NOT permitted to be burned.

ALL PLASTIC MATERIALS SUCH AS:
* bottles for household chemicals
* grocery and retail bags

WASTE PETROLEUM PRODUCTS:
* waste crankcase oil
* transmission oil
* used oil
* oil filters

HAZARDOUS MATERIAL CONTAINERS THAT CONTAINED:
* pesticides
* lead compounds
* cadmium compounds
* mercury compounds
* arsenic compounds

TAR PAPER

POISON OAK

ASBESTOS

POISON IVY

POISON SUMAC

OLEANDERS

AEROSOL SPRAY CANS

FLAMMABLE LIQUIDS

ANTIFREEZE

EXPLOSIVES OR AMMUNITION

POLYESTER

THERMAL INSULATION

TIRES

ELECTRICAL WIRE INSULATION

BATTERIES

HAZARDOUS WASTE PRODUCTS:
* paints
* pesticides
* cleaners
* stains and varnishes

ASPHALT SHINGLES

See the back of this form for Burning Regulations.

My initials indicate that I have read and understand the burning Regulations and Restrictions. Initial ______

This permit is issued under UFC Article 11, Section 1101.3;
Discontinuance is authorized under UFC Article 11, Section 1102.3.8.
Per ADEQ regulations, any VIOLATION is punishable under ARS 49502 / ARS 13-3903 for violation of this permit.
Per ARS 49-503 there is no defense for unlawful burning.

This Permit must be in the possession of the Burn Attendee during the duration of the burn. All conditions of the permit and the Uniform Fire Code must be strictly adhered to. Permit void after Sundown on the day issued.

I certify that I have knowledge of the facts herein set forth, that the same are true, accurate and complete to the best of my knowledge and belief. I further state that I will assume responsibility for conducting open burning in accordance with the Arizona Administrative Code, Title 18, Chapter 2. I have received a copy of this Permit and will comply.

Date of Burn: ______ Time of Burn: ______ Type of Burn: ______

Location of Burn: ______ Phone # : ______

Printed Name of Signer: ______

Address of Signer: ______

Signature: ______ Date: ______

Signature of Official issuing Permit: ______ I.D. # ______

Date and Time: ______

81167

Quartzsite Fire & Rescue

#70 Tyson Drive - Mail: P.O. Box 1889 - Quartzsite, Arizona 85346
Phone 928-927-6556 Fax 928-927-4277

Jim Browning, Chief

10-23-2003

Kevin Force
Arizona Department of Environmental Quality
1110 W. Washington
Phoenix, AZ 85007

Ref; Rulemaking

Mr. Force

I've received a copy of the proposed rule changes dated 09-19-2003.
Quartzsite Fire District wishes to oppose R18-2-602 (G) as not enforceable.
Permits issued by your agency for our area would amount to chaos. We currently issue burn permit and inspect the site before allowing the burn. Your issuance of a permit takes away our ability to control responses to fires and may cause a response when none is needed. Additional, is your agency going to inspect each site and respond when the fire must be extinguished? If the rule is past and open burning takes place and no permit is issued is your agency going to respond to control and extinguish the fire? If an agency is not responsible enough to control its own fires and training then why should they be allowed issue permits to the public?

Sincerely,

Jim Browning, Fire Chief
Quartzsite Fire District

3/291

UNITED STATES MARINE CORPS
MARINE CORPS AIR STATION
BOX 99100
YUMA, ARIZONA 85369-9100

IN REPLY REFER TO:
6280
ENVL
23 OCT 2003

AIR QUALITY DIVISION
03 OCT 24 PM 12:55

CERTIFIED MAIL

Arizona Department of Environmental Quality
Attn: Mr. R. Kevin Force
1110 W. Washington Street, 3415A-3
Phoenix, Arizona 85007-2955

Dear Mr. Force:

Subject: COMMENTS TO NOTICE OF PROPOSED REVISIONS TO ARIZONA ADMINISTRATIVE CODE R18-2-602 AND ARTICLE 15

Marine Corps Air Station (MCAS), Yuma has reviewed the proposed revisions to Arizona Administrative code R18-2-602 and are providing the following comments for inclusion into the proposed revision of R18-2-602, and article 15:

a. During the Public Meeting held in Yuma Arizona on 20 Oct 2003, Arizona Department of Environmental Quality (ADEQ) stated that it used Title 40 Part 51.308 and 309 as guidance when writing the amendments to the proposed revisions. After a careful review of the aforementioned, MCAS Yuma contends that the title refers to prescribed burning, which does not include fire-fighting training. Therefore, fire-fighting training should continue to be exempt.

b. It appears that 40 CFR 51.309(d)(6) actually refers to 16 Class I areas covered by the Grand Canyon Visibility Transport Commission Report. MCAS Yuma, Yuma, Arizona and Yuma County does not have any Class I areas within the affected regions. The prescribed fire programs, by definition, refer to fires set in wild lands and agricultural burns.

c. Clean-Air Corridors are referenced in 51.309(C)(3), but these must be identified to the Environmental Protection Agency (EPA) by the state. We have been unable to see any designation of these clean-air corridors in the proposed amendment. ADEQ has not demonstrated modeling has been performed to show that fire fighter training in Yuma will affect regional haze in the Grand Canyon or any of the other Class I areas.

d. Subparagraph (i) under Regional Haze Requirements refers to all Federal, State, and private prescribed fire program. Prescribed burning, in the proposed revision Article 15, R18-2-1501, defines the controlled application of fire to wild land fuels that are in either a natural or modified state, under certain burn prescription conditions and smoke management prescription conditions that have been specified by the land manager in charge of or assisting the burn, to attain planned resource management objectives;

e. Prescribed burning does not include a fire set or permitted by a public officer to provide instruction in fire fighting methods, or construction or residential burning under R18-2-602.

f. Subsection 51.308(d) indicates that Arizona must address regional haze in each mandatory Class I Federal area. The only smoke issues raised in this section are in 308(d)(3)(v)(E), which addresses smoke management techniques for agricultural and forestry management purposes. Fire-fighting training is neither.

g. Under 602(A)(12) ADEQ list open outdoor fires or open burning as agricultural, residential, prescribed, and construction burning, followed by instruction in the methods of fighting fires as a purpose for one of the defined types of open burning. Fire-fighting training does not meet any of the definitions of agricultural, residential, prescribed, or construction burning per the definitions listed in this section.

MaxXam Analytics Inc

A Chemex Labs Alberta/Novamann International Partnership

Jim Lindsay
PRO-SAFE Fire
91 Esna Park Dr., Unit 2
Markham, Ontario
L3R 2S2

DATE OF REPORT : July 14, 1998
DATE OF RECEIPT: July 08, 1998
MAXXAM NO. : 986172
PROJECT NO. :

TYPE OF ANALYSIS REQUESTED: Formaldehyde
TYPE OF SAMPLE SUBMITTED : XAD-2 Tube **CHAIN OF CUSTODY (Y/N):** Y
METHOD : Liquid Chromatograph

ANALYTICAL RESULTS

Sample Identification	Formaldehyde (mg/m^3)
Exhaust Vent in Tail During 30 Second Burn*	BMDL
Method Detection Limit	0.1

BMDL – Below Method Detection Limit
** - Note: Sample was collected over a 1 hour period during which 3 burns of 30 seconds were run.*

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
Elizabeth M. Cliffe
CHEMIST

CERTIFIED BY:
Paul Forsythe, Ph.D., C.Chem.
Senior Chemist, Air Quality Services

WITNESSED BY:
Elizabeth Cliffe, C. Chem
Manager, Air Quality Services

6172-psf

ALPHA LABORATORIES INC.
1262 DON MILLS ROAD, NORTH YORK, ONTARIO M3B 2W7 TEL: (416) 449-2166

REPORT IS FINAL

CERTIFICATE OF ANALYSIS

ALA NO.	00092805
DATE	17-11-97
LOT NO.	11/11/97
CUST. P.O. NO.	97NOV17
PRODUCT NO.	0614001

PRO-SAFE FIRE TRAINING SYSTEMS
91 ESNA PARK DRIVE, #2
MARKHAM, ONTARIO
L3R2S2
TOM KIATIPIS

PRODUCT NAME
WATER SAMPLE BURN PAN
AFTER FIRE

TESTS	METHOD	SPECIFICATIONS	RESULTS	CODE	OUT OF SPEC
IDENTIFICATION	USP		Propane in the sample = 0.000054% (0.54 ppm)		
YST:		N. Theivendra			
BEET: IDNT. (641, 000 ; 001, 000					

CHIEF CHEMIST: [signature] 11/17/97

DATE: 97/11/17 PAGE: 1 OF 1

This Report applies specifically to sample investigated and not to the bulk, unless otherwise stated herein. Although our investigation has

DD FORM 1348-1A, JUL 91 (EG) ISSUE RELEASE/RECEIPT DOCUMENT

DOC IDENT (1-3)	RI FROM (4-6)	M&S (7)	UNITS (23-24)	QUANTITY (25-29)	SER (45)	SUPPLEMENTARY ADDRESS (46-50)	SIG (51)	FUND (52-53)	DISTRIBUTION (54-56)	PROJECT (57-59)	PRI (60-61)	REQD DATE (62-64)	ADV (65-66)	RI (67-69)	O/P (70)	COND (71)	MGT (72)
			EA	00001					YY06								

UNIT PRICE (74-80): DOLLARS | CTS

1. TOTAL PRICE: DOLLARS | CTS

2. SHIP FROM
MCAS
BOX 99110

3. SHIP TO
SEE BLOCK 27

4. MARK FOR

5. DOC DATE | 6. NMFC | 7. FRT RATE | 8. TYPE CARGO | 9. PS

10. QTY. REC'D | 11. UP | 12. UNIT WEIGHT | 13. UNIT CUBE | 14. UFC | 15. SL

16. FREIGHT CLASSIFICATION NOMENCLATURE

17. ITEM NOMENCLATURE

18. TY CONT | 19. NO CONT | 20. TOTAL WEIGHT | 21. TOTAL CUBE

22. RECEIVED BY | 23. DATE RECEIVED

24. DOCUMENT NUMBER & SUFFIX (30-44)
M629743069PE05

25. NATIONAL STOCK NO. & ADD (8-22)
1741106. 27A0 000 M62974067443 000PE 90 KP 25B8 9171 AE103

26. RIC (4-6) UI (23-24) QTY (25-29) CON CODE (71) DIST (55-56) UP (74-80)

27. ADDITIONAL DATA

MAILING ADDRESS: ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
ATTN: MR. R. KEVIN FORCE
1110 W. WASHINGTON STREET, 3415A-3
PHOENIX, ARIZONA 85007-2955

PREVIOUS EDITION MAY BE USED

PerFORM (DLA)

AIR QUALITY DIVISION
03 OCT 24 PM 12:55

8/2/91

h. Your proposed rule did not consider fire and aircraft incidents that may occur during all hours of the day and night. It is not reasonable to limit fire-fighting training to only daylight hours. How to safely fight a fire is different at night. It is essential that all Firefighters be trained day and night to ensure their safety as well as the publics.

i. Aircraft Rescue Fire Fighting (ARFF) Division has identified several problems that will be encountered if MCAS Yuma firefighters are required to apply for a burn permit for each training exercise:

(1). Current shifts require the individual Marine to work over 90 hours per week, every week of the year. Training is conducted in a way that we attempt not to increase those hours further do to safety of flight considerations. We need latitude to ensure this happens.

(2). Current fire training is conducted around weather, scheduled and surge flight operations and other factors that are not easily projected.

(3). Operational commitments for vehicles and personnel are sometimes unforeseen with concern to outlying airfields.

(4). Several of the firefighting classes MCAS Yuma conducts include hands-on fire portion are open to other Department of Defense (DOD), Military, and Civilian personnel. Attendees may include fire services from El Centro, Yuma Proving Ground (YPG), Miramar and Camp Pendleton, Casa Grande, Prescott, Tucson, Grand Canyon, Hualapai Valley, Bullhead City, Kingman, Mesa, Evergreen, New Mexico, and Nevada. Scheduling can be cumbersome without the added lead-time for permitting each burn, now the difficulty will increase.

(5). Unannounced Live Fire drills are a key way to determine the operational readiness of ARFF. By scheduling these drills too far in advance the element of surprise is compromised and the true tone of ARFF's emergency operations is not analyzed.

(6). Most of our training is conducted when a window of opportunity occurs. Due to the large amount of other required training, daily operations, and emergency operations it is necessary to conduct training fires on short notice.

j. Reference Section 602 (C) Exemptions MCAS Yuma request that the proposed rule be amended to include:

(1). Any fire set or permitted by a public officer in the performance of official duty, if such fire is set or permission given for the purpose of instruction in the methods of fighting fires.

k. Reference section 602(D)(1)(e) Permit Requirements MCAS Yuma request that the rule be amended to read:

(1). Any fire set or permitted by a public officer in the performance of official duty, if such fire is set or permission given for the purpose of weed abatement or the prevention of a fire hazard, unless the fire is exempt from the permit requirement under subsection (C)(3).

l. Reference section 602(D)(3)(c), Prescribed Periods of Burning MCAS Yuma request that the rule be amended by adding the following:

6280
ENVL

Subject: COMMENTS TO NOTICE OF PROPOSED REVISIONS TO ARIZONA ADMINISTRATIVE CODE R18-2-602 AND ARTICLE 15

(1). Fires may be set by a public officer in the performance of his or her official duty during the hours between sunset and sunrise for the purposes of fire fighting training.

MCAS Yuma has written procedures in-place for all open burning. The Fire Department as well as our Crash Fire Rescue Division are aware and follow these procedures. Environmental personnel verify what is being burned prior to each training exercise. Only unpainted, unlaminated wood, or uncontaminated jet fuel may be burned. Prior to ignition, all metal and plastic are to be removed from the wood. The Environmental Department contacts ADEQ's automated system for atmosphere conditions the morning of the burn to ensure it is a good burn day. Procedures for Environmental and Station Structural Fire Departments are shown in (Enclosure 1 and 2).

MCAS Yuma long-term goals are to acquire a portable propane fire-training unit to conduct training. A copy of the emission data for this equipment is shown (Enclosure 3).

The proposed revision to Arizona Administrative Code R18-2-602 and Article 15 would severely impact MCAS, Yuma ARFF Training ability to ensure that our firefighters receive ARFF Training under similar firefighting conditions.

If additional information is needed, please contact our Air Quality Manager, Ms. Stewart at (928) 269-3201.

HERBERT GIL GUILLORY
Environmental Director
Environmental Department
By direction
of the Commanding Officer

Enclosures:
1. Environmental Department Open Burning Standard Operating Procedures
2. Structural Fire Department Standard Operating Procedures
3. Analytical Results for the Propane Fire Training Equipment

MCAS Yuma Environmental Department
OPEN BURNING STANDARD OPERATING POCEEDURES (SOP)

In accordance with the Arizona Administrative Code Article 6 R18-2-602, it is unlawful "for any person to ignite, cause to be ignited, permit to be ignited, or suffer, allow or maintain any open outdoor fire."

FIRE TRAINING OPERATIONS

R18-2-602(C)(2) "Any fire set or permitted by any public officer in the performance of official duty, if such fire is set or permission given for the purpose of weed abatement, the prevention of a fire hazard, or instruction in the methods of fighting fires" are excepted from the provisions of this rule.

The following policy is in effect on MCAS Yuma:

MCAS Yuma's Crash Fire Rescue (CFR) training division will call the Environmental Department 24 hours in advance requesting clearance to burn the following day.

On the morning of the burn, the Environmental Department will call the Air Quality Division of the Arizona Department of Environmental Quality (ADEQ) for permission to burn at (602) 771-4825. The recording at this number will advise if it is a good burn day or not based on atmospheric venting conditions only. Environmental personnel will need to use best judgment based on local weather conditions (i.e.: if overcast, it is not a good burn day because it will prevent smoke from rising.) **Phone calls to ADEQ will only be made by Environmental Department personnel.**

If it is not a good burn day, immediately call CFR Section Leader Office at 269-3494 and advise them not to burn.

If it is a good burn day, do nothing and CFR will assume that it is a "go" for them to conduct training.

Wood is the only product that will be burned in the fuselage or the fire tower. The wood must not be laminated or painted. All metal and plastic hardware will be removed prior to burning.

At the conclusion of each burn, CFR will document the following:

Date of burn.
Amount of fuel burned
Number of personnel trained.
Agency trained (MCAS personnel, Prescott Fire Dept, etc.)

A monthly report will be submitted to the Environmental Department with the above information.

Records of all burns will be maintained in the Environmental Department office and made available at all times.

RANGE ACTIVITIES AND TRAINING

All personnel entering into the range are briefed by Environmental, Range Management, or MAWTS-1.

In the *Handbook for Environmental Compliance*, Range Management Department, for the Barry M. Goldwater Range and the Chocolate Mountain Aerial Gunnery Range "No open fires, wood cutting or collection of firewood shall be allowed. Charcoal fires are allowed."

No trash, including paper, food wrappers, cans, or bottles, will be burned. The fire will be extinguished using water. The fire will not be left unattended until it is determined the fire is extinguished. The fire will not be abandoned until the embers are cool.

Enclosure (1)

Permission for burning on the ranges is dependent on Range Management and BLM fire restrictions. These restrictions may be obtained at the Range Management Office, building 1758, 269-2405.

AGRICULTURAL OUT-LEASE LAND

R18-2-602(C) has exceptions for obtaining burn permits for the following reasons:
1. Fires used only for cooking of food or for providing warmth for human beings or for recreational purposes or the branding of animals or the use of orchard heaters for the purpose of frost protection in farming or nursery operations.
2. Any fire set or permitted by any public officer in the performance of official duty, if such fire is set or permission given for the purpose of weed abatement, the prevention of a fire hazard, or instruction in the methods of fighting fires.
3. Fires set by or permitted by the state entomologist or county agricultural agents of the county for the purpose of disease and pest prevention.
4. Fires set by or permitted by the federal government or any of its departments, agencies or agents, the state or any of its agencies, departments or political subdivisions, for the purpose of watershed rehabilitation or control through vegetative manipulation."

With the exception of the above items, burn permits for agricultural burns must be obtained from Yuma County.

No dead trees or brush will be ignited by government contractors prior to obtaining a burn permit and notifying the Environmental Department.

No fuels will be used to ignite the fires. All trash, including paper, cans, and bottles will be removed from the dead wood prior to burning. No treated, laminated, or painted wood will be burned. All metal and plastic hardware will be removed prior to burning.

Structural fire Department
Marine Corps Air Station
Yuma AZ 85369-9127

Structural Fire Department
Standard Operating Procedure

Subject: Pre and Post Action on Live Fire Training Operations	Effective Date: 07 Oct 03	S.O.P #
Applies To: All FD Personnel	**Revised Date:**	**Page 1 of 3**

Scope:

This procedure applies to the MCAS Structural Fire Department personnel prior to and after live fire training exercises.

Purpose:

To comply with Arizona Administrative Code Article 6 R18-2-602(C)(2) and Station Environmental regulations.

Procedure:

In accordance with the Arizona Administrative Code Article 6 R18-2-602, it is unlawful "for any person to ignite, cause to be ignited, permit to be ignited, or suffer, allow or maintain any open outdoor fire."

R18-2-602(C)(2) "Any fire set or permitted by any public officer in the performance of official duty, if such fire is set or permission given for the purpose of weed abatement, the prevention of a fire hazard, or instruction in the methods of fighting fires" are excepted from the provisions of this rule.

In order to comply with these requirements, the following procedures are to be followed for training fires:
MCAS Yuma's Structural Fire Department, training division will call the Environmental Department at 269-6669 or 269-3161, 24-hours in advance requesting clearance to burn the following day.

On the morning of the burn, the Environmental Department will call the Air Quality Division of the Arizona Department of Environmental Quality (ADEQ) for permission to burn. The recording at this number will advise if it is a good burn day or not based on atmospheric venting conditions only.

Environmental personnel will need to use best judgment based on local weather conditions (i.e.: if overcast, it is not a good burn day because it will prevent smoke from rising.) **Environmental Department personnel will only make phone calls to ADEQ.**

If it is not a good burn day, Environmental Department personnel will immediately call the Structural Fire Branch Office at 269-2887 and advise them not to burn.

If it is a good burn day, there will be no phone call and the Fire Department will assume that it is a "go" for them to conduct training.

Uncontaminated JP-5 or JP-8 is the only fuel that will be burned in the burn pit.
Wood is the only product that will be burned in the fuselage or the fire tower. The wood must not be laminated or painted. All metal and plastic hardware will be removed prior to burning. No furniture with cushions or cloth may be burned.

At the conclusion of each burn, the Fire Department will document the following using the normal Fire Department Training Sheet: **(a copy will be maintained within the Live Fire After Action Report file located in the Lead Firefighter's Office)**

1. Date of burn.
2. Amount of fuel burned
3. Number of personnel trained.
4. Agency trained (MCAS personnel, CFR, YFD, Rural Metro Fire Dept, etc.)

A monthly report will be submitted to the Environmental Department from the Structural Fire Department via Memo format with the above information (see attached.)
Records of all burns will be maintained in the Environmental Department office and made available at all times. A copy will also be maintained within the Lead Firefighter's Office.

Asst. Fire Chief " A" Shift

Asst. Fire Chief "B" Shift

Station Fire Chief

Memorandum

Date:

From: Structural Fire Department

To: Station Environmental

Subj: Monthly After Action Burn Report

As per Article R18-2-602(C)(2) under the Arizona Administrative Code, the Marine Corps Air Station Structural Fire Division submits the After Action Burn Report concerning monthly live fire training exercises.

1. Burn Date:
   Type and amount of fuel burned:
   Number of personnel trained:
   Trained personnel's organization:

2. Burn Date:
   Type and amount of fuel burned:
   Number of personnel trained:
   Trained personnel's organization:

3. Burn Date:
   Type and amount of fuel burned:
   Number of personnel trained:
   Trained personnel's organization:

Remarks:

Any questions please call 269-3369

Assistant Fire Chief
Operations

MaxXam Analytics Inc

A Chemex Labs Alberta/Novamann International Partnership

Jim Lindsay
PRO-SAFE Fire
91 Esna Park Dr., Unit 2
Markham, Ontario
L3R 2S2

DATE OF REPORT : July 10, 1998
DATE OF RECEIPT: July 08, 1998
MAXXAM NO. : 986172
PROJECT NO. :

TYPE OF ANALYSIS REQUESTED: Carbon Monoxide, Nitrous Oxide and Benzene
TYPE OF SAMPLE SUBMITTED : Tedlar Bag **CHAIN OF CUSTODY (Y/N):** Y
METHOD : Gas Chromatograph/Flame Ionization Detector and Gas Chromatograph/Mass Spectrometer

ANALYTICAL RESULTS

Sample Identification	Benzene (ppm_v)	Nitrous Oxide (ppm_v)	Carbon Monoxide (ppm_v)	Carbon Dioxide (ppm_v)
30 feet Upwind	BMDL	0.5	BMDL	371
Inside Cabin During 30 Second Burn	0.73	0.9	64	>20000
Exhaust Vent in Tail During 30 Second Burn	0.04	0.5	1.8	929
Method Detection Limit	0.03	0.1	0.5	5.0

BMDL – Below Method Detection Limit

ASSOCIATION OF THE CHEMICAL PROFESSION OF ONTARIO
CHARTERED
Elizabeth M. Cliffe
CHEMIST

CERTIFIED BY: Paul Forsythe
Paul Forsythe, Ph.D., C.Chem.
Senior Chemist, Air Quality Services

WITNESSED BY:
Elizabeth Cliffe, C. Chem
Manager, Air Quality Services

6172-psf

Enclosure (3)

Kevin Force - Re: Open Burning Regulations

From: "Paul Coe" <psfdchief@hotmail.com>
To: <kf1@ev.state.az.us>, <force.kevin@ev.state.az.us>
Date: 10/24/03 12:03 PM
Subject: Re: Open Burning Regulations

>Mr. Force,

> (Kevin, this is a resend of my original email from yesterday. I tried to call you today, but you were out. I sent emails to AFCA and AFDA to let them know that your email was posted incorrectly on the email sent out by bthompson of the AFCA. Hopefully everyone will get the word in time. If you need to talk to me I will be at 928-476-2088 for the rest of the day)

>You will probably be receiving many emails on this topic. I hope you
>will consider the recommended changes. They are critical to the fire
>service need to be able to conduct live fire training exercises under
>realistic conditions.
>
>Recommended Change to Proposed rules # 1
>
>Arizona Administrative Register Volume 9, Issue 38
>
>ARTICLE 6. EMISSIONS FROM EXISTING AND NEW NONPOINT SOURCES R-18-2-602
>Unlawful Open burning
>
>C. Open Outdoor Fires Exempt From a Permit. The Following fires do not
>require an
>
>open burning permit from the Director or a Delegated Authority: (Page
>4075)
>
>1. Fires used Only For:
>
>a. Cooking of food
>
>b. Providing warmth for human beings
>
>c. Recreational purposes
>

>d. Branding of animals
>
>e. Orchard heaters for the purpose of frost protection in farming or
>nursery
>
>operations
>
>f. The proper disposal of flags under 4 U.S.C. 8
>
>2. Any fire set or permitted by any public officer in the performance of
>official duty, if
>
>such fire is set or permission given for the purpose of fire control of
>an active
>
>wildfire.
>
>3. Fires set or permitted by the Director of the Department of
>Agriculture for the
>
>purpose of disease and pest prevention in organized, area wide control
>of
>
>epidemics or infestations affecting livestock or crops.
>
>4. Prescribed burns set by or assisted the federal government or any of
>its
>
>departments, agencies or agents, the state or any of its agencies,
>departments or
>
>political subdivisions, pursuant to Article 15 of this chapter.
>
>Recommend the above be changed to: (Add #5)
>
>C. Open Outdoor Fires Exempt From a Permit. The Following fires do not
>require an
>
>open burning permit from the Director or a Delegated Authority:
>
>1. Fires used Only For:
>
>a. Cooking of food
>
>b. Providing warmth for human beings
>
>c. Recreational purposes
>
>d. Branding of animals
>
>e. Orchard heaters for the purpose of frost protection in farming or

>nursery
>
>operations
>
>f. The proper disposal of flags under 4 U.S.C. 8
>
>2. Any fire set or permitted by any public officer in the performance of
>official duty, if
>
>such fire is set or permission given for the purpose of fire control of
>an active
>
>wildfire.
>
>3. Fires set or permitted by the Director of the Department of
>Agriculture for the
>
>purpose of disease and pest prevention in organized, area wide control
>of
>
>epidemics or infestations affecting livestock or crops.
>
>4. Prescribed burns set by or assisted the federal government or any of
>its
>
>departments, agencies or agents, the state or any of its agencies,
>departments or
>
>political subdivisions, pursuant to Article 15 of this chapter.
>
>5. Any Fire set or permitted by any public officer in the performance of
>official duty, if
>
>such fire is set or permission given for the purpose of instruction in
>the methods of
>
>fighting fires.
>
>D. Open Outdoor Fires Requiring a Permit. (Page 4075)
>
>e. Current proposed language "Any fire set or permitted by a public
>officer in the performance of official duty, if such fire is set or
>permission given for the purpose of weed abatement, the prevention of
>fire hazard, or instruction in the methods of fighting fires, unless
>such fire is exempt from the permit requirement under subsection
>(C)(3)."
>
>Recommend the above be changed to:
>
>e. Current proposed language "Any fire set or permitted by a public
>officer in the performance of official duty, if such fire is set or

>permission given for the purpose of weed abatement, or the prevention of
>fire hazard, fires, unless such fire is exempt from the permit
>requirement under subsection (C)(3)."
>
>
>
>G. Permits Issued by a delegated authority. The Director may delegate
>authority for the issuance of open burning permits to a county, city,
>town, air pollution control district, or a fire district. A delegated
>authority may not permit its own open burning activity.
>
>Recommend changes to above to read:
>
>G. Permits Issued by a delegated authority. The Director may delegate
>authority for the issuance of open burning permits to a county, city,
>town, air pollution control district, or a fire district. A delegated
>authority may not permit its own open burning activity. Permits issued
>by a delegated authority for the purpose of instruction in the methods
>of fire fighting are excepted from the provisions of this rule.
>
>I can be reached at this email address or 928-476-4272 if you have any
>questions for me! Thanks for your consideration in this matter.
>
>
>Paul Coe, Fire Chief
>Pine-Strawberry Fire District
>

Kevin Force - Comment; proposed revision of R18-2-602

From: "Don Gabrielson" <Don.Gabrielson@co.pinal.az.us>
To: <force.kevin@ev.state.az.us>
Date: 10/24/03 3:45 PM
Subject: Comment; proposed revision of R18-2-602
CC: "Jean Parkinson" <Jean.Parkinson@co.pinal.az.us>, "Kale Walch" <Kale.Walch@co.pinal.az.us>

To: Kevin Force
Environmental Rules Specialist
Air Quality Division
Arizona Department of Environmental Quality

From: Don Gabrielson, Director
Pinal County Air Quality

Date: 10/24/03

Re: Comment; ADEQ's open burning rule revision proposal; 9 AAR 4066

I appreciate the opportunity to comment on this proposal.

I offer the following:

1. At 9 AAR 4068, the proposal suggests that the Regional Haze Rule encourages elimination of administrative barriers to certain types of burning. To the contrary, I believe the Regional Haze Rule encourages elimination of administrative barriers to alternatives to burning.

2. Proposed R18-2-602.D.1.a implicilty allows "construction burning." R18-2-602.A.4 defines "construction burning" to allow burning of various materials, including materials from "demolition, or modification of any bulidings or other land improvements." That definition does qualify the range of permissible combustibles, by precluding the burning of "prohibited materials."

R18-2-602.A.13 defines "prohibited materials" to include a host of common building materials, including chemically treated wood, asphalt shingles, tar paper, electrical wire insulation and thermal insulation. However, a variety of other potentially objectionable products are not clearly included in the list of "prohibited materials." For example, it is not at all clear that list includes such products as floor tile, linoleum flooring, lead-painted wood, and composite counter-tops. Seemingly, at least those products should be added to the list of "prohibited materials."

In addition, in Pinal County, for many years we have separately regulated the "demolition of building materials" as a special type of burning permit. Such a permit requires an initial on-site inspection to visually verify the character and sorting of the material to be burned. Only then is a burn permit actually issued. Experience has repeatedly shown that meaningful oversight is often required in order to get a permit holder to actually go through the effort of sorting out what can, and can't, be burned. To provide a reasonable prospect for actually acheiving compliance, ADEQ's proposed rule should also provide for such oversight.

3. Proposed R18-2-602.D.3.f allows for a permit-holder to submit an annual report detailing the timing and nature of burning activity during the preceding calendar year. While such a reporting requirement is not unduly burdensome, it seems that both the likely response level and

anticipated quality of the ensuing reports may not necessarily provide a comprehensive picture of burning activity.

4. Proposed R18-2-602.D.3.g calls for a daily report of burning activity either "the local fire-fighting agency" or to the state forester.

Initially, it is not clear whether "local fire-fighting agency" only includes a municipal fire department organized under A.R.S. Title 9 or a fire district organized under A.R.S. Title 48, or whether that phrase includes for-profit corporations that typically operate on a subscription or fee-for-service basis. A statutory fire-suppression organization will constitute a political subdivision with clearly defined boundaries. However, private for-profit fire fighting organizations can operate where they wish. Under those circumstances, it is not clear how the "operational boundaries" of such a for-profit organization would be defined for purposes of informing a burn-permit holder who to notify.

5. Proposed R18-2-602.F proposes to allow burning of "household waste."

As defined in R18-2-602.A.10, household waste that can be burned includes the full range of "prohibited materials" such as garbage from the processing, storage, service or consumption of food; plastic and rubber products, including bottles for household chemicals and garbage and retail plastic bags. The definition also allows for burning "septic waste."

Based on first-hand observation, I submit that the acrid stench of burning garbage can carry for long distances, including up to a mile or more. Burning household garbage constitutes activity that will inevitably cause nuisance impacts.

Would the person who thinks that burning loaded disposable diapers constitutes a sound public policy for Arizona please step forward and be counted!

The legislature did amend A.R.S. §49-501 to allow ADEQ to issue a restricted general permit for such burning. The legislature did not require that ADEQ allow burning of household waste.

I respectfully submit that allowing the burning of household garbage constitutes a policy that will adversely impact Arizona, the citizens of Arizona, and the image of Arizona. Therefore, I ask that ADEQ delete R18-2-602.F from this proposal.

NOTICE OF FINAL RULEMAKING

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY - AIR POLLUTION CONTROL

PREAMBLE

1.	**Sections Affected**	**Rulemaking Action**
	Article 6	
	R18-2-602	Amend
	Article 15	
	R18-2-1501	Amend
	R18-2-1502	Amend
	R18-2-1503	Amend
	R18-2-1504	Amend
	R18-2-1505	Amend
	R18-2-1506	Amend
	R18-2-1507	Amend
	R18-2-1508	Amend
	R18-2-1509	Amend
	R18-2-1510	Renumber
	R18-2-1510	New Section
	R18-2-1511	Renumber
	R18-2-1511	Amend
	R18-2-1512	Renumber
	R18-2-1512	Amend
	R18-2-1513	Renumber
	R18-2-1513	Amend
	R18-2-1514	Repeal
	R18-2-1514	Renumber
	R18-2-1514	Amend
	R18-2-1515	Amend

2. The statutory authority for the rulemaking, including both the authorizing statute (general)

<u>and the statutes the rules are implementing (specific):</u>

Authorizing statute: A.R.S. ' ' 49-414, 49-414.01 and 49-425

Implementing statutes: A.R.S. ' 49-501

<u>3. The effective date of the rules:</u>

60 days after filing with the Secretary of State.

<u>4. A list of all previous notices appearing in the Register addressing the final rules:</u>

Notice of Rulemaking Docket Opening: 9 A.A.R. 3386, August 1, 2003

Notice of Proposed Rulemaking: 9 A.A.R. 4066, September 19, 2003

<u>5. The name and address of agency personnel with whom persons may communicate regarding the rulemaking:</u>

Name: Kevin Force

Address: Arizona Department of Environmental Quality
1110 W. Washington Ave.
Phoenix, AZ 85007

Telephone: (602) 771-4480 (This number may be reached in-state by dialing 1-800-234-5677 and requesting the seven digit number.)

Fax: (602) 771-2366

<u>6. An explanation of the rules, including the agency=s reasons for initiating the rules:</u>

<u>Summary.</u> This final rule amends Arizona=s existing open burning and prescribed burning rules to make them conform to EPA requirements for states= Regional Haze State Implementation Plans. In addition, these amendments make other technical changes, including improvements of the rules= clarity, conciseness, and understandability.

<u>Regional Haze SIP Requirements.</u> The revisions to R18-2-602 and Article 15 will allow the state=s Regional Haze SIP that Arizona is required to submit to EPA by December 31, 2003, to meet the approvability test. (40 CFR 51.309(c)) The specific requirements for state regional haze SIPs are found at 40 CFR 51.308 and 51.309.

Under 40 CFR 51.309(d)(6), *Programs Related to Fire*, the plan must provide for:

A(i) Documentation that all Federal, State, and private prescribed fire programs within the State evaluate and address the degree visibility impairment from smoke in their planning and application. In addition the plan must include smoke management programs that include all necessary components including, but not limited to, actions to minimize emissions, evaluation of smoke dispersion, alternatives to fire, public notification, air quality monitoring, surveillance and enforcement, and program evaluation.

(ii) A statewide inventory and emissions tracking system (spatial and temporal) of VOC, NOX, elemental and organic carbon, and fine particle emissions from fire. In reporting and tracking emissions from fire from within the State, States may use information from regional data-gathering and tracking initiatives.

(iii) Identification and removal wherever feasible of any administrative barriers to the use of alternatives to burning in Federal, State, and private prescribed fire programs within the State.

(iv) Enhanced smoke management programs for fire that consider visibility effects, not only health and nuisance objectives, and that are based on the criteria of efficiency, economics, law, emission reduction opportunities, land management objectives, and reduction of visibility impact.

(v) Establishment of annual emission goals for fire, excluding wildfire, that will minimize emission increases from fire to the maximum extent feasible and that are established in cooperation with States, tribes, Federal land management agencies, and private entities.@

In early 2002, ADEQ's Regional Haze stakeholders established a Fire Emissions Work Group (FEWG) to discuss visibility issues related to fire emissions and make recommendations to ADEQ for the Regional Haze SIP. Fifteen stakeholders, representing public and private entities in geographically diverse areas of the state, agreed to participate in the work group.

The FEWG held a series of meetings from June 2002 through May 2003 to learn about and discuss options for all categories of burning activities that occur in the state. The draft rules were presented at public workshops in Casa Grande, Flagstaff, Phoenix, Show Low, and Yuma from April 10-17, 2003. The extensive meeting schedule was proposed by work group members in order to provide local access to the rulemaking process and obtain early input from sectors of the community who would be most affected by these rules. The current final rule is a joint effort of ADEQ and the FEWG based on input received at those public meetings and the decisions of the FEWG.

<u>Structure of open burning authority in Arizona.</u> A.R.S. ' 49-425 provides ADEQ with general air quality rule authority, including authority to promulgate rules for open burning permits. It requires the Director to adopt rules determined necessary and feasible Ato reduce the release into the atmosphere of air contaminants

originating within the territorial limits of the state.@ A.R.S. ' 49-501 adds related authority by excepting from its provisions those open outdoor fires that are permitted by any rule issued pursuant to A.R.S. ' 49-425 (see subsections (C)(5)), and in(E), by allowing the director to delegate authority to issue open burn permits to a Acounty, city, town, or fire district.@ A.R.S. ' 49-414.01(A) sets forth regional haze goals and requires the Director to submit a plan to EPA that addresses Aprograms related to emissions from fire sources@ Aas necessary to submit an approvable plan@ and authorizes rules necessary for the revisions to the state implementation that address regional haze.@

R18-2-602 and A.R.S. ' 49-501 govern open burning activities under ADEQ=s jurisdiction. A.R.S. ' 49-501 was last amended in 1997. In 1996, the delegation subsection E was added. In 1994, the general permit for household waste was added. Based on the statute and rule, ADEQ published guidelines on open burning in February, 1997.

Open Burning Revisions

At the public meetings mentioned above, the three frequent topics for comment were: time-of-day burning restrictions in R18-2-602(D)(3), permitting requirements for air curtain destructors, and the relationship of the state rule to counties that have independent authority to permit fires. However, in the public comment period, most commenters mentioned ADEQ=s proposed inclusion of fire training in those permits that would require an open burn permit. ADEQ has returned fire training to those fires that are exempted from an open burning permit. The issue is discussed in more detail in item 11 of this preamble.

Compared to the existing rule, this final rule contains a number of additional definitions in a separate subsection. ADEQ has finalized definitions for various categories of open burning, such as agricultural, construction, and residential. In addition, there are new definitions for Adelegated authority@, Aindependent authority to permit fires@, and Aprohibited materials@. Prohibited materials were previously described in the February 97 guidelines. By placing all of the necessary material from the guidelines in the final rule, ADEQ intends that this amended R18-2-602 will replace the guidelines as of the effective date of the rule.

The final rule also clarifies which open burning activities require open burning permits and those that are exempt from a permit. The final rule contains a more complete list of information that is required to be in the permit. This is both for more efficient permit administration, and to comply with various aspects of the regional haze rule.

ADEQ considered exempting certain fires using air curtain destructors from the open burn permit requirement in order to remove an administrative barrier to this type of burning. The Regional Haze Rule requires that administrative barriers to the use of alternatives to burning be removed wherever feasible. (See 40 CFR 51.309(d)(6)(iii)) ADEQ considered a barrier to a burning method with arguably lower emissions in the same way. Air curtain destructors (ACDs) are basically incinerators with high velocity air blown across and into the upper portion of the combustion chamber. This curtain of air traps particulates (smoke) and oxygenates the chamber, resulting in better combustion and less smoke. After reviewing two studies and considering the comments, ADEQ has remained with its conclusion that these devices do require oversight and it is appropriate that they be subject to permits under the rule. ADEQ does not view the requirement that ACDs obtain an open burning permit as much of an administrative barrier. ADEQ also notes that certain air curtain destructors are subject to New Source Performance Standards (see 40 CFR 60, subparts CCCC and DDDD). The issue is discussed in more detail in item 11 of this preamble. Studies reviewed by ADEQ relevant to air curtain destructors are listed in item 7 of this preamble.

ADEQ has added language in the final rule clarifying that the state rule will not operate in counties with independent authority to permit fires, and has listed the three counties in the definition. This independent authority is derived in part from language in A.R.S. ' 49-501(C)(5) specifying that fires permitted pursuant to county rules are excepted from A.R.S. ' 49-501. The three counties referenced in the definition all have rules creating permits for open outdoor fires, other than dangerous materials. (see Maricopa County Rule 341; Pima County Rule 17.12.480, et seq.; Pinal County Rule 3-8-700 and 3-8-710.) Pursuant to A.R.S. ' 49-501(G) and the current Phoenix area PM_{10} SIP, the Maricopa County rule prohibits burning of household waste.

The final rule also clarifies provisions on burning of dangerous materials and household waste. Finally, new restrictions on permits issued by delegated authorities that minimize the potential for conflict of interest on the part of delegated authorities have been included in subsection (G). First, the final rule specifies that a delegated authority may not issue itself open burning permits. Second, the rule prohibits private fire protection providers from conditioning the issuance of open burning permits on the applicant being their customer.

<u>Final Prescribed Burning Revisions</u>

State and federal forest and range land make up more than half of the land in Arizona. Despite potential air quality concerns, state and federal land managers (F/SLMs) use fire as a resource management tool on this land for a variety of purposes. Article 15 governs those fires that are set or allowed to burn on these lands in Arizona from a general air quality perspective. The two primary air quality concerns are violations of national ambient air quality standards (NAAQS) for particulates, and visibility impairment. Research indicates that, on average, 90 percent of smoke particles from wildland and prescribed fires are PM_{10}, and 10 percent are $PM_{2.5}$. Arizona=s Prescribed Burning requirements in Article 15 address these air quality concerns, primarily through efforts to ensure the best times for >burns= and by promoting other techniques to reduce the amount of smoke produced and the effects of that smoke.

A.R.S. ' 49-414.01 specifically requires the Director to submit a plan to EPA, and allows ADEQ to promulgate rules addressing programs related to emissions from wildland fire, including prescribed fires and wildfires (see A.R.S. ' 49-414.01(A)(7)). The final revisions to Article 15 of the Code, which govern the procedures relating to prescribed and wildland fires, will better conform to EPA=s regional haze requirements, be more understandable, and facilitate enhanced compliance. Most of the final changes to Article 15 directly reflect the mandates of the EPA=s regional haze rule requirements, particularly those relating to the collection and recording of burn data, the evaluation of burn programs and setting of annual emission goals. The former structure of the rule remains intact: 1) Annual registration; 2) submittal of a Burn Plan at least 14 days before the burn; 3) a daily Burn Request; and 4) a Burn Accomplishment Form.

<u>Section by Section Explanation of significant final changes.</u>

Article 6

R18-2-602	This rule describes the process by which permits may be issued for open burns, and identifies open burning activities that are exempt from the permit requirement.

Article 15

R18-2-1501	This section lists the definitions applicable to Article 15. In response to the EPA regulation, there are new definitions for AAnnual Emissions Goal,@ and Anon-burning alternatives to fire.@ In addition, ABest Management Practices@ has been replaced by ASmoke management techniques@ and AEmission reduction techniques,@ and APrescribed natural fire@ has been replaced by AWildland fire use.@
R18-2-1502	This section limits the applicability of the rule to state and federal land

	mangers, while excluding Indian Trust lands. The final change clarifies that private burners, such as the Nature Conservancy, may also be subject to the Article.
R18-2-1503	This section describes the process by which land managers annually register their planned burns with ADEQ. The final changes incorporate emission reduction techniques and non-burning alternatives to fire and facilitate the setting of annual emission goals. A new annual period and other clarifying changes have been included.
R18-2-1504	This section requires the details of each burn to be included in the Burn Plan form to be submitted to ADEQ 14 days before requesting permission to ignite. The final changes clarify the process and supplement the information related to it.
R18-2-1505	This section requires land mangers to submit a daily burn request for each day of the burn and describes optional agency response to the request. The final changes are primarily clarifying.
R18-2-1506	This section describes how the agency will determine whether and how much burning to allow. The final changes also add clarifying factors not directly related to regional haze.
R18-2-1507	This section requires land managers to report acreage and fuel types burned, the emission reduction and smoke management techniques used, and requires ADEQ to keep records of this information. A subsection has been added for wildfire reporting to allow those fires= emissions to be entered into the regional haze emission tracking system.
R18-2-1508	This section describes how land managers shall inform the agency of wildfires and seek permission for wildland burn uses. Clarifications have been included based on recent experiences with wildfires.
R18-2-1509	This section replaces the former BMP section and describes Emission Reduction Techniques, many of which were listed previously as BMPs. It requires land mangers to use as many as feasible.
R18-2-1510	This section also replaces the former BMP section and describes Smoke Management Techniques, some of which were listed previously as BMPs. It requires land managers to use as many as feasible.
R18-2-1511	This section describes how the agency may require land managers to

	monitor aspects of their prescribed burns and wildland burn uses. The final changes are clarifications and minor changes to weather and air quality monitoring.
R18-2-1512	This section requires all burn projects to be conducted by personnel trained in prescribed fire and smoke management techniques. The final changes are clarifications.
R18-2-1513	This section directs the agency to conduct burn-related public awareness programs and make burn information available to the public. The final changes attempt to promote regional coordination.
R18-2-1514	This section describes how the agency may inspect, verify, and audit burn information, and actions the agency may take regarding enforcement.
R18-2-1514(former)	In a recent 5-year-review report, ADEQ stated that it would reevaluate the need for this section. ADEQ is deleting subsection (B) because the changes in R18-2-1503 provide for a more efficient and effective system. Subsection (A) has been moved to R18-2-1511(B).
R18-2-1515	This section directs the agency to make its forms and data relating to prescribed burns and wildland burn uses available in an electronic format. The final changes are clarifying only.

7. A reference to any study relevant to the rules that the agency reviewed and either relied on in its evaluation of or justification for the rules or did not rely on in its evaluation of or justification for the rules, where the public may obtain or review each study, all data underlying each study, and any analysis of each study and other supporting material:

The Use of Air Curtain Destructors for Fuel Reduction, Alan R. Shapiro, United States Department of Agriculture, Forest Service Technology and Development Program (September 2002).

Reducing PM2.5 Emissions Through Technology, Evaluations of the Effectiveness of an Air Curtain Incinerator, Ronald A. Scott, Ronald Babbitt, Emily Lincoln, and Wei Min Hao, USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula MT (October 2002) Studies available for review at the ADEQ Library, First Floor, 1110 W. Washington St., Phoenix, AZ 85007.

8. A showing of good cause why the rules are necessary to promote a statewide interest if the rules

will diminish a previous grant of authority of a political subdivision of this state:

Not Applicable

9. The summary of the economic, small business, and consumer impact:

A. Rule Identification

The sixteen rules amended in this rulemaking are R18-2-602, AUnlawful Open Burning,@ and Article 15, AForest and Range Management Burns,@ R18-2-1501 through R18-2-1515.

B. Entities Affected by R18-2-602, AUnlawful Open Burning@

Open burning may be done by many entities for a variety of purposes, such as waste disposal, weed control, site preparation, disease and pest prevention, resource management, and training and fire prevention. Unless specifically exempted by this rule, persons setting outdoor fires would have to obtain a permit from ADEQ or a delegated authority, a city or fire district, or one of the three counties with independent authority to issue permits (Maricopa, Pima, Pinal). Persons who might be subject to this final rule therefore include: (1) individuals; (2) businesses, such as farms, ranches, orchards, electric generating plants, construction and mines; (3) federal sources, such as military installations; (4) state agencies, such as the Departments of Transportation and Corrections; and, (5) political subdivisions, such as counties, cities, irrigation districts, and fire districts.

ADEQ has delegated authority to issue permits to about 50 fire departments, fire districts and cities or towns located in 9 of Arizona=s 15 counties. Authority to issue permits in Graham County is delegated to Graham County Health Department, while Maricopa, Pima and Pinal Counties have independent authority to permit fires. ADEQ has jurisdiction to issue permits in areas outside the delegated authorities= jurisdiction in these counties. ADEQ typically issues more than 100 open burning permits annually to a wide variety of permittees, most of which are for burns in Gila and Cochise Counties. Permits for burns in LaPaz, Yavapai, Santa Cruz, Apache, Greenlee and Coconino Counties are also common.

The following represents a sampling of the level of permits issued by delegated authorities based on the calendar year 2002. The City of Prescott in Yavapai County issued about 200 permits in 2002, of which the majority was for residential burning. The City of Yuma issued 15 open burning permits, mainly for agriculture. Rural Metro Fire Department, which has jurisdiction outside of the municipalities of Somerton and Yuma, typically issues 300-400 residential open burning permits and 50-60 permits for agriculture in Yuma County. The City of Payson in Gila County issued 146 open burning permits for brush and weeds. Bullhead City in Mohave County annually issues 50-70 open burning permits of which the majority is for residential burning. The 384 open burning permits issued by Graham County Health Department in fiscal year 2003 were all for purposes of weed abatement.

C. Potential Impact of R18-2-602

This rulemaking only makes minor changes and incorporates current practice, therefore ADEQ expects the rule to create minimal actual impact, such as the costs associated with minor changes in record-keeping, documentation, and reporting requirements. ADEQ and delegated authorities will have to maintain copies of effective permits, as well as prepare annual reports for submission to ADEQ. While some of these changes will generate minimal costs, ADEQ expects the overall benefits to exceed those costs. It should also be noted that ADEQ does not charge fees for open burning permits because most permits are issued in a day or two and it would require minimal administrative effort.

D. Entities Affected by Article 15, AForest and Range Management Burns@

Since ADEQ has jurisdiction, outside tribal lands, over air pollution resulting from prescribed burning, this rule will impact the following federal and state agencies that do burning: (1) Federal Land Managers (FLMs) involved in burning activities, such as U.S. Forest Service, U.S. Fish and Wildlife Service, National Parks Service, Bureau of Land Management, Bureau of Reclamation, Department of Defense; (2) State Land Managers (SLMs), such as Arizona State Land Department, Arizona Department of Transportation, Arizona Department of Game and Fish, and Parks Department. Additionally, there are entities not actually subject to this rule but who may voluntary comply with some or all of the rule provisions, such as the Bureau of Indian Affairs, one of the largest burners in Arizona. Also, private land managers, such as The Nature Conservancy, or individuals, might also need to comply with this rule or request assistance from one of the F/SLMs.
Each year, ADEQ receives more than 1,000 daily burn requests from F/SLMs. For example, in calendar year 2002, about 1,400 requests to burn were received, and slightly more than 104,000 acres were burned, which represents about 56 percent of the total acres approved to burn. This figure is approximately equal to the the number of acres burned each year for the past ten years (106,429) on federal, state, and tribal lands. The major fuel types burned in 2002 and their relative proportions include: piled ponderosa pine (22%), non-piled ponderosa pine (21%), and natural ponderosa pine (17%). The remaining 40% of fuel types include: natural

shrub, non-piled grass and ponderosa pine, natural grass, natural grass and ponderosa pine, non-piled mixed, and other.

For comparison, in 1999, F/SLMs requested nearly 450,000 acres to burn. Although ADEQ approved close to 80 percent of the requested acreage, the actual number of acres burned was about 200,000. The fuel types burned in 1999 were: broadcast slash (32%), ponderosa pine (22%), grass (20%), slash piles (14%), brush (10%), and pinyon juniper (2%). As shown with these two years, proportions, however, vary from one year to another.

Combining acres burned for 1994 through 1999, shows the percentage of acres burned by F/SLMs agencies: U.S. Forest Service (49%), Bureau of Indian Affairs (30%), National Park Service (7%), Bureau of Land Management (7%), U.S. Fish and Wildlife (6%), Arizona State Land Department (1%), and other (1%).

E. Potential Impact of Article 15

Because this rule involves forest and range management burning by federal and state land managers, private persons, political subdivisions of the state, and small businesses will not bear any direct incremental costs from the final rule changes. However, because the rule requires both better tracking of emissions, better management of smoke, and public education and notification, benefits are expected to accrue to the public, particularly to populations living close to the burns. Specifically, there is potential for incremental benefits arising from better planning and implementation of measures which increase burn efficiency, prevent wildfires, improve visibility, and reduce smoke impacts to both the general public and more sensitive segments of the population.

F/SLMs currently pay for two full-time positions to work with ADEQ at an estimated annual value of $120,000 at ADEQ. Office space and equipment are provided by ADEQ. ADEQ currently supports one full-time position for the smoke management program. Although implementing this amended rule may require minimally increased planning and evaluation time, ADEQ does not expect to need additional employees to handle the workload. This increased workload, together with administrative costs associated with making burn information publicly available and conducting public awareness programs, are all that comprise the incremental impact to ADEQ. Thus, ADEQ judges that the costs to the agency are minimal.

The incremental impact of the changes to Article 15 is based on the rule=s new requirements, and are expected to result in minimal economic impact to F/SLMs and ADEQ. For example, F/SLMs will have to provide more information about their prescribed burns, including emission reduction techniques and non-burning alternatives. They will also be encouraged to attend annual meetings for program evaluation and the establishment of annual emissions goals, and will be looked to for the development of long-term projections of future prescribed fire and wildland fire use activities. The information provided by F/SLMS will be used by ADEQ to assess visibility impairment and other air quality concerns. Additional compliance costs include those associated with the incorporation of additional emission reduction and smoke management techniques.

Together, these rule changes are expected to improve the state=s smoke management program, which could lead to improvements in air quality through reduction and better management of burns. Evidence shows that exposure to criteria pollutants, either to individual pollutants such as particulate matter (PM), or collectively to a variety of pollutants, is associated with increased mortality. The positive correlation is most closely related to ambient air concentrations of PM. Human health effects of PM, for example, include premature mortality, bronchitis, new asthma cases and exacerbated asthma in existing individuals, increased hospital admissions, lower and upper respiratory illness, shortness of breath, respiratory symptoms, restricted activity days, and lost days of work. Other health effects ascribed to exposure to PM include changes in pulmonary function, chronic respiratory diseases (other than chronic bronchitis), morphological changes, neonatal mortality, cancer, altered host defense mechanisms, and non-asthma respiratory emergency room visits. Estimated economic values have been assigned to death and other adverse health effects. For example, a statistical death has been estimated to cost $6.3 million (in year 2000 dollars), chronic bronchitis due to PM costs $260,000 per patient, mortality life years lost is valued at $293,000 per each life year, and work days lost due to PM is worth about $83 per day. (EPA, *The Benefits and Costs of the Clean Air Act 1990-2010*, Office of Air and Radiation, Office of Policy, November 1999, Table 5-1.)

F. Reduction of Impacts to Small Businesses for R18-2-602 and Article 15

These rules create minimal increased compliance costs for ADEQ to administer the open burning and prescribed forestry burning programs. ADEQ considered each of the methods prescribed in A.R.S. ' 41-1035 for reducing the impact on small businesses. Likewise, it considered each of the methods prescribed in A.R.S. ' 41-1055(B)(5)(c). For example, A.R.S. ' 41-1035 requires agencies implementing rules to reduce the impacts on small businesses by using certain methods where legal and feasible. Methods that may be used include the following: (1) exempt them from any or all rule requirements, (2) establish performance standards which could replace more costly design or operational requirements, or (3) institute reduced compliance or reporting requirements.

ADEQ cannot provide additional regulatory relief for small businesses applying for open burning permits. As the agency does not charge fees for open burning permits, ADEQ expects that R18-2-602's reporting requirement (on forms developed by ADEQ) will create minimal economic impacts to individual persons or small businesses. The rule procedures have been kept as simple and straightforward as possible. Article 15 does not directly impact small businesses as it applies primarily to public entities.

10. A description of the changes between the proposed rules, including supplemental notices, and final rules (if applicable):

In response to comments, and to improve clarity, conciseness, and understandability, ADEQ has made the following changes to the proposed rule:

ARTICLE 6. EMISSIONS FROM EXISTING AND NEW NONPOINT SOURCES

R18-2-602. Unlawful Open Burning

A. In addition to the definitions contained in A.R.S. ' 49-501, in this Section:

1. AAgricultural ~~Burning~~ burning@ means burning ~~of~~ vegetative materials related to ~~the production~~ producing and harvesting ~~of~~ crops and raising ~~of~~ animals for the purpose of marketing for profit, or providing a livelihood, but does not ~~including~~ include the burning of household waste or prohibited materials. ~~Burning may be conducted~~ A person may conduct agricultural burns in fields, piles, ditch banks, fence rows, or canal laterals for purposes such as weed control, waste disposal, disease and pest prevention, or site preparation.
2. AApproved waste burner@ means an incinerator constructed of fire resistant material with a cover or screen ~~which~~ that is closed when in use ~~having~~ and has openings in the sides or top no greater than one inch in diameter.
3. AClass I Area@ means any one of the Arizona mandatory federal class I areas defined in A.R.S. ' 49-401.01.
4. AConstruction burning@ means burning ~~of~~ wood or vegetative material from land clearing, site preparation, or fabrication, erection, installation, demolition, or modification of any buildings or other land improvements, but does not ~~including~~ include ~~the~~ burning ~~of~~ household waste or prohibited ~~materials~~ material.
5. ADangerous material@ ~~is~~ means any substance or combination of substances that is capable

of causing bodily harm or property loss unless neutralized, consumed, or otherwise disposed of in a controlled and safe manner.

6. ADelegated authority@ means any of the following:
   a. A county, city, town, air pollution control district, or fire district that has been delegated authority to issue open burning permits by the Director under A.R.S. ' 49-501(E); or
   b. A private fire protection service provider that has been assigned authority to issue open burning permits by one of the authorities in subsection (a).
7. ADirector@ means the Director of the Department of Environmental Quality, or ~~his~~ designee.
8. AEmission reduction techniques@ ~~are~~ means ~~techniques~~ methods for controlling emissions from open outdoor fires to minimize the amount of emissions output per unit ~~or~~ of area burned.
9. AFlue,@ as used in this ~~subsection~~ Section, means any duct or passage for air or combustion gases, such as a stack or chimney.
10. AHousehold waste@means any solid waste including garbage, rubbish, and sanitary waste from a septic ~~tanks~~ tank that is generated from households including single and multiple family residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds and day-use recreation areas, but does not ~~including~~ include construction debris, landscaping rubble, or demolition debris.
11. AIndependent authority to permit fires@ means the authority of a county to permit fires by a rule adopted ~~pursuant to~~ under Arizona Revised Statutes, Title 49, Chapter 3, Article 3, and includes only Maricopa, Pima, and Pinal counties. ~~have independent authority to permit fires.~~
12. AOpen outdoor fire or open burning@ means the combustion of material of any type outdoors~~,~~ and in the open, where the products of combustion are not directed through a flue. Open outdoor fires include agricultural, residential, prescribed, and construction burning, and fires using air curtain destructors. ~~Purposes for fires can include prevention of a fire hazard, instruction in the methods of fighting fires, watershed rehabilitation, disease and pest prevention.~~
13. AProhibited materials@ means nonpaper garbage from the processing, storage, service, or consumption of food; chemically treated wood; lead-painted wood; linoleum flooring, or composite counter-tops; tires; explosives or ammunition; oleanders; asphalt shingles; tar

paper; plastic and rubber products, including bottles for household chemicals; plastic grocery and retail bags; waste petroleum products, such as waste crankcase oil, transmission oil, and oil filters; transformer oils; asbestos; batteries; anti-freeze; aerosol spray cans; electrical wire insulation; thermal insulation; polyester products; hazardous waste products such as paints, pesticides, cleaners and solvents, stains and varnishes, and other flammable liquids; plastic pesticide bags and containers; and hazardous material containers including those that contained lead, cadmium, mercury, or arsenic compounds.

14. AResidential burning@ means open burning of vegetative materials conducted by or for the occupants of residential dwellings, but does not ~~including~~ include burning ~~of~~ household waste or prohibited ~~materials~~ material.

15. APrescribed burning@ has the same meaning as in R18-2-1501.

B. Unlawful open burning. Notwithstanding any other rule in this Chapter, ~~it is unlawful for any~~ a person ~~to~~ shall not ignite, cause to be ignited, permit to be ignited, ~~or suffer,~~ allow, or maintain any open outdoor fire in a county without independent authority to permit fires except as provided in A.R.S. ' 49-501 and this Section.

C. Open outdoor fires exempt from a permit. The following fires do not require an open burning permit from the Director or a delegated authority:

1. Fires used only for:
   a. Cooking of food~~;~~,
   b. Providing warmth for human beings~~;~~,
   c. Recreational purposes~~;~~,
   d. Branding of animals~~;~~,
   e. Orchard heaters for the purpose of frost protection in farming or nursery operations~~;~~, and
   f. The proper disposal of flags under 4 U.S.C. ' 8.
2. Any fire set or permitted by any public officer in the performance of official duty, if ~~such~~ the fire is set or permission given for the following purpose ~~of~~:
   a. ~~Fire~~ Control of an active wildfire; or
   b. Instruction in the method of fighting fires, except that the person setting these fires must comply with the reporting requirements of subsection (D)(3)(f).
3. ~~Fires~~ Fire set by or permitted by the Director of Department of Agriculture for the purpose of disease and pest prevention in an organized, area-wide control of an epidemics or

~~infestations~~ infestation affecting livestock or crops.

4. Prescribed burns set by or assisted by the federal government or any of its departments, agencies or agents, or the state or any of its agencies, departments, or political subdivisions, ~~pursuant to~~ regulated under Article 15 of this Chapter.

D. Open outdoor fires requiring a permit.

1. The following open outdoor fires are allowed with an open burning permit from the Director or a delegated authority:
   a. Construction burning;
   b. Agricultural burning;
   c. Residential burning;
   d. Prescribed burns conducted on private lands without the assistance of a federal or state land manager as defined under R18-2-1501;
   e. Any fire set or permitted by a public officer in the performance of official duty, if ~~such~~ the fire is set or permission given for the purpose of weed abatement, the prevention of a fire hazard, ~~or instruction in the methods of fighting fires,~~ unless ~~such~~ the fire is exempt from the permit requirement under subsection (C)(3);
   f. Open outdoor fires of dangerous material under subsection (E); ~~and~~
   g. Open outdoor fires of household waste under subsection (F)~~.~~; and
   h. Open outdoor fires that use an air curtain destructor, as defined in R18-2-101.

2. A person conducting an open outdoor fire in a county without independent authority to permit fires shall obtain a permit from the Director or a delegated authority unless exempted under subsection (C). Permits may be issued for a period not to exceed one year. A person shall obtain a permit by completing an ADEQ-approved application form.

3. Open outdoor fire permits issued under this Section shall include:
   a. A list of the materials that the permittee may ~~be burned~~ burn under the permit;
   b. A means of contacting the ~~person~~ permittee authorized by the permit to set an open fire in the event that an order to extinguish the open outdoor fire is issued by the Director or the delegated authority;
   c. A requirement that burns be conducted during the following periods, unless otherwise waived or directed by the Director on a specific day basis:
      i. Year round: ~~start ignition~~ ignite fire no earlier than ~~1~~one hour after sunrise; and
      ii. Year round: extinguish fire ~~must be extinguished~~ no later than ~~2~~two hours

before sunset.

d. A requirement that the permittee conduct all open burning ~~shall be conducted~~ only during atmospheric conditions ~~which~~ that:

   i. Prevent dispersion of smoke into populated areas;

   ii. Prevent visibility impairment on traveled roads or at airports that result~~s~~ in a safety hazard;

   iii. Do not create a public nuisance or adversely affect public safety;

   iv. Do not cause an adverse impact to visibility in a Class I area; and

   v. Do not cause uncontrollable spreading of the fire;

e. A ~~listing~~ list of the ~~types of actions~~ emission reduction techniques that the permittee shall ~~be~~ ~~utilized~~ use to minimize fire emissions; ~~including any emission reduction techniques;~~

f. A reporting requirement that the permittee shall ~~be met~~ meet by providing the following information in a format provided by the Director for each date open burning occurred, on either a daily basis on the day of the fire, or ~~in~~ an annual basis in a report to the Director or delegated authority due on March 31 for the previous calendar year:

   i. The date of the burn;

   ii. The type and quantity of fuel burned for each date open burning occurred;

   iii. The fire type, such as pile or ~~windrow~~ pit, for each date open burning occurred; and

   iv. For each date open burning occurred, the legal location, to the nearest section, or latitude and longitude, to the nearest degree minute, or street address for residential burns.

g. A requirement that the person conducting the open burn notify the local fire-fighting agency~~,~~ or private fire protection service provider, if the service provider is a delegated authority, before burning. ~~or~~ If ~~none~~ neither is in existence, the person conducting the burn shall notify the state forester.~~, prior to commencement of open burning~~;

h. A requirement that the permittee start each open outdoor fire ~~be started~~ using items that do not cause the production of black smoke;

i. A requirement that the permittee attend the fire ~~shall be attended~~ at all times until it is completely extinguished;

j. A requirement that <u>the permittee provide</u> fire extinguishing equipment ~~must be~~ on-site for the duration of the burn;

k. A requirement that the <u>permittee ensure that a</u> burning pit, burning pile, or approved waste burner be at least 50 feet from any structure;

l. A requirement that the ~~burner must~~ <u>permittee</u> have a copy of the burn permit on-site during open burning;

m. A requirement that <u>the permittee not conduct</u> ~~no~~ open burning ~~shall be conducted~~ when an air stagnation advisory, as issued by the National Weather Service, is in effect in the area of the burn or during periods when smoke can be expected to accumulate to the extent that it will significantly impair visibility in Class I areas;

n. A requirement that <u>the permittee not conduct</u> ~~no~~ open burning ~~shall be conducted~~ when any stage air pollution episode is declared under R18-2-220.

o. A statement that the Director, or any other public officer may order that the burn be extinguished or prohibit burning during periods of inadequate smoke dispersion, excessive visibility impairment, or ~~during periods of~~ extreme fire danger; and

p. A ~~copy~~ <u>list</u> of the activities prohibited and the criminal penalties provided under A.R.S. ' 13-1706.

4. The Director or a delegated authority shall not issue an open burning permit under this Section:

a. That would allow ~~the~~ burning ~~of~~ prohibited materials other than under a permit for the burning of dangerous materials;

b. If the applicant has applied for a permit under this Section to burn <u>a</u> dangerous ~~materials~~ <u>material</u> which ~~are~~ <u>is</u> also hazardous waste under 40 CFR 261, but does not have a permit ~~for the burning~~ <u>to burn</u> ~~of~~ hazardous waste under 40 CFR 264, or is not an interim status facility allowed to burn hazardous waste under 40 CFR 265; or

c. If the burning would occur at a solid waste facility in violation of 40 CFR 258.24 and the Director has not issued a variance ~~approval~~ under A.R.S. ' 49-763.01~~(A)~~.

E. Open outdoor fires of dangerous material. <u>A</u> ~~fires~~ <u>fire</u> set for the disposal of <u>a</u> dangerous ~~materials~~ <u>material</u> ~~are~~ <u>is</u> allowed by the provisions of this Section, when the ~~materials~~ <u>material</u> are <u>is</u> too dangerous to store and transport, ~~as permitted in writing by~~ <u>and</u> the Director <u>has issued a permit for the fire</u>. <u>A</u> ~~permits~~ <u>permit</u> issued <u>under this subsection</u> shall contain all provisions in subsection (D)(3) except for subsections <u>(D)(3)</u>(e) and <u>(D)(3)</u>(f). <u>The Director shall permit</u> fires ~~set for~~ the disposal of dangerous materials ~~shall be permitted~~ only when ~~there is~~ no safe alternative method of disposal exists, and ~~when the~~ burning ~~of such~~ the materials does not result in the emission of hazardous or toxic substances either directly or as a product of combustion in amounts that will endanger health or safety.

F. Open outdoor fires of household waste. An open outdoor ~~fires~~ fire for the disposal of household waste ~~are~~ is allowed by provisions of this Section when permitted in writing by the Director or a delegated authority. ~~Permits~~ A permit issued under this subsection shall contain all provisions in subsection (D)(3) except for subsections (D)(3)(e) and (D)(3)(f). The applicant shall conduct open outdoor fires of household waste ~~shall be burned~~ in an approved waste burner and shall either:

1. Burn household waste generated on-site on farms or ranches of 40 acres or more where no household waste collection or disposal service is available; or
2. Burn household waste generated on-site where no household waste collection and disposal service is available and where the nearest other dwelling unit is at least 500 feet away.

G. Permits issued by a delegated authority. The Director may delegate authority for the issuance of open burning permits to a county, city, town, air pollution control district, or fire district. A delegated authority may not issue a permit for its own open burning activity. ~~Authority~~ The Director shall not delegate authority for issuance of permits to burn dangerous material under subsection (E). ~~shall be retained by the Director and not delegated.~~ A county, city, town, air pollution control district, or fire district with delegated authority from the Director may assign that authority to one or more private fire protection service providers that perform fire protection services within the county, city, town, air pollution control district, or fire district. A private fire protection provider shall not directly or indirectly condition the issuance of open burning permits on the applicant being a customer. Permits issued under this subsection shall comply with the requirements in subsection (D)(3) and be in a format prescribed by the Director. Each delegated authority shall:

1. Maintain a copy of each permit issued for the previous five years available for inspection by the Director;
2. For each permit currently issued, have a means of contacting the person authorized by the permit to set an open fire ~~in the event that~~ if an order ~~for extinguishing of~~ to extinguish open burning is issued; and
3. Annually submit to the Director by May 15 a record of daily burn activity, excluding household waste burn permits, on a form provided by the Director for the previous calendar year containing the information required in subsections (D)(3)(e) and (D)(3)(f).

H. The Director shall hold an annual public meeting for interested parties to review operations of the open outdoor fire program and discuss emission reduction techniques.

I. Nothing in this Section is intended to permit any practice ~~which~~ that is a violation of any statute, ordinance, rule, or regulation.

ARTICLE 15. FOREST AND RANGE MANAGEMENT BURNS

R18-2-1501. Definitions

In addition to the definitions contained in A.R.S. ' 49-501 and R18-2-101, in this Article:

1. AActivity fuels@ means those fuels created by human activities such as thinning or logging.

~~1.~~2. "ADEQ" means the Department of Environmental Quality.

~~2.~~3. AAnnual emissions goal@ means the annual establishment in cooperation with the F/SLM=s, under R18-2-1503(G), of a planned quantifiable value of emissions reduction from prescribed fires and fuels management activities.

~~3.~~4. ABurn plan@ means the ADEQ form that includes information on the conditions under which ~~the~~ a burn will occur with details of the burn and smoke management prescriptions.

~~4.~~5. "Burn prescription" means, with regard to a burn project, the pre-determined area, fuel, and weather conditions required to attain planned resource management objectives.

~~5.~~6. "Burn project" means an active or planned prescribed burn, including a wildland fire use incident.

~~6.~~7. "Duff" means forest floor material consisting of decomposing needles and other natural materials.

~~7.~~8. AEmission reduction techniques (ERT)@ means ~~techniques~~ methods for controlling emissions from prescribed fires to minimize the amount of emission output per unit of area burned.

~~8.~~9. AFederal land manager (FLM)@ means any department, agency, or agent of the federal government, including the following:

   a. United States Forest Service,
   b. United States Fish and Wildlife Service,
   c. National Park Service,
   d. Bureau of Land Management,
   e. Bureau of Reclamation,
   f. Department of Defense,
   g. Bureau of Indian Affairs, and
   h. Natural Resources Conservation Service.

~~9.~~10. "F/SLM" means a federal land manager or a state land manager.

~~10.~~11. "Local fire management officer" means a person designated by a F/SLM as responsible for fire management in a local district or area.

~~11.~~12. "Mop-up" means the act of extinguishing or removing burning material from a prescribed fire to reduce smoke impacts.

~~12.~~13. "National Wildfire Coordinating Group" means the national inter-agency group of federal and state land managers that shares similar wildfire suppression programs and ~~that~~ has established standardized inter-agency training courses and qualifications for fire management positions.

~~13.~~14. ANon-burning alternatives to fire@ ~~are~~ means techniques that replace fire for at least five years as a means to treat activity fuels created to achieve a particular land management objective (e.g., reduction of fuel-loading, manipulation of fuels, enhancement of wildlife habitat, and ecosystem restoration~~, etc.~~). These alternatives are not used in conjunction with fire. Techniques used in conjunction with fire are referred to as emission reduction techniques (ERTs).

~~14.~~15. "Planned resource management objectives" means public interest goals in support of land management agency objectives including silviculture, wildlife habitat management, grazing enhancement, fire hazard reduction, wilderness management, cultural scene maintenance, weed abatement, watershed rehabilitation, vegetative manipulation, and disease and pest prevention.

~~15.~~16. "Prescribed burning" means the controlled application of fire to wildland fuels that are in either a natural or modified state, under certain burn ~~prescription conditions~~ and smoke management prescription conditions that have been specified by the land manager in charge of or assisting the burn, to attain planned resource management objectives. Prescribed burning does not include a fire set or permitted by a public officer to provide instruction in fire fighting methods, or construction or residential burning under R18-2-602.

~~16.~~17. "Prescribed fire manager" means a person designated by a F/SLM as responsible for prescribed burning for that land manager.

~~17.~~18. "Smoke management prescription" means the predetermined meteorological conditions that affect smoke transport and dispersion under which a burn could occur without adversely affecting public health and welfare.

~~18.~~19. ASmoke management techniques@ (SMT) means management and dispersion practices used during a prescribed burn or wildland fire use incident which affect the direction, duration, height, or density of smoke.

~~19.~~20. "Smoke management unit" means any of the geographic areas defined by ADEQ whose area is based on primary watershed boundaries and whose ~~outlines are~~ outline is determined by diurnal windflow patterns that allow smoke to follow predictable drainage patterns. A map of the state divided into the smoke management units is on file with ADEQ.

~~20.~~21. "State land manager (SLM)" means any department, agency, or political subdivision of the state government including the following:

a. State Land Department,

b. Department of Transportation,

c. Department of Game and Fish, and

d. Parks Department.

~~21.~~22. "Wildfire" means an unplanned wildland fire subject to appropriate control measures. Wildfires include those incidents where suppression may be limited for safety, economic, or resource ~~limitations~~ concerns.

~~22.~~23. AWildland fire use@ means a wildland fire that is ignited by natural causes, such as lightning, ~~that~~ and is ~~subsequently~~ managed using the same controls and for the same planned resource management objectives as prescribed burning.

R18-2-1502. Applicability

A. A F/SLM that is conducting or assisting a prescribed burn shall follow the requirements of this Article.

B. A private or municipal burner with whom ADEQ has entered into a memorandum of agreement shall follow the requirements of this Article.

C. The provisions of this Article apply to all areas of the state except Indian Trust lands. All federally-managed lands and all state lands, parks, and forests are under the jurisdiction of ADEQ in matters relating to air pollution from prescribed burning.

D. Notwithstanding subsection ~~(B)~~ (C), ADEQ and any Indian tribe may enter into a memorandum of agreement to implement this Article.

E. ADEQ and any private or municipal prescribed burner may enter into a memorandum of agreement to implement this Article.

R18-2-1503. Annual Registration, Program Evaluation and Planning

A. Each F/SLM shall register annually with ADEQ on a form prescribed by ADEQ, all planned burn projects, including areas planned for wildland fire use.

B. Each planned year extends from January 1 of the registration year to December 31 of the same year. Each F/SLM shall use best efforts to register before December 31 and no later than January 31 of each year.

C. A F/SLM shall include the following information on the registration form:

1. The F/SLM's name, address, and business telephone number;
2. The name, address, and business telephone number of an air quality representative who will provide technical support to ADEQ for decisions regarding prescribed burning. The same air quality representative may be selected by more than one F/SLM;
3. All prescribed burn projects and potential wildland fire use areas planned for the next year;
4. ~~By prescribed burn project,~~ Maximum project and annual acres to be burned, maximum daily acres to be burned, fuel types within project area, and planned use of emission reduction techniques to support the annual emissions goal for each prescribed burn project;
5. ~~By prescribed burn project,~~ Planned use of any smoke management techniques for each prescribed burn project;
6. ~~By area planned for wildland fire use,~~ Maximum project and annual acres projected to be burned, maximum daily acres projected to be burned, and a map of the anticipated project area, fuel types and loading within the planned area for an area the F/SLM anticipates for wildland fire use;
7. A list of all burn projects that were completed during the previous year;
8. ~~By area to be treated using non-burning alternatives to fire,~~ Project area for treatment, treatment type, fuel types to be treated, and activity fuel loading to support the annual emissions goal for areas to be treated using non-burning alternatives to fire; and
9. The area treated using non-burning alternatives to fire ~~utilized~~ during the previous year including the number of acres, the specific types of alternatives utilized, and the location of these areas.

D. After consultation with the F/SLM, ADEQ may request additional information for registration of prescribed burns and wildland fire use to support regional coordination of smoke management, annual emission goal setting ~~utilizing~~ using ERTs, and non-burning alternatives to fire.

E. A F/SLM may amend a registration at any time with a written submission to ADEQ.

F. ADEQ ~~shall accept~~ accepts a facsimile or other electronic methods as a means of complying with the deadline for registration. If an electronic means are is used, the F/SLM shall deliver the original paper registration form to ADEQ for its records. ADEQ shall acknowledge in writing the receipt of each registration.

G. ADEQ shall hold ~~an annual~~ a meeting after January 31 and ~~prior to~~ before April 1 of each year between ADEQ and F/SLM=s ~~for program evaluation~~ to evaluate the program and ~~to~~ cooperatively establish the annual emission goal. The annual emission goal shall be developed to minimize prescribed fire emissions to the maximum extent feasible using emission reduction techniques and alternatives to burning subject to economic, technical, and safety feasibility criteria, and consistent with land management objectives.

H. At least once every five years, ADEQ shall request long-term projections of future prescribed fire and wildland fire use activity from the F/SLMs to support planning for visibility impairment and assessment of other air quality concerns by ADEQ.

R18-2-1504. Prescribed Burn Plan

Each F/SLM planning a prescribed burn~~,~~ shall complete and submit to ADEQ the "Burn Plan" form supplied by ADEQ no later than 14 days before the date on which the F/SLM requests permission to burn. ~~The information supplied on the Burn Plan Form are considered~~ ADEQ shall consider the information supplied on the Burn Plan Form as binding conditions under which the burn shall be conducted. A Burn Plan~~s~~ shall be maintained by ADEQ until notification from the F/SLM of the completion of the burn project. Revisions to the Burn Plan for a burn project shall be submitted in writing no later than 14 days before the date on which the F/SLM requests permission to burn. To facilitate the Daily Burn authorization process under R18-2-1505, the F/SLM shall include on the Burn Plan form:

1. An emergency telephone number that is answered 24 hours a day, seven days a week;
2. Burn prescription;
3. Smoke management prescription;
4. The number of acres to be burned, the quantity and type of fuel, type of burn, and the ignition technique to be used;
5. The land management objective or purpose for the burn such as restoration or maintenance of ecological function and indicators of fire resiliency;
6. A map depicting the potential impact of the smoke unless waived either ~~verbally~~ orally or in writing by ADEQ. The potential impact shall be determined by mapping both the daytime and nighttime smoke path and down-drainage flow for 15 miles from the burn site, with smoke-sensitive areas delineated. The map shall use the appropriate scale to show the impacts of the smoke adequately;
7. Modeling of smoke impacts unless waived either ~~verbally~~ orally or in writing by ADEQ, for burns greater than 250 acres per day, or greater than 50 acres per day if the burn is within 15 miles of a Class I Area, an area that is non-attainment for particulates, a carbon monoxide non-attainment area, or other smoke-sensitive area. In consultation with the F/SLM, ADEQ shall provide guidelines on modeling;
8. The name of the official submitting the Burn Plan on behalf of the F/SLM; and

9. After consultation with the F/SLM, any other information to support the Burn Plan needed by ADEQ to assist in the Daily Burn authorization process for smoke management purposes or assessment of contribution to visibility impairment of Class I areas.

R18-2-1505. Prescribed Burn Requests and Authorization

A. Each F/SLM planning a prescribed burn, shall complete and submit to ADEQ the "Daily Burn Request" form supplied by ADEQ. The Daily Burn Request form shall include:

1. The contact information of the F/SLM conducting the burn;
2. Each day of the burn;
3. The area to be burned on ~~that~~ the day for which the Burn Request is submitted, with reference to the Burn Plan, including size, legal location to the section and latitude~~/~~ and longitude to the minute;
4. Projected smoke impacts; and
5. Any local conditions or circumstances known to the F/SLM that, if conveyed to ADEQ, could impact the Daily Burn authorization process.

B. After consultation with the F/SLM, ADEQ may request additional information related to the burn, meteorological, smoke dispersion, or air quality conditions to supplement the Daily Burn Request form and to aid in the Daily Burn authorization process.

C. The F/SLM shall submit the Daily Burn Request form to ADEQ as expeditiously as practicable, but no later than 2 p.m. of the business day preceding the burn. An original form, a facsimile, or an electronic information transfer are acceptable submittals.

D. An F/SLM shall not ignite a prescribed burn without receiving the approval of ADEQ, as follows:

1. ADEQ shall approve, approve with conditions, or disapprove a burn on the same business day as the Burn Request submittal.
2. If ADEQ fails to address a Burn Request by 10 p.m. of the business day on which the request ~~was~~ is submitted, the Burn Request is approved by default after the burner makes a good faith effort to contact ADEQ to confirm that the Burn Request was received.
3. ADEQ may communicate its decision by verbal, written, or electronic means. ADEQ shall provide a written or electronic reply if requested by the F/SLM.

E. If weather conditions cease to conform to those in the smoke management prescription of either the Burn Plan or an Approval with Conditions, the F/SLM shall take appropriate action to reduce further smoke impacts, ensure safe and appropriate fire control, and notify the public when necessary. After consultation with ADEQ, the smoke management prescription or burn plan may be modified.

F. The F/SLM ~~is responsible for~~ shall ensure that there is appropriate signage and notification to protect public safety on transportation corridors including roadways and airports during a prescribed fire.

R18-2-1506. Smoke Dispersion Evaluation

ADEQ shall approve, approve with conditions, or disapprove a Daily Burn Request submitted ~~pursuant to~~ under R18-2-1505, by using the following factors for each smoke management unit:

1. Analysis of the emissions from burns in progress and residual emissions from previous burns on a day-to-day basis;
2. Analysis of emissions from active wildland fire use incidents, and active multiple-day burns, and consideration of potential long-term emissions estimates;
3. Analysis of the emissions from wildfires greater than 100 acres and consideration of their potential long-term growth;
4. Local burn conditions;
5. Burn prescription and smoke management prescription from the applicable Burn Plan;
6. Existing and predicted local air quality;
7. Local and synoptic meteorological conditions;
8. Type and location of areas to be burned;
9. Protection of the national visibility goal for Class I Areas ~~pursuant to~~ under ' 169A(a)(1) of the Act and 40 CFR 51.309;
10. Assessment of duration and intensity of smoke emissions to minimize cumulative impacts; ~~and~~
11. Minimization of smoke impacts in Class I Areas, areas that are non-attainment for particulate matter, carbon monoxide non-attainment areas, or other smoke-sensitive areas~~.~~; and
12. Protection of the National Ambient Air Quality Standards.

R18-2-1507. Prescribed Burn Accomplishment; Wildfire Reporting

A. Each F/SLM conducting a prescribed burn shall complete and submit to ADEQ the "Burn Accomplishment" form supplied by ADEQ. For each burn approval, the F/SLM shall submit a Burn Accomplishment form to ADEQ by 2 p.m. of the business day following the approved ~~burning~~ burn. The F/SLM shall include the following information on the Burn Accomplishment form:

1. Any known conditions or circumstances that could impact the Daily Burn decision process;
2. The date, location, fuel type, fuel loading, and acreage accomplishments;
3. The ERTs and SMTs described in R18-2-1509 and R18-2-1510, respectively, and may

include any further ERTs and SMTs that become available, that the F/SLM used to reduce emissions or manage the smoke from the burn.

B. The F/SLM shall submit the Burn Accomplishment form as an original form, a facsimile, or an electronic information transfer.

C. ADEQ shall maintain a record of Burn Requests, Burn Approvals/Conditional Approvals/Denials and Burn Accomplishments for ~~5~~ five years.

D. The F/SLM in whose jurisdiction a wildfire occurs shall make available to ADEQ no later than the day after the activity all required information for wildfire incidents that burned more than 100 acres per day in timber or slash fuels or 300 acres per day in brush or grass fuels. For each day of a wildfire incident that ~~exceeded~~ exceeds the daily activity threshold, the F/SLM shall provide the location, an estimate of predominant fuel type and quantity consumed, and an estimate of the area blackened that day.

R18-2-1508. Wildland Fire Use: Plan, Authorization, Monitoring; Inter-agency Consultation; Status Reporting

A. In order for ADEQ to participate in the wildland fire use decision-making process, the F/SLM shall notify ADEQ as soon as practicable of any wildland fire use incident projected to attain or attaining a size of 50 acres of timber fuel or 250 acres of brush or grass fuel.

B. For each wildland fire use incident that has been declared as such by the F/SLM, the F/SLM shall complete and submit to ADEQ a Wildland Fire Use Burn Plan in a format approved by ADEQ in cooperation with the F/SLM. The F/SLM shall submit the Wildland Fire Use Burn Plan to ADEQ as soon as practicable but no later than 72 hours after the wildland fire use incident is declared or under consideration for such designation. The F/SLM shall include the following information in the Wildland Fire Use Burn Plan:

1. An emergency telephone number that is answered 24 hours a day seven days a week;
2. Anticipated burn prescription;
3. Anticipated smoke management prescription;
4. The estimated daily number of acres, quantity, and type of fuel to be burned;
5. The anticipated maximum allowable perimeter or size with map;
6. Information on the condition of the area to be burned, such as whether it is in maintenance or restoration, its ecological function ~~or~~ , and other indicators of fire resiliency;
7. The anticipated duration of the wildland fire use incident;

8. The anticipated long-range weather trends for the site;

9. A map depicting the potential impact of the smoke. The potential impact shall be determined by mapping both the daytime and nighttime smoke path and down-drainage flow for 15 miles from the wildland fire use incident, with smoke-sensitive areas delineated. Mapping is mandatory unless waived either ~~verbally~~ orally or in writing by ADEQ. The map shall use the appropriate scale to show the impacts of the smoke adequately; and

10. Modeling or monitoring of smoke impacts, if requested by ADEQ after consultation with the F/SLM.

C. ADEQ shall approve or disapprove a Wildland Fire Use Burn Plan within ~~3~~ three hours of receipt. ADEQ shall consult directly with the requesting F/SLM before disapproving a Wildland Fire Use Burn Plan. If ADEQ fails to address the Wildland Fire Use Burn Plan within the time allotted, the Plan is approved by default under the condition that the F/SLM makes a good faith effort to contact ADEQ to confirm that the Plan was received. Approval by ADEQ of a Wildland Fire Use Burn Plan ~~shall be~~ is binding upon ADEQ for the duration of the wildland fire use incident, unless smoke from the incident creates a threat to public health or welfare. If a threat to public health or welfare is created, ADEQ shall consult with the F/SLM regarding the situation and develop a joint action plan for reducing further smoke impacts.

D. The F/SLM shall submit a Daily Status Report for each wildland fire use incident to ADEQ for each day of the burn that the fire burns more than 100 acres in timber or slash fuels or 300 acres in brush or grass fuels. The F/SLM shall include a synopsis of smoke behavior, future daily anticipated growth, and location of the activity of the wildland fire use incident in the Daily Status Report.

E. The F/SLM shall consult with ADEQ prior to initiating ~~man-made~~ human-made ignition on the wildland fire use incident when greater than 250 acres is anticipated to be burned by the ignition. Emergency ~~man-made~~ human-made ignition on the incident for protection of public or fire-fighter safety does not require consultation with ADEQ regardless of the size of the area to be burned.

F. The F/SLM ~~is responsible for~~ shall ensure that there is appropriate signage and notification to protect public safety on transportation corridors including roadways and airports during a wildland fire use incident.

R18-2-1509. Emission Reduction Techniques

A. Each F/SLM conducting a prescribed burn shall implement as many Emission Reduction Techniques as are feasible subject to economic, technical, and safety feasibility criteria, and land management objectives.

B. Emission reduction techniques include :

1. Reducing biomass to be burned by use of techniques such as yarding or consolidation of unmerchandisable material, multi-product timber sales, or public firewood access, when economically feasible;
2. Reducing biomass to be burned by fuel exclusion practices such as preventing the fire from consuming dead snags or dead and downed woody material through lining, application of fire-retardant foam, or water;
3. Using mass ignition techniques such as aerial ignition by helicopter to produce high intensity fires of high fuel density areas such as logging slash decks;
4. Burning only fuels essential to meet resource management objectives;
5. Minimizing consumption and smoldering by burning under conditions of high fuel moisture of duff and litter;
6. Minimizing fuel consumption and smoldering by burning under conditions of high fuel moisture of large woody fuels;
7. Minimizing soil content when slash piles are constructed by using brush blades on material-moving equipment and by constructing piles under dry soil conditions or by using hand piling methods;
8. Burning fuels in piles;
9. Using a backing fire in grass fuels;
10. Burning fuels with an air curtain destructor, as defined in R18-2-101, operated ~~pursuant~~ according to manufacturer specifications and meeting applicable ~~State~~ state or local opacity requirements;
11. Extinguishing or mopping-up of smoldering fuels;
12. Chunking of piles and other consolidations of burning material to enhance flaming~~,~~ and fuel consumption, and to minimize smoke production;
13. ~~Burn~~ Burning before litter fall;
14. ~~Burn~~ Burning before green-up of fuels;
15. ~~Burn~~ Burning before recently cut large fuels cure in areas with activity; and
16. ~~Burn~~ Burning just ~~prior to~~ before precipitation to reduce fuel smoldering and consumption.

R18-2-1510. Smoke Management Techniques

A. Each F/SLM conducting a prescribed burn shall implement as many Smoke Management Techniques as are feasible subject to economic, technical, and safety feasibility criteria, and land management objectives.

B. Smoke ~~Management Techniques~~ management techniques include:

1. Burning from March 15 through September 15, when meteorological conditions allow for good smoke dispersion;
2. Igniting burns under good-to-excellent ventilation conditions;
3. Suspending operations under poor smoke dispersion conditions;
4. Considering smoke impacts on local community activities and land users;
5. Burning piles when other burns are not feasible, such as when snow or rain is present;
6. Using mass ignition techniques such as aerial ignition by helicopter to produce high intensity fires with short duration impacts;
7. Using all opportunities that meet the burn prescription and all burn locations to spread smoke impacts over a broader time period and geographic area;
8. Burning during optimum mid-day dispersion hours, with all ignitions in a burn unit completed by 3 p.m. to prevent trapping smoke in inversions or diurnal windflow patterns;
9. ~~When allowing public firewood access, provide~~ Providing information on the adverse impacts of using green or wet wood as fuel when public firewood access is allowed;
10. Implementing maintenance burning in a periodic rotation to shorten prescribed fire duration and to reduce excessive fuel accumulations ~~which~~ that could result in excessive smoke production in a wildfire; and
11. Using wildland fire-use strategies to shift smoke into more favorable smoke dispersion seasons.

R18-2-1511. Monitoring

A. ADEQ may require a F/SLM to monitor air quality before or during a prescribed burn or a wildland fire use incident if necessary to assess smoke impacts. Air quality monitoring may be conducted using both federal and non-federal reference method as well as other techniques.

B. ADEQ may require a F/SLM to monitor weather before or during a prescribed burn or a wildland fire use incident, if necessary to predict or assess smoke impacts. After consultation with the F/SLM, ADEQ may also require the F/SLM to establish burn site or area-representative remote automated weather stations or their equivalent, having telemetry that allows retrieval on a real-time basis by ADEQ. An F/SLM ~~planning to make a change to any long-term established remote automated weather station~~ shall give ADEQ notice and an opportunity to comment before making ~~the~~ any change to a long-term established remote automated weather station.

C. A F/SLM shall employ the following types of monitoring, unless waived by ADEQ, for burns greater than 250 acres per day, or greater than 50 acres per day if the burn is within 15 miles of a Class I Area, an area that is non-attainment for particulate matter, carbon monoxide, or ozone, or other smoke-sensitive area:

1. Smoke plume measurements, using a format supplied by ADEQ; and
2. The release of pilot balloons (PIBALs) at the burn site to verify needed wind speed, direction, and stability.

~~In lieu~~ Instead of pilot balloons, a test burn at the burn site may be used for specific prescribed burns on a case-by-case basis as approved by ADEQ, to verify needed wind speed, direction, and stability.

D. An F/SLM shall make monitoring information required ~~pursuant to~~ under subsection (C) available to ADEQ on the business day following the burn ignition.

E. The F/SLM shall keep on file for ~~1~~ one year following the burn date any monitoring information required ~~pursuant~~ under to this Section.

R18-2-1512. Burner Qualifications

A. All burn projects shall be conducted by personnel trained in prescribed fire and smoke management techniques as required by the F/SLM in charge of the burn and established by National Wildfire Coordinating Group training qualifications.

B. A Prescribed Fire Boss or other local Fire Management Officer of the F/SLM having jurisdiction over prescribed burns shall have smoke management training obtained through one of the following:

1. Successful completion of a National Wildfire Coordinating Group or F/SLM-equivalent course addressing smoke management; or
2. Attendance at an ADEQ-approved smoke management workshop.

R18-2-1513. Public Notification and Awareness Program; Regional Coordination

A. The Director shall conduct a public education and awareness program in cooperation with F/SLMs and other interested parties to inform the general public of the smoke management program described by this Article. The program shall include smoke impacts from prescribed fires and the role of prescribed fire in natural ecosystems.

B. ADEQ shall make annual registration, prescribed burn approval, and wildfire and wildland fire use activity information readily available to the public and to facilitate regional coordination efforts and public notification.

R18-2-1514. Surveillance and Enforcement

A. An F/SLM conducting a prescribed burn shall permit ADEQ to enter and inspect burn sites unannounced to verify the accuracy of the Daily Burn Request, Burn Plan, or Accomplishment data as well as matching burn approval with actual conditions, smoke dispersion, and air quality impacts. On-ground site inspection procedures and aerial surveillance shall be coordinated by ADEQ and the F/SLM for safety purposes.

B. ADEQ may use remote automated weather station data if necessary to verify current and previous meteorological conditions at or near the burn site.

C. ADEQ may audit burn accomplishment data, smoke dispersion measurements, or weather measurements from previously conducted burns, if necessary to verify conformity with, or deviation from, procedures and authorizations approved by ADEQ.

D. Deviation from procedures and authorizations approved by ADEQ constitute a violation of this Article. Violations may require containment or mop-up of any active burns and may also require, in the Director's discretion, a ~~5~~ five-day moratorium on ignitions by the responsible F/SLM. Violations of this Article are also subject to a civil penalty of not more than $10,000 per day per violation ~~pursuant to~~ under A.R.S. ' 49-463.

R18-2-1515. Forms; Electronic Copies; Information Transfers

A. ADEQ shall make available on paper and in electronically-readable format any form required to be developed by ADEQ and completed by a F/SLM.

B. After consultation with ~~the~~ an F/SLM, ADEQ may require ~~each~~ the F/SLM to provide data in a manner that facilitates electronic transfers of information.

11. A summary of the comments made regarding the rule and the agency response to them:

Comment #1: A large number of commenters focused on the proposed requirement that fires set for the purpose of training firefighters now be permitted. In the current rule, fires set for training purposes are excepted from the permit requirement. Commenters felt that requiring permits for such fires was an unnecessary and impracticable interference in their operations.

Response #1: ADEQ had proposed to require that fires set for training purposes be permitted in an effort to better track and report emissions data from such fires through the notice requirement included in fire permits (R18-2-602(D)(3)(f)). However, ADEQ agrees that requiring fire officers to apply to ADEQ or a delegated authority could be impracticable; the data can be adequately tracked with a similar notice requirement while still exempting such fires from the actual permit requirement. ADEQ will add language to R18-2-602(C)(2), the subsection which enumerates those fires exempted from the permit requirement, to read A. . . if such fire is set or permission given for the purpose of fire control of an active wildfire, <u>or instruction in the methods of fighting fires</u>,@ with the inclusion of a notice requirement similar to the one in subsection (D)(3)(f). It should be noted that this notice requirement can be satisfied by an annual report to the Director or delegated authority; it is not required that each individual training fire be reported.

Comment #2: One commenter suggested that subsection (G), which deals with permits issued by a delegated authority, be changed. Specifically, there is a provision in that subsection which prohibits delegated authorities from issuing permits to themselves. Commenter suggested adding a sentence (APermits issued by a delegated authority for the purpose of instruction in the methods of fire fighting are excepted from the provisions of this rule.@) excepting training fires from this prohibition.

Response #2: Exempting training fires from the permit requirement, generally, makes it unnecessary to add an exception to subsection (G).

Comment #3: One commenter objected to subsection (G), claiming it was unenforceable and would create administrative and practical difficulties. Commenter asked, Aif an agency is not responsible enough to control its own fires and training then why should they be allowed to issue permits to the public?@

Response #3: ADEQ does not intend to prevent a delegated authority from issuing any permits, just permits from themselves to themselves. ADEQ thinks it is appropriate to oversee permits to delegated authorities, both to avoid potential conflicts of interest as well as better track emissions data. It should be noted that a number of commenters think that these permits are issued on a fire-by-fire basis. In fact, open burning permits have a term of up to one year, and can cover multiple burn projects.

Comment #4: One commenter asked if any of the model fire codes, or the National Fire Protection Agency Standards were consulted when drafting these rules.

Response #4: No. ADEQ has reviewed the National Fire Protection Agency Standards and the NFPA 1 Uniform Fire Code, 2003 Edition, to determine their relevance to air quality and whether their consideration might improve the proposed rules. ADEQ found that these documents deal with fire safety, fire-fighting and fire preparedness issues. These areas fall outside the scope of this rule. ADEQ=s fire rules deal with the control of emissions and the tracking of emissions related data, rather than the actual control of fires themselves.

Comment #5: One commenter requested clarification on the difference between subsection (C)(3), fires set for the Apurpose of disease and pest prevention in organized, area-wide control of epidemics or infestations . . .@ which are exempt from permit requirements, and subsection (D)(1)(e) fires set for the Apurpose of weed abatement, the prevention of a fire hazard . . .@ which are subject to permit requirements.

Response #5: Fires described in (C)(3) would be fires authorized by the Director of the Department of Agriculture in an emergency in order to prevent the spread of disease or pest infestation. In such a situation, time constraints may make the normal permitting procedure ineffective. Representatives from the Department of Agriculture were included in the Fire Emissions Work Group. They indicated that they needed this authority so that they might effectively deal with such an emergency. It should be noted that there has been no need, up to the present time, for this authority to be exercised. Fires under (D)(1)(e), however, are not likely to be emergency in nature, and such burners should go through the normal permitting procedure.

Comment #6: Commenter proposed changing (D)(3)(c) so that it reads A[a] requirement that burns be conducted during the following periods, unless otherwise waived or directed by the Director <u>or delegated authority</u> on a specific day basis@. The provision limits fires from one hour after sunrise to 2 hours before sunset.

Response #6: ADEQ thinks it is appropriate that the Director retain authority in this matter. Atmospheric conditions change just before sunset, usually minimizing smoke dispersion. For this reason, most burns should be conducted during the day. There are circumstances where nighttime, or extended daytime, burns might be appropriate, but ADEQ thinks that authority to make that decision should, in general, remain centralized with the Director.

Comment #7: Commenter noted that R18-2-602(D)(3)(f) is in reference to a reporting requirement, and asks if the report form will be available to the delegated authority or will each applicant be responsible for providing this information.

Response #7: The most likely scenario is that the burner will be required by his or her permit to notify the permitting authority of their burn, either on a daily or annual basis. The delegated authority would then take down the pertinent information on the form provided by ADEQ for this purpose, and report that information to ADEQ, under subsection (G)(3), in an annual report to the Director.

Comment #8: Commenter suggested that, in (D)(3)(g) Aa notation should be made that the applicant contact the local fire jurisdiction to determine what local open burning requirements have been established, to obtain a local permit if required, and to follow all local adopted fire code requirements.@

Response #8: ADEQ thinks that this issue is adequately addressed by R18-2-602(I) which states that A[n]othing in this Section is intended to permit any practice which is a violation of any statute, ordinance, rule, or regulation.@

Comment #9: Commenter pointed out that ADEQ=s preamble to the proposed rule was inaccurate. The preamble suggested that a permit exemption for air curtain destructors was considered, under the federal regional haze rule, in order to remove an administrative barrier to certain types of burning. In fact, the regional haze rule requires removal of administrative barriers for *alternatives* to burning.

Response #9: ADEQ has retained and clarified the referenced paragraph in the preamble. The preamble now distinguishes between alternatives to burning and burning with a method that has lower emissions, but notes that removing an administrative barrier to either could be beneficial.

Comment #10: Commenter noted that subsection (D)(1)(a) allows construction burning, with a permit. (A)(4) defines Aconstruction burning@ as including materials from Ademolition or modification of any buildings@ but precludes burning of Aprohibited materials.@ (A)(13) defines Aprohibited materials@ to include a number of common building materials, but that the list is not exhaustive and does not include other potentially harmful materials such as linoleum flooring, lead-painted wood, and composite counter-tops. He suggested adding such materials to (A)(13). Additionally, he suggested requiring a separate permit for the burning of building materials, as does Pinal County. Such a permit requires an on-site inspection before the permit is issued.

Response #10: ADEQ thinks that onsite inspections are an inefficient use of limited resources. However, the list of prohibited materials in R18-2-602(A)(13) can be expanded to include those items that commenter suggested.

Comment #11: Commenter noted that under subsection (D)(3)(g) permittees should know to make daily notifications of burning activity to the Alocal fire-fighting agency,@ or to the State Forester. He thought it unclear whether Alocal fire-fighting agency@ includes private fee-for-service firefighting corporations or is limited to municipal fire departments and local fire districts. Private for-profit services operate outside of jurisdictional limits and it is unclear how Aoperational bounds@ of such services would be defined for the purposes of informing permittees whom to notify.

Response #11: ADEQ will clarify, in the rule, that private fee-for-service fire-fighting corporations are considered Alocal fire-fighting agencies,@ for the purpose of fulfilling notice requirements, when such private services are delegated authorities as defined in R18-2-602(A)(6). In the absence of such a delegated authority, permittees would be required to notify the state forester, as indicated by subsection (D)(3)(g).

Comment #12: Commenter noted that subsection (F) allows the permitting of household waste burning. Commenter thinks that such burning inevitably leads to nuisance and suggested that statutory authority to allow it does not equal legislative mandate, and therefore suggested that subsection (F) be deleted.

Response #12: ADEQ thinks it better to deal with the issue of household waste on an individual basis. Writing household waste entirely out of the rule would not allow for such individual assessment of each such burn. If the burning is likely to cause a nuisance, the application for that burn permit can be denied. Such nuisance is more likely to be an issue in urban counties than it would in rural. Therefore, ADEQ will retain subsection (F) in the rule of statewide application. Those counties with more urban development such as Maricopa, Pima and Pinal, which have independent authority to permit fires, may prohibit such burning if they so choose, as is the case with the Maricopa county rules.

Comment #13: Commenter asserted that 40 CFR 51.308 and 51.309, the Regional Haze rule, refers to prescribed burning, which does not include fire-fighting training. Commenter listed a number of reasons how sections 308 and 309 do not apply to fires set for training purposes and stated that those fires should continue to be exempt from permit requirements.

Response #13: Without addressing the issue of whether or not 40 CFR 51.308 and 309 do apply to fires set for the purpose of conducting fire-fighting training, ADEQ has decided to exempt such fires from the open burning permit requirement, while retaining the notice requirements that would allow ADEQ to track the relevant emissions data.

Comment #14: Commenter stated that the limitations, in subsection (D)(3)(c), set on the hours when permitted burns may be conducted unreasonably limit such fires to daylight hours. They claimed that in order to properly train their fire-fighters to combat fires arising from aircraft incidents, training must be conducted both day and night.

Response #14: Since ADEQ has decided to exempt fires set for training purposes from the permit requirement, subsection (D)(3)(c) no longer applies to such fires.

Comment #15: Commenter listed several practical problems that would make training difficult if they are required to apply for a permit from ADEQ for each training exercise.

Response #15: These issues should be adequately addressed by ADEQ=s decision to continue to exempt training fires from the permit requirement. While ADEQ will retain a notice requirement to allow for the tracking and monitoring of necessary emissions data, it should be noted that this requirement can be filled by the filing of an annual report; it is unnecessary to report on a fire-by-fire basis.

Comment #16: Commenter expressed concern that the requirements of Article 15 relating to Burn Plans, Authorizations, and Accomplishment Forms will be a burdensome addition to his paperwork when conducting his own range management burns on his privately owned land. Commenter was uncertain of what the actual burden was on a private landowner.

Response #16: Under R18-2-1502, the provisions of this Article do not apply to private landowners conducting burns unless they enter into a memorandum of agreement with ADEQ. Private landowners conducting burns would be governed by the provisions of R18-2-602, Unlawful Open Burning. However, when a private landowner conducts a range management burn in cooperation with a State or Federal Land Manager, that Land Manager, not the private landowner, would be covered by the provisions of Article 15, Forest and Range Management Burns.

Comment #17: Commenter was concerned with the language used in R18-2-1503(C)(6) A[b]y area *planned* for wildland fire use, . . . and annual acres *to be* burned . . .@ etc. (emphasis added). Commenter noted that wildland fires cannot, by virtue of their very nature, be planned, and asked if there is more appropriate language that might be used.

Response #17: ADEQ recognizes that wildland fires, or wildfires, cannot be accurately predicted. However, a wildland fire use, as defined in this rule, is a pre-planned event, and a wildland fire use may only take place in an area planned for it. The purpose of R18-2-1503(C)(6) is to get an estimate of the area, fuel types and acreage that may be burned in a wildland fire use incident. ADEQ has clarified some language but kept the phrase Aplanned area.@

Comment #18: Commenter wondered how one should properly coordinate prescribed burning activities on federal land with adjacent private landowners.

Response #18: ADEQ considers this to be an operational issue not addressed in the scope of these rules, but is better dealt with at a practical level between the appropriate Land Manager and the private landowner.

Comment #19: Commenter asked if there is a definition of Anuisance@ for R18-2-602(D)(3)(d)(iii).

Response #19: The definition of Anuisance@ appropriate to this section is to be found in A. R. S. ' 13-2917, Public Nuisance; Abatement; Classification.

Comment #20: Commenter asked whether the reporting requirement of R18-2-602(D)(3)(f) falls on the permit applicant or the delegated authority.

Response # 20: While the specific forms dealing with these requirements are still being designed, the permit applicant would, under R18-2-602(D)(3)(g) notify the local fire-fighting agency or state forester of the burn. That official would, at that time, collect the necessary data to meet the reporting requirement of (D)(3)(f) which would then be reported to the Director or delegated authority in their daily or annual report.

Comment #21: Commenter suggested that it be clarified that fires using air curtain destructors are required to be permitted.

Response #21: Fires using air curtain destructors will be added to R18-2-602(D), Open Outdoor Fires Requiring a Permit, under subsection (D)(1).

Comment #22: Commenter expressed some confusion over whether, under R18-2-602(C)(4) all fires set by the federal government or any of its departments, agencies or agents, etc., are exempt from the permit open outdoor fire permit requirement.

Response #22: Only those fires set by the federal government that would be regulated under Article 15, Forest and Range Management Burns, would be exempt from the requirements of R18-2-602, Unlawful Open Fires. ADEQ will change the language of subsection (C)(4) to better reflect the intention that such fires are to be governed by either the open burning rule, *or* the range management rules.

Comment #23: Commenter was concerned with the inclusion of Awindrows@ in R18-2-602(D)(3)(f)(iii) as an example of the fire types to be included in the permit reporting requirement. He suggested that such fires are dangerously unstable and would like mention of them to be removed from rule.

Response #23: ADEQ has removed Awindrow@ as an example and substituted Apit@ in subsection (D)(3)(f)(iii).

12. Any other matter prescribed by statute that are applicable to the specific agency or to any other specific rule or class of rules:

Not applicable

13. Incorporations by reference and their location in the rules:

Not applicable

14. Was this rule previously made as an emergency rule?

No

<u>15.</u> **<u>The full text of the rules follows:</u>**

TITLE 18. ENVIRONMENTAL QUALITY

CHAPTER 2. DEPARTMENT OF ENVIRONMENTAL QUALITY- AIR POLLUTION CONTROL

ARTICLE 6. EMISSIONS FROM EXISTING AND NEW NONPOINT SOURCES

ARTICLE 15. FOREST AND RANGE MANAGEMENT BURNS

ARTICLE 6. EMISSIONS FROM EXISTING AND NEW NONPOINT SOURCES

R18-2-602. Unlawful Open Burning

~~**A.**~~ ~~Notwithstanding the provisions of any other rule in this Chapter, it is unlawful for any person to ignite, cause to be ignited, permit to be ignited, or suffer, allow or maintain any open outdoor fire.~~

~~**B.**~~ ~~"Open outdoor fire," as used in this rule, means any combustion of combustible material of any type outdoors, in the open where the products of combustion are not directed through a flue. "Flue," as used in this rule, means any duct or passage for air, gases or the like, such as a stack or chimney.~~

~~**C.**~~ ~~The following fires are excepted from the provisions of this rule:~~

~~1.~~ ~~Fires used only for cooking of food or for providing warmth for human beings or for recreational purposes or the branding of animals or the use of orchard heaters for the purpose of frost protection in farming or nursery operations.~~

~~2.~~ ~~Any fire set or permitted by any public officer in the performance of official duty, if such fire is set or permission given for the purpose of weed abatement, the prevention of a fire hazard, or instruction in the methods of fighting fires.~~

~~3.~~ ~~Fires set by or permitted by the state entomologist or county agricultural agents of the county for the purpose of disease and pest prevention.~~

~~4.~~ ~~Fires set by or permitted by the federal government or any of its departments, agencies or agents, the state or any of its agencies, departments or political subdivisions, for the purpose of watershed rehabilitation or control through vegetative manipulation.~~

~~**D.**~~ ~~Permission for the setting of any fire given by a public officer in the performance of official duty under subsections (C)(2), (3), or (4) shall be given, in writing, and a copy of such written permission shall be transmitted immediately to the Director of the Department of Environmental Quality and the control officer, if any, of the county, district or region in which such fire is allowed. The setting of any such fire shall be constructed in a manner and at such time as approved by the Director, unless doing so would defeat the purpose of the exemption.~~

~~**E.**~~ ~~The following fires may be excepted from the provisions of this Section when permitted in writing by the Director of the Department of Environmental Quality or the control officer of the county, district or region in which such fire is allowed:~~

~~1.~~ ~~Fires set for the disposal of dangerous materials where there is no safe alternative method of disposal.~~

~~a.~~ ~~"Dangerous material" is any substance or combination of substances which is able or~~

~~likely to inflict bodily harm or property loss unless neutralized, consumed or otherwise disposed of in a controlled and safe manner.~~

~~b.~~ ~~Fires set for the disposal of dangerous materials shall be permitted only when there is no safe alternative method of disposal, and when the burning of such materials does not result in the emission of hazardous or toxic substances either directly or as a product of combustion in amounts which will endanger health or safety.~~

~~2.~~ ~~Open outdoor fires for the disposal of ordinary household trash in an approved waste burner in nonurban areas of less than 100 well spread out dwelling units per square mile where no refuse collection and disposal service is available.~~

~~a.~~ ~~An "approved waste burner" is an incinerator constructed of fire resistant material with a cover or screen which is closed when in use having openings in the sides or top no greater than 1 inch in diameter.~~

~~b.~~ ~~Open burning of the following materials is forbidden: Garbage resulting from the processing, storage, service or consumption of food; asphalt shingles; tar paper; plastic and rubber products (such as waste crankcase oil, transmission oil and oil filters); transformer oils; and hazardous material containers including those that contained inorganic pesticides, lead, cadmium, mercury, or arsenic compounds.~~

~~F.~~ ~~The Director of the Department of Environmental Quality or the air pollution control officer, if any, of the county, district, or region may delegate the authority for the issuance of allowable open burning permits to responsible local officers. Such permits shall contain conditions limiting the manner and the time of the setting of such fires as specified in the Arizona Guidelines for Open Burning and shall contain a provision that all burning be extinguished at the discretion of the Director or his authorized representative during periods of inadequate atmospheric smoke dispersion, periods of excessive visibility impairment which could adversely affect public safety, or periods when smoke is blown into populated areas so as to create a public nuisance. Any local officer delegated the authority for issuance of open burning permits shall maintain a copy of all currently effective permits issued including a means of contacting the person authorized by the permit to set an open fire in the event that an order for extinguishing of open burning is issued.~~

~~G.~~ ~~Nothing in this rule is intended to permit any practice which is a violation of any statute, ordinance, rule or regulation.~~

A. In addition to the definitions contained in A.R.S. ' 49-501, in this Section:

1. AAgricultural burning@ means burning vegetative materials related to producing and harvesting crops and raising animals for the purpose of marketing for profit, or providing a

livelihood, but does not include burning of household waste or prohibited materials. A person may conduct agricultural burns in fields, piles, ditch banks, fence rows, or canal laterals for purposes such as weed control, waste disposal, disease and pest prevention, or site preparation.

2. AApproved waste burner@ means an incinerator constructed of fire resistant material with a cover or screen that is closed when in use, and has openings in the sides or top no greater than one inch in diameter.

3. AClass I Area@ means any one of the Arizona mandatory federal class I areas defined in A.R.S. ' 49-401.01.

4. AConstruction burning@ means burning wood or vegetative material from land clearing, site preparation, or fabrication, erection, installation, demolition, or modification of any buildings or other land improvements, but does not include burning household waste or prohibited material.

5. ADangerous material@ means any substance or combination of substances that is capable of causing bodily harm or property loss unless neutralized, consumed, or otherwise disposed of in a controlled and safe manner.

6. ADelegated authority@ means any of the following:

   a. A county, city, town, air pollution control district, or fire district that has been delegated authority to issue open burning permits by the Director under A.R.S. ' 49-501(E); or

   b. A private fire protection service provider that has been assigned authority to issue open burning permits by one of the authorities in subsection (A)(6)(a).

7. ADirector@ means the Director of the Department of Environmental Quality, or designee.

8. AEmission reduction techniques@ means methods for controlling emissions from open outdoor fires to minimize the amount of emissions output per unit of area burned.

9. AFlue,@ as used in this Section, means any duct or passage for air or combustion gases, such as a stack or chimney.

10. AHousehold waste@means any solid waste including garbage, rubbish, and sanitary waste from a septic tank that is generated from households including single and multiple family residences, hotels and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas, but does not include construction debris, landscaping rubble, or demolition debris.

11. AIndependent authority to permit fires@ means the authority of a county to permit fires by a rule adopted under Arizona Revised Statutes, Title 49, Chapter 3, Article 3, and includes only Maricopa, Pima, and Pinal counties.

12. AOpen outdoor fire or open burning@ means the combustion of material of any type, outdoors and in the open, where the products of combustion are not directed through a flue. Open outdoor fires include agricultural, residential, prescribed, and construction burning, and fires using air curtain destructors.

13. AProhibited materials@ means nonpaper garbage from the processing, storage, service, or consumption of food; chemically treated wood; lead-painted wood; linoleum flooring, and composite counter-tops; tires; explosives or ammunition; oleanders; asphalt shingles; tar paper; plastic and rubber products, including bottles for household chemicals; plastic grocery and retail bags; waste petroleum products, such as waste crankcase oil, transmission oil, and oil filters; transformer oils; asbestos; batteries; anti-freeze; aerosol spray cans; electrical wire insulation; thermal insulation; polyester products; hazardous waste products such as paints, pesticides, cleaners and solvents, stains and varnishes, and other flammable liquids; plastic pesticide bags and containers; and hazardous material containers including those that contained lead, cadmium, mercury, or arsenic compounds.

14. AResidential burning@ means open burning of vegetative materials conducted by or for the occupants of residential dwellings, but does not include burning household waste or prohibited material.

15. APrescribed burning@ has the same meaning as in R18-2-1501.

B. Unlawful open burning. Notwithstanding any other rule in this Chapter, a person shall not ignite, cause to be ignited, permit to be ignited, allow, or maintain any open outdoor fire in a county without independent authority to permit fires except as provided in A.R.S. ' 49-501 and this Section.

C. Open outdoor fires exempt from a permit. The following fires do not require an open burning permit from the Director or a delegated authority:

1. Fires used only for:
   a. Cooking of food,
   b. Providing warmth for human beings,
   c. Recreational purposes,
   d. Branding of animals,
   e. Orchard heaters for the purpose of frost protection in farming or nursery operations,

and

f. The proper disposal of flags under 4 U.S.C. ' 8.

2. Any fire set or permitted by any public officer in the performance of official duty, if the fire is set or permission given for the following purpose:

   a. Control of an active wildfire; or

   b. Instruction in the method of fighting fires, except that the person setting these fires must comply with the reporting requirements of subsection (D)(3)(f).

3. Fire set by or permitted by the Director of Department of Agriculture for the purpose of disease and pest prevention in an organized, area-wide control of an epidemic or infestation affecting livestock or crops.

4. Prescribed burns set by or assisted by the federal government or any of its departments, agencies, or agents, or the state or any of its agencies, departments, or political subdivisions, regulated under Article 15 of this Chapter.

D. Open outdoor fires requiring a permit.

1. The following open outdoor fires are allowed with an open burning permit from the Director or a delegated authority:

   a. Construction burning;

   b. Agricultural burning;

   c. Residential burning;

   d. Prescribed burns conducted on private lands without the assistance of a federal or state land manager as defined under R18-2-1501;

   e. Any fire set or permitted by a public officer in the performance of official duty, if the fire is set or permission given for the purpose of weed abatement, or the prevention of a fire hazard, unless the fire is exempt from the permit requirement under subsection (C)(3);

   f. Open outdoor fires of dangerous material under subsection (E);

   g. Open outdoor fires of household waste under subsection (F); and

   h. Open outdoor fires that use an air curtain destructor, as defined in R18-2-101.

2. A person conducting an open outdoor fire in a county without independent authority to permit fires shall obtain a permit from the Director or a delegated authority unless exempted under subsection (C). Permits may be issued for a period not to exceed one year. A person shall obtain a permit by completing an ADEQ-approved application form.

3. Open outdoor fire permits issued under this Section shall include:

a. A list of the materials that the permittee may burn under the permit;

b. A means of contacting the permittee authorized by the permit to set an open fire in the event that an order to extinguish the open outdoor fire is issued by the Director or the delegated authority;

c. A requirement that burns be conducted during the following periods, unless otherwise waived or directed by the Director on a specific day basis:

   i. Year round: ignite fire no earlier than one hour after sunrise; and

   ii. Year round: extinguish fire no later than two hours before sunset.

d. A requirement that the permittee conduct all open burning only during atmospheric conditions that:

   i. Prevent dispersion of smoke into populated areas;

   ii. Prevent visibility impairment on traveled roads or at airports that result in a safety hazard;

   iii. Do not create a public nuisance or adversely affect public safety;

   iv. Do not cause an adverse impact to visibility in a Class I area; and

   v. Do not cause uncontrollable spreading of the fire;

e. A list of the types of emission reduction techniques that the permittee shall use to minimize fire emissions.

f. A reporting requirement that the permittee shall meet by providing the following information in a format provided by the Director for each date open burning occurred, on either a daily basis on the day of the fire, or an annual basis in a report to the Director or delegated authority due on March 31 for the previous calendar year:

   i. The date of each burn;

   ii. The type and quantity of fuel burned for each date open burning occurred;

   iii. The fire type, such as pile or pit, for each date open burning occurred; and

   iv. For each date open burning occurred, the legal location, to the nearest section, or latitude and longitude, to the nearest degree minute, or street address for residential burns.

g. A requirement that the person conducting the open burn notify the local fire-fighting agency or private fire protection service provider, if the service provider is a delegated authority, before burning. If neither is in existence, the person conducting the burn shall notify the state forester.

h. A requirement that the permittee start each open outdoor fire using items that do not cause the production of black smoke;

i. A requirement that the permittee attend the fire at all times until it is completely extinguished;

j. A requirement that the permittee provide fire extinguishing equipment on-site for the duration of the burn;

k. A requirement that the permittee ensure that a burning pit, burning pile, or approved waste burner be at least 50 feet from any structure;

l. A requirement that the permittee have a copy of the burn permit on-site during open burning;

m. A requirement that the permittee not conduct open burning when an air stagnation advisory, as issued by the National Weather Service, is in effect in the area of the burn or during periods when smoke can be expected to accumulate to the extent that it will significantly impair visibility in Class I areas;

n. A requirement that the permittee not conduct open burning when any stage air pollution episode is declared under R18-2-220.

o. A statement that the Director, or any other public officer, may order that the burn be extinguished or prohibit burning during periods of inadequate smoke dispersion, excessive visibility impairment, or extreme fire danger; and

p. A list of the activities prohibited and the criminal penalties provided under A.R.S. ' 13-1706.

4. The Director or a delegated authority shall not issue an open burning permit under this Section:

a. That would allow burning prohibited materials other than under a permit for the burning of dangerous materials;

b. If the applicant has applied for a permit under this Section to burn a dangerous material which is also hazardous waste under 40 CFR 261, but does not have a permit to burn hazardous waste under 40 CFR 264, or is not an interim status facility allowed to burn hazardous waste under 40 CFR 265; or

c. If the burning would occur at a solid waste facility in violation of 40 CFR 258.24 and the Director has not issued a variance under A.R.S. ' 49-763.01.

E. Open outdoor fires of dangerous material. A fire set for the disposal of a dangerous material is allowed by the provisions of this Section, when the material is too dangerous to store and transport, and the Director has issued a permit for the fire. A permit issued under this subsection shall contain all provisions in subsection (D)(3) except for subsections (D)(3)(e) and (D)(3)(f). The Director shall permit fires for the disposal of dangerous materials only when no safe alternative method of disposal exists, and burning the materials does not result in the emission of hazardous or toxic substances either directly or as a product of combustion in amounts that will endanger health or safety.

F. Open outdoor fires of household waste. An open outdoor fire for the disposal of household waste is allowed by provisions of this Section when permitted in writing by the Director or a delegated authority. A permit issued under this subsection shall contain all provisions in subsection (D)(3) except for subsections (D)(3)(e) and (D)(3)(f). The permittee shall conduct open outdoor fires of household waste in an approved waste burner and shall either:

1. Burn household waste generated on-site on farms or ranches of 40 acres or more where no household waste collection or disposal service is available; or
2. Burn household waste generated on-site where no household waste collection and disposal service is available and where the nearest other dwelling unit is at least 500 feet away.

G. Permits issued by a delegated authority. The Director may delegate authority for the issuance of open burning permits to a county, city, town, air pollution control district, or fire district. A delegated authority may not issue a permit for its own open burning activity. The Director shall not delegate authority to issue permits to burn dangerous material under subsection (E). A county, city, town, air pollution control district, or fire district with delegated authority from the Director may assign that authority to one or more private fire protection service providers that perform fire protection services within the county, city, town, air pollution control district, or fire district. A private fire protection provider shall not directly or indirectly condition the issuance of open burning permits on the applicant being a customer. Permits issued under this subsection shall comply with the requirements in subsection (D)(3) and be in a format prescribed by the Director. Each delegated authority shall:

1. Maintain a copy of each permit issued for the previous five years available for inspection by the Director;
2. For each permit currently issued, have a means of contacting the person authorized by the permit to set an open fire if an order to extinguish open burning is issued; and
3. Annually submit to the Director by May 15 a record of daily burn activity, excluding household waste burn permits, on a form provided by the Director for the previous calendar year containing the information required in subsections (D)(3)(e) and (D)(3)(f).

H. The Director shall hold an annual public meeting for interested parties to review operations of the open outdoor fire program and discuss emission reduction techniques.

I. Nothing in this Section is intended to permit any practice that is a violation of any statute, ordinance, rule, or regulation.

ARTICLE 15. FOREST AND RANGE MANAGEMENT BURNS

R18-2-1501. Definitions

In addition to the definitions contained in A.R.S. ' 49-501 and R18-2-101, in this Article:

1. AActivity fuels@ means those fuels created by human activities such as thinning or logging.

~~1.~~2. "ADEQ" means the Department of Environmental Quality.

3. AAnnual emissions goal@ means the annual establishment in cooperation with the F/SLM=s, under R18-2-1503(G), of a planned quantifiable value of emissions reduction from prescribed fires and fuels management activities.

~~2. "BMP" means best management practices as described in R18-2-1509.~~

4. ABurn plan@ means the ADEQ form that includes information on the conditions under which a burn will occur with details of the burn and smoke management prescriptions.

~~3.~~5. "Burn prescription" means, with regard to a burn project, the pre-determined area, ~~intensity of heat, and rate of spread~~ fuel, and weather conditions required to attain planned resource management objectives.

~~4.~~6. "Burn project" means an active or planned prescribed burn, including a ~~prescribed natural fire~~ wildland fire use incident.

~~5. "Class I Area" means a mandatory area designated pursuant to Section 169A of the Clean Air Act Amendments of 1990.~~

~~6.~~7. "Duff" means forest floor material consisting of decomposing needles and other natural materials.

8. AEmission reduction techniques (ERT)@ means methods for controlling emissions from prescribed fires to minimize the amount of emission output per unit of area burned.

~~7.~~9. AFederal land manager (FLM)@ means any department, agency, or agent of the federal government, including the following:

   a. United States Forest Service,
   b. United States Fish and Wildlife Service,
   c. National Park Service,
   d. Bureau of Land Management,
   e. Bureau of Reclamation,

f. Department of Defense,

g. Bureau of Indian Affairs, and

h. ~~United States Soil Conservation Service.~~ Natural Resources Conservation Service.

~~8.~~10. "F/SLM" means a federal land manager or a state land manager.

~~9.~~11. "Local fire management officer" means a person designated by a F/SLM as responsible for fire management in a local district or area.

~~10.~~12. "Mop-up" means the act of extinguishing or removing burning material from a prescribed fire to reduce smoke impacts.

~~11.~~13. "National Wildfire Coordinating Group" means the national inter-agency group of federal and state land managers that shares similar wildfire suppression programs and has established standardized inter-agency training courses and qualifications for fire management positions.

14. ANon-burning alternatives to fire@ means techniques that replace fire for at least five years as a means to treat activity fuels created to achieve a particular land management objective (e.g., reduction of fuel-loading, manipulation of fuels, enhancement of wildlife habitat, and ecosystem restoration). These alternatives are not used in conjunction with fire. Techniques used in conjunction with fire are referred to as emission reduction techniques (ERTs).

~~12.~~15. "Planned resource management objectives" means public interest goals in support of land management agency objectives including silviculture, wildlife habitat management, grazing enhancement, fire hazard reduction, wilderness management, cultural scene maintenance, weed abatement, watershed rehabilitation, vegetative manipulation, and disease and pest prevention.

~~13.~~16. "Prescribed burning" means the controlled application of fire to wildland fuels that are in either a natural or modified state, under certain burn ~~prescription conditions~~ and smoke management prescription conditions that have been specified by the land manager in charge of or assisting the burn, to attain planned resource management objectives. Prescribed burning ~~includes~~ does not include a fire set or permitted by a public officer to provide instruction in fire fighting methods, or construction or residential burning under R18-2-602. ~~A prescribed fire may be ignited either by a trained fire specialist or by natural causes such as lightning.~~

~~14.~~17. "Prescribed fire manager" means a person designated by a F/SLM as responsible for prescribed burning for that land manager.

~~15. "Prescribed natural fire" means a wildland fire that is ignited by natural causes such as lightning rather than by a trained fire specialist, that is subsequently allowed to continue burning using the same controls and for the same planned resource management objectives as prescribed burning.~~

~~16.~~18. "Smoke management prescription" means the predetermined meteorological conditions that affect smoke transport and dispersion under which a burn could occur without adversely affecting public health and welfare.

19. ASmoke management techniques@ (SMT) means management and dispersion practices used during a prescribed burn or wildland fire use incident which affect the direction, duration, height, or density of smoke.

~~17.~~20. "Smoke management unit" means any of ~~11~~ the geographic areas defined by ADEQ whose area is based on primary watershed boundaries and whose ~~outlines are~~ outline is determined by diurnal windflow patterns that allow smoke to follow predictable drainage patterns. A map of the state divided into ~~11~~ the smoke management units is on file with ADEQ.

~~18.~~21. "State land manager (SLM)" means any department, agency, or political subdivision of the state government ~~that is responsible for wildland management~~ including the following:

a. State Land Department,

b. Department of Transportation,

c. Department of Game and Fish, and

d. Parks Department.

~~19.~~22. "Wildfire" means ~~a~~ an unplanned wildland fire subject to appropriate control measures ~~that does not meet resource management objectives and that may threaten life, property, public health, or the ecosystem~~. Wildfires include those incidents where suppression may be limited for safety, economic, or resource concerns.

~~20. "Wildland" means an area in which development is essentially non-existent, except for pipelines, power lines, roads, railroads, or other transportation or conveyance facilities.~~

23. AWildland fire use@ means a wildland fire that is ignited by natural causes, such as lightning, and is managed using the same controls and for the same planned resource management objectives as prescribed burning.

R18-2-1502. Applicability

A. A F/SLM that is conducting or assisting a prescribed burn shall follow the requirements of this Article.

B. A private or municipal burner with whom ADEQ has entered into a memorandum of agreement shall follow the requirements of this Article.

~~B.~~C. The provisions of this Article apply to all areas of the state except Indian Trust lands. All federally-managed lands and all state lands, parks, and forests are under the jurisdiction of ADEQ in matters relating to air pollution from prescribed burning.

~~C.~~D. Notwithstanding subsection ~~(B)~~ (C), ADEQ and any Indian tribe may enter into a memorandum of agreement to implement this Article.

E. ADEQ and any private or municipal prescribed burner may enter into a memorandum of agreement to implement this Article.

R18-2-1503. Annual Registration, Program Evaluation and Planning ~~for Prescribed Burns~~

A. Each F/SLM shall register annually with ADEQ~~,~~ on a form prescribed by ADEQ, all planned burn projects, including areas ~~considered for potential~~ ~~prescribed natural fires~~ planned for wildland fire use~~, for the following year~~.

~~C.~~B. Each planned year extends from ~~August~~ January 1 of the registration year to ~~July~~ December 31 of the same ~~following~~ year. Each F/SLM shall use best efforts to register before ~~August~~ December 31 and no later than January 31 of each year.

~~B.~~C. A F/SLM shall ~~provide~~ include the following information on the registration form:

1. The F/SLM's name, address, and business telephone number;
2. The name, address, and business telephone number of an air quality representative who will provide technical support to ADEQ for decisions regarding prescribed burning. The same air quality representative may be selected by more than one F/SLM ~~or Indian tribe~~;
3. All prescribed burn projects and potential ~~prescribed natural fire~~ wildland fire use areas planned for the next year; ~~and~~
4. Maximum project and annual acres to be burned, maximum daily acres to be burned, fuel types within project area, and planned use of emission reduction techniques to support the annual emissions goal for each prescribed burn project;
5. Planned use of any smoke management techniques for each prescribed burn project;
6. Maximum project and annual acres projected to be burned, maximum daily acres projected to be burned, and a map of the anticipated project area, fuel types and loading within the planned area for an area the F/SLM anticipates for wildland fire use;

~~4.~~7. A list of all burn projects that were completed during the previous year;

8. Project area for treatment, treatment type, fuel types to be treated, and activity fuel loading to support the annual emissions goal for areas to be treated using non-burning alternatives to fire; and
9. The area treated using non-burning alternatives to fire during the previous year including the number of acres, the specific types of alternatives utilized, and the location of these areas.

D. After consultation with the F/SLM, ADEQ may request additional information ~~related to tracking burn projects~~ for registration of prescribed burns and wildland fire use to support regional coordination of smoke management, annual emission goal setting using ERTs, and non-burning alternatives to fire.

E. A F/SLM may amend a registration at any time with a written submission to ADEQ. ~~ADEQ shall approve a new prescribed burn even if the F/SLM has failed to amend a registration if the F/SLM has complied with the other provisions of this Article.~~

F. ADEQ ~~shall accept~~ accepts a facsimile or other electronic method as a means of complying with the deadline for registration. If an electronic means is used ~~a facsimile is submitted~~, the F/SLM shall deliver the original paper registration form to ADEQ for its records. ADEQ shall acknowledge in writing the receipt of each registration. ~~If ADEQ and the F/SLMs jointly develop an electronic filing and reporting system, the original paper form may be waived, and ADEQ shall notify all F/SLMs of this change.~~

~~**G.** No later than 14 days before a F/SLM requests permission to proceed with a registered burn project other than a prescribed natural fire, the F/SLM shall submit a Burn Plan to ADEQ, as described in R18-2-1504. A Burn Plan for a prescribed natural fire shall be submitted as prescribed by R18-2-1508.~~

G. ADEQ shall hold a meeting after January 31 and before April 1 of each year between ADEQ and F/SLM=s to evaluate the program and cooperatively establish the annual emission goal. The annual emission goal shall be developed to minimize prescribed fire emissions to the maximum extent feasible using emission reduction techniques and alternatives to burning subject to economic, technical, and safety feasibility criteria, and consistent with land management objectives.

H. At least once every five years, ADEQ shall request long-term projections of future prescribed fire and wildland fire use activity from the F/SLMs to support planning for visibility impairment and assessment of other air quality concerns by ADEQ.

R18-2-1504. Prescribed Burn Plan ~~Contents~~

~~**A.**~~ Each F/SLM planning a prescribed burn ~~other than a prescribed natural fire,~~ shall complete and submit to ADEQ the "Burn Plan" form supplied by ADEQ no later than 14 days before the date on which the F/SLM requests permission to burn. ADEQ shall consider the information supplied on the Burn Plan Form as binding conditions under which the burn shall be conducted. A Burn Plan shall be maintained by ADEQ until notification from the F/SLM of the completion of the burn project.

Revisions to the Burn Plan for a burn project shall be submitted in writing no later than 14 days before the date on which the F/SLM requests permission to burn. ~~The F/SLM shall provide the following information on the "Burn Plan" form~~ To facilitate the Daily Burn authorization process under R18-2-1505, the F/SLM shall include on the Burn Plan form:

1. An emergency telephone number that is answered 24 hours a day, seven days a week;
2. Burn prescription;
3. Smoke management prescription;
4. The number of acres to be burned, the quantity and type of fuel, type of burn, and the ignition technique to be used;
5. The land management objective or purpose for the burn such as restoration or maintenance of ecological function and indicators of fire resiliency;

~~5.~~6. A map depicting the potential impact of the smoke unless waived either orally or in writing by ADEQ. The potential impact shall be determined by mapping both the daytime and nighttime smoke path and down-drainage flow for 15 miles from the burn site, with smoke-sensitive areas delineated. The map shall use the appropriate scale to show the impacts of the smoke adequately;

~~6.~~7. Modeling of smoke impacts unless waived either orally or in writing by ADEQ, for burns greater than 250 acres per day, or greater than 50 acres per day if the burn is within 15 miles of a Class I Area, an area that is non-attainment for particulates, a carbon monoxide non-attainment area, or other smoke-sensitive area. ~~Air quality modeling for these areas is mandatory unless waived either verbally or in writing by ADEQ.~~ In consultation with the F/SLM, ADEQ shall provide guidelines on modeling;

~~7.~~8. The name of the official submitting the Burn Plan on behalf of the F/SLM; and

~~8.~~9. After consultation with the F/SLM, any other information to support the Burn Plan needed by ADEQ to assist in the Daily Burn authorization process for smoke management purposes or assessment of contribution to visibility impairment of Class I areas.

~~**B.** A Burn Plan shall be submitted for a prescribed natural fire as prescribed by R18-2-1508.~~

R18-2-1505. Prescribed Burn Requests and Authorization

A. Each F/SLM planning a prescribed burn, ~~other than a prescribed natural fire~~, shall complete and submit to ADEQ the "Daily Burn Request" form supplied by ADEQ. The ~~F/SLM shall include the following information on the~~ Daily Burn Request form shall include:

1. The contact information of the F/SLM conducting the burn;

2. Each day of the burn;

~~2.~~3. The area to be burned ~~per~~ on the day for which the Burn Request is submitted, with reference to the Burn Plan, including size, ~~and~~ legal location to the section, and latitude and longitude to the minute;

4. Projected smoke impacts; and

~~3.~~5. Any local conditions or circumstances known to the F/SLM that, if conveyed to ADEQ, could impact the Daily Burn authorization process.

B. After consultation with the F/SLM, ADEQ may request additional information related to the burn, meteorological, smoke dispersion, or air quality conditions to supplement the Daily Burn Request form and to aid in the Daily Burn authorization process. ~~This information may include same day on-site and area meteorological, smoke dispersion, or air quality measurements.~~

C. The F/SLM shall submit the Daily Burn Request form to ADEQ as expeditiously as practicable, but no later than 2 p.m. of the business day preceding the burn. An original form, a facsimile, or an electronic information transfer are acceptable submittals.

D. An F/SLM shall not ignite a prescribed burn without receiving the approval of ADEQ, as follows:

1.~~**D.**~~ ADEQ shall approve, approve with conditions, or disapprove a burn on the same business day as the Burn Request submittal.

2. If ADEQ fails to address a Burn Request by 10 p.m. of the business day on which the request is submitted, the Burn Request is approved by default after the burner makes a good faith effort to contact ADEQ to confirm that the Burn Request was received.

3. ADEQ may communicate its decision by verbal, written, or electronic means. ADEQ shall provide a written or electronic reply if requested by the F/SLM. ~~If ADEQ does not communicate its decision, or a confirmation that the Burn Request was received, by 10 p.m., the burn is deemed approved.~~

~~**E.** Except as provided in subsection (D), an F/SLM shall not ignite a prescribed burn without receiving the approval of ADEQ.~~

~~**F.**~~**E.** If weather conditions cease to conform to those in the smoke management prescription of either the Burn Plan or an Approval with Conditions, the F/SLM shall ~~cease ignitions and~~ take appropriate action to reduce further smoke impacts, ensure safe and appropriate fire control, and notify the public when necessary.~~, unless after~~ After consultation with ADEQ, the smoke management prescription or burn plan may be ~~is~~ modified.

F. The F/SLM shall ensure that there is appropriate signage and notification to protect public safety on transportation corridors including roadways and airports during a prescribed fire.

~~**G.**~~ ~~Burn authorization for prescribed natural fires shall be as prescribed by R18-2-1508.~~

~~**H.**~~ ~~The F/SLM in whose jurisdiction a wildfire occurs shall report all wildfires greater than 100 acres on a daily basis to ADEQ. The F/SLM shall include in the report the location, estimated control date, and estimated incident size of each wildfire. The F/SLM shall provide information on projected smoke and air quality impacts and on estimated control size upon request by ADEQ.~~

R18-2-1506. Smoke Dispersion Evaluation

ADEQ shall approve, approve with conditions, or disapprove a Daily Burn Request submitted ~~pursuant to~~ under R18-2-1505, by using the following factors for each smoke management unit:

1. Analysis of the emissions from burns in progress and residual emissions from previous burns on a day-to-day basis;
2. Analysis of emissions from active ~~prescribed natural fires~~ wildland fire use incidents, and active multiple-day burns, and consideration of potential long-term emissions estimates;
3. Analysis of the emissions from wildfires greater than 100 acres and consideration of their potential long-term growth;
4. Local burn conditions;
5. Burn prescription and smoke management prescription from the applicable Burn Plan;
6. Existing and predicted local air quality;
7. Local and synoptic meteorological conditions;
8. Type and location of areas to be burned;
9. Protection of the national visibility goal for Class I Areas ~~pursuant to~~ under ' 169A(a)(1) of the Act and 40 CFR 51.309; ~~and~~
10. Assessment of duration and intensity of smoke emissions to minimize cumulative impacts;

~~10.~~11. Minimization of smoke impacts in Class I Areas, ~~roads or highways, airports~~, areas that are non-attainment for particulate matter, carbon monoxide non-attainment areas, or other smoke-sensitive areas~~.~~; and

12. Protection of the National Ambient Air Quality Standards.

R18-2-1507. Prescribed Burn Accomplishment; ~~ADEQ Recordkeeping;~~ Wildfire Reporting

A. Each F/SLM conducting a prescribed burn shall complete and submit to ADEQ the "Burn Accomplishment" form supplied by ADEQ. For each burn approval, the F/SLM shall submit a Burn

Accomplishment form to ADEQ by 2 p.m. of the business day following the approved burn. The F/SLM shall include the following information on the Burn Accomplishment form:

1. Any known conditions or circumstances that could impact the Daily Burn decision process;
2. The ~~subsequent~~ date, location, fuel type, fuel loading, and acreage accomplishments;
3. The ~~BMP~~ ERTs and SMTs ~~for emission reduction~~ described in R18-2-1509 and R18-2-1510, respectively, and may include any further ERTs and SMTs that become available, that the F/SLM used to reduce emissions or manage the smoke from the burn.

~~**B.** For each burn approval, the F/SLM shall submit a Burn Accomplishment form to ADEQ by 2 p.m. of the business day following the approved burning.~~

~~C.~~B. The F/SLM shall submit the Burn Accomplishment form as an original form, a facsimile, or an electronic information transfer.

~~D.~~C. ADEQ shall maintain a record of Burn Requests, Burn Approvals/Conditional Approvals/Denials and Burn Accomplishments for ~~5~~ five years.

D. The F/SLM in whose jurisdiction a wildfire occurs shall make available to ADEQ no later than the day after the activity all required information for wildfire incidents that burned more than 100 acres per day in timber or slash fuels or 300 acres per day in brush or grass fuels. For each day of a wildfire incident that exceeds the daily activity threshold, the F/SLM shall provide the location, an estimate of predominant fuel type and quantity consumed, and an estimate of the area blackened that day.

R18-2-1508. ~~Prescribed Natural Fires;~~ Wildland Fire Use: Plan~~;~~, Authorization~~;~~, Monitoring; Inter-agency Consultation; Status Reporting

A. In order for ADEQ to participate in the wildland fire use decision-making process, the ~~A~~ F/SLM shall notify ADEQ as soon as practicable of any ~~potential~~ wildland fire use incident ~~prescribed natural fire when it is~~ projected to attain or attaining a size of 50 acres of timber fuel or 250 acres of brush or grass fuel.

B. For each wildland fire use incident ~~prescribed natural fire~~ that has been declared as such by the F/SLM, the F/SLM shall complete and submit to ADEQ a Wildland Fire Use Burn ~~prescribed natural fire~~ Plan in a format approved by ADEQ in cooperation with the F/SLM. The F/SLM shall submit the Wildland Fire Use Burn ~~prescribed natural fire~~ Plan to ADEQ as soon as practicable but no later than 72 hours after the wildland fire use incident ~~prescribed natural fire~~ is declared or under consideration for such designation ~~1st observed~~. The F/SLM shall include the following information in the

Wildland Fire Use Burn ~~prescribed natural fire~~ Plan:

1. An emergency telephone number that is answered 24 hours a day, seven days a week;
2. Anticipated burn prescription ~~and anticipated emissions~~;
3. Anticipated smoke management prescription;

~~3.~~4. The estimated daily ~~anticipated~~ ~~growth in the~~ number of acres, quantity, and type of fuel to be ~~potentially~~ burned;

~~4.~~5. The anticipated maximum allowable perimeter or size with map;

~~5.~~6. ~~The type or types of fuel involved;~~ Information on the condition of the area to be burned, such as whether it is in maintenance or restoration, its ecological function, and other indicators of fire resiliency;

~~6.~~7. The anticipated duration of the wildland fire use incident ~~prescribed natural fire~~;

~~7.~~8. The anticipated long-range weather trends for the site ~~onsite~~;

~~8.~~9. A map depicting the potential impact of the smoke. The potential impact shall be determined by mapping both the daytime and nighttime smoke path and down-drainage flow for 15 miles from the wildland fire use incident ~~burn site~~, with smoke-sensitive areas delineated. Mapping is mandatory unless waived either orally or in writing by ADEQ. The map shall use the appropriate scale to show the impacts of the smoke adequately; ~~The map shall use the standard agency scale for that F/SLM;~~ and

~~9.~~10. Modeling or monitoring of smoke impacts, if requested by ADEQ after consultation with the F/SLM.

C. ADEQ shall approve or disapprove a Wildland Fire Use Burn ~~prescribed natural fire~~ Plan within ~~3~~ three hours of receipt. ADEQ shall consult directly with the requesting F/SLM before disapproving a Wildland Fire Use Burn ~~prescribed natural fire~~ Plan. If ADEQ fails to address the Wildland Fire Use Burn Plan within the time allotted, the Plan is approved by default under the condition that the F/SLM makes a good faith effort to contact ADEQ to confirm that the Plan was received. ~~If ADEQ fails to respond to the submittal of the prescribed natural fire Plan, approval of the prescribed natural fire may be assumed by the F/SLM.~~ Approval by ADEQ of a Wildland Fire Use Burn ~~prescribed natural fire~~ Plan ~~shall be~~ is binding upon ADEQ for the duration of the wildland fire use incident ~~prescribed natural fire project~~, unless smoke from the incident ~~prescribed natural fire~~ creates a threat to public health or welfare. If a threat to public health or welfare is created, ADEQ shall consult with the F/SLM regarding the situation and ~~the development of~~ develop a joint action plan for reducing further smoke impacts.

D. The F/SLM shall submit a Daily Status Report for each wildland fire use incident ~~prescribed natural~~

~~fire~~ to ADEQ for each day of the burn that the fire burns more than 100 acres in timber or slash fuels or 300 acres in brush or grass fuels ~~perimeter increases~~. The F/SLM shall include a synopsis of smoke behavior, future daily anticipated growth, and location of the activity of the wildland fire use incident ~~prescribed natural fire~~ in the Daily Status Report.

E. The F/SLM shall consult with ADEQ prior to initiating human-made ignition on the wildland fire use incident when greater than 250 acres is anticipated to be burned by the ignition. Emergency human-made ignition on the incident for protection of public or fire-fighter safety does not require consultation with ADEQ regardless of the size of the area to be burned.

F. The F/SLM shall ensure that there is appropriate signage and notification to protect public safety on transportation corridors including roadways and airports during a wildland fire use incident.

R18-2-1509. Emission Reduction Techniques~~; BMP~~

A. Each F/SLM conducting a prescribed burn shall implement as many Emission Reduction Techniques ~~BMP for emission reduction~~ as are feasible subject to economic, technical, and safety feasibility criteria, and land management objectives. ~~for the specific burn and shall include the BMP in the Burn Accomplishment submitted pursuant to R18-2-1507.~~

B. ~~The following measures are considered~~ Emission Reduction Techniques include ~~BMP~~:

1. Reducing biomass to be burned by use of techniques such as yarding or consolidation of unmerchandisable material, multi-product timber sales, or public firewood access, when economically feasible. ~~When allowing public firewood access, provide information on the adverse impacts of using green or wet wood as fuel~~;

~~2. Burning in seasons characterized by meteorological conditions that allow for good smoke dispersion, especially March 15 through September 15;~~

2. Reducing biomass to be burned by fuel exclusion practices such as preventing the fire from consuming dead snags or dead and downed woody material through lining, application of fire-retardant foam, or water;

3. Using mass ignition techniques such as aerial ignition by helicopter to produce high intensity fires of high fuel density areas such as logging slash decks ~~with short duration impacts~~;

~~4. Igniting burns under good-to-excellent ventilation conditions and suspending operations under poor smoke dispersion conditions;~~

~~5. Considering smoke impacts on local community activities and land users;~~

~~6.~~4. Burning only fuels essential ~~fuels~~ to meet resource management objectives;

~~7.~~5. Minimizing ~~duff~~ consumption and smoldering by burning under conditions of high ~~through~~

fuel moisture of duff and litter ~~considerations~~;

6. Minimizing fuel consumption and smoldering by burning under conditions of high fuel moisture of large woody fuels;

~~8.~~7. Minimizing ~~dirt~~ soil content when slash piles are constructed by using brush blades on material-moving equipment and by constructing piles under dry soil conditions or by using hand piling methods;

8. Burning fuels in piles;

~~9. Burning piles when other burns are not feasible, such as when snow or rain is present;~~

9. Using a backing fire in grass fuels;

~~10. Using all opportunities that meet the burn prescription and all burn locations to spread smoke impacts over a broader time period and geographic area;~~

10. Burning fuels with an air curtain destructor, as defined in R18-2-101, operated according to manufacturer specifications and meeting applicable state or local opacity requirements;

~~11. Burning during optimum mid-day dispersion hours, with all ignitions in a burn unit completed by 3 p.m. to prevent trapping smoke in inversions or diurnal windflow patterns;~~

11. Extinguishing or mopping-up of smoldering fuels;

12. ~~Using chunking~~ Chunking of piles and other consolidations of burning material to enhance flaming and fuel consumption, and to minimize smoke production;

~~13. Implementing maintenance burning in a periodic rotation mimicking natural fire cycles to reduce excessive fuel accumulations and subsequent excessive smoke production through smoldering or wildfire;~~

13. Burning before litter fall;

~~14. Using prescribed natural fires and unplanned ignitions; and~~

14. Burning before green-up of fuels;

~~15. Managing smoke impacts as follows:~~

~~a. Limiting smoke impacts to roads, highways, and airports to the amounts, frequencies, and durations consistent with any guidance provided by highway and airport personnel;~~

~~b. Using appropriate signing if smoke will impact any roadways;~~

~~c. Notifying control towers if smoke will intrude in any air traffic control zone;~~

~~d. Determining nighttime impacts and taking appropriate precautions; and~~

~~e. Contacting appropriate authorities as needed regarding smoke or visibility impacts.~~

15. Burning before recently cut large fuels cure in areas with activity; and

16. Burning just before precipitation to reduce fuel smoldering and consumption.

R18-2-1510. Smoke Management Techniques

A. Each F/SLM conducting a prescribed burn shall implement as many Smoke Management Techniques as are feasible subject to economic, technical, and safety feasibility criteria, and land management objectives.

B. Smoke management techniques include:

1. Burning from March 15 through September 15, when meteorological conditions allow for good smoke dispersion;
2. Igniting burns under good-to-excellent ventilation conditions;
3. Suspending operations under poor smoke dispersion conditions;
4. Considering smoke impacts on local community activities and land users;
5. Burning piles when other burns are not feasible, such as when snow or rain is present;
6. Using mass ignition techniques such as aerial ignition by helicopter to produce high intensity fires with short duration impacts;
7. Using all opportunities that meet the burn prescription and all burn locations to spread smoke impacts over a broader time period and geographic area;
8. Burning during optimum mid-day dispersion hours, with all ignitions in a burn unit completed by 3 p.m. to prevent trapping smoke in inversions or diurnal windflow patterns;
9. Providing information on the adverse impacts of using green or wet wood as fuel when public firewood access is allowed;
10. Implementing maintenance burning in a periodic rotation to shorten prescribed fire duration and to reduce excessive fuel accumulations that could result in excessive smoke production in a wildfire; and
11. Using wildland fire-use strategies to shift smoke into more favorable smoke dispersion seasons.

~~R18-2-1510.~~ R18-2-1511. Monitoring

A. ADEQ may require a F/SLM to monitor ~~weather and~~ air quality before or during a prescribed burn or a ~~excluding~~ wildland fire use incident ~~prescribed natural fires, which are governed by R18-2-1508,~~ if necessary to ~~accurately predict~~ assess smoke impacts. Air quality monitoring may be conducted using both federal and non-federal reference method as well as other techniques.

B. ADEQ may require a F/SLM to monitor weather before or during a prescribed burn or a wildland fire use incident, if necessary to predict or assess smoke impacts. After consultation with the F/SLM, ADEQ may also require the F/SLM to establish burn site or area-representative remote automated weather stations or their equivalent, having telemetry that allows retrieval on a real-time basis by ADEQ. An F/SLM shall give ADEQ notice and an opportunity to comment before making any change to a long-term established remote automated weather station.

~~B.~~C. A F/SLM shall employ the following types of monitoring, unless waived by ADEQ, for burns greater than 250 acres per day, or greater than 50 acres per day if the burn is within 15 miles of a Class I Area, an area that is non-attainment for particulate matter, ~~a~~ carbon monoxide, or ozone ~~non-attainment area~~, or other smoke-sensitive area:

1. Smoke plume measurements, using a format supplied by ADEQ; and

~~1.~~2. The release of pilot balloons (PIBALs) at the burn site to verify needed wind speed, direction, ~~or~~ and stability.~~; and~~

~~2. Smoke plume measurements, using a format supplied by ADEQ.~~

Instead of pilot balloons, a test burn at the burn site may be used for specific prescribed burns on a case-by-case basis as approved by ADEQ, to verify needed wind speed, direction, and stability.

~~C.~~D. ~~A~~ An F/SLM shall make monitoring information required ~~pursuant to~~ under subsection ~~(B)~~(C) available to ADEQ on the business day following the burn ignition.

~~**D.** After consultation with the F/SLM, ADEQ may also require the F/SLM to establish burn site or area-representative remote automated weather stations or their equivalent, having telemetry that allows retrieval on a real-time basis by ADEQ, if necessary to accurately predict smoke impacts.~~

E. The F/SLM shall keep on file for ~~1~~ one year following the burn date any monitoring information required ~~pursuant to~~ under this Section.

~~R18-2-1511.~~ R18-2-1512. Burner Qualifications

A. All ~~burns~~ burn projects shall be conducted by personnel trained in prescribed fire and smoke management techniques ~~to the minimum level~~ as required by the F/SLM in charge of the burn and established by National Wildfire Coordinating Group training qualifications.

B. A Prescribed Fire ~~Manager~~ Boss or other local Fire Management Officer of the F/SLM having jurisdiction over prescribed burns shall have smoke management training obtained through one of the following:

1. Successful completion of a National Wildfire Coordinating Group or F/SLM-equivalent course ~~dedicated to~~ addressing smoke management; or

2. Attendance at an ADEQ-approved smoke management workshop.

~~R18-2-1512.~~ R18-2-1513. Public Notification and Awareness Program; Regional Coordination

A. ~~At the Director's discretion,~~ The Director shall conduct a public education and awareness program ~~may be conducted by ADEQ~~ in cooperation with F/SLMs and other interested parties to inform the general public of the smoke management program described by this Article. ~~If conducted, the~~ The program shall include smoke impacts from prescribed fires and the role of prescribed fire in natural ecosystems.

B. ADEQ shall make annual registration, prescribed burn approval, and wildfire and wildland fire use activity information readily available to the public and to facilitate regional coordination efforts and public notification.

~~R18-2-1514. Oversight~~

~~**A.** An F/SLM planning to make a change to any long-term established remote automated weather station shall give ADEQ notice and an opportunity to comment before making the change.~~

~~**B.** On or before August 15 of each year, each F/SLM shall submit to ADEQ a report generally describing each of the following:~~

~~1. The emissions reductions for each project from the previous year as a result of using BMP. Emissions reductions may be estimated using methods and emission factors developed jointly by ADEQ and F/SLMs;~~

~~2. The smoke management cost estimates for each active project from the previous year including estimates for monitoring, training, applying emission reduction techniques, research, and compliance with the requirements of this Article; and~~

~~3. Any research on or development of innovative techniques for emission reductions.~~

~~R18-2-1513.~~ R18-2-1514. Surveillance and Enforcement

A. An F/SLM conducting a prescribed burn shall permit ADEQ to enter and inspect burn sites unannounced to verify the accuracy of the Daily Burn Request, Burn Plan, or Accomplishment data ~~described pursuant to R18-2-1505~~ as well as matching burn approval with actual conditions, ~~and~~ smoke dispersion, and air quality impacts. On-ground site inspection procedures and aerial surveillance shall be coordinated by ADEQ and the F/SLM for safety purposes.

B. ADEQ may use remote automated weather station data if necessary to verify current and previous meteorological conditions at or near the burn site.

C. ADEQ may audit burn accomplishment data, smoke dispersion measurements, or weather measurements from previously conducted burns, if necessary to verify conformity with, or deviation from, procedures and authorizations approved by ADEQ.

D. Deviation from procedures and authorizations approved by ADEQ constitute a violation of this Article. Violations may require containment or mop-up of any active burns and may also require, in the Director's discretion, a ~~5~~ five-day moratorium on ignitions by the responsible F/SLM. Violations of this Article are also subject to a civil penalty of not more than $10,000 per day per violation ~~pursuant to~~ under A.R.S. ' 49-463.

R18-2-1515. Forms; Electronic Copies; Information Transfers

A. ADEQ shall make available on paper and in electronically-readable format any form required to be developed by ADEQ and completed by a F/SLM.

B. After consultation with ~~the~~ an F/SLM, ADEQ may require ~~each~~ the F/SLM to provide data in a manner that ~~allows for and~~ facilitates electronic transfers of information.

<u>Appendix A-10e. WRAP "Policy on Fire Tracking Systems"</u>

WRAP POLICY

FIRE TRACKING SYSTEMS

APPROVED BY CONSENSUS:
WESTERN REGIONAL AIR PARTNERSHIP – APRIL 2, 2003

APPROVED BY CONSENSUS:
FIRE EMISSIONS JOINT FORUM – DECEMBER 19, 2002

PREPARED BY:
FIRE TRACKING SYSTEMS TASK TEAM OF THE FIRE EMISSIONS JOINT FORUM

APRIL 2, 2003

Executive Summary

The Western Regional Air Partnership (WRAP) is charged with developing technical and policy tools to assist states (or the delegated regulatory authority) and tribes with implementing the Regional Haze Rule (Rule).

The *WRAP Policy on Fire Tracking Systems* (WRAP FTS Policy) has been developed over a six-month period through a stakeholder-based consensus process to assist the WRAP region states and tribes in addressing emissions from fire sources. In this Policy, the WRAP seeks to provide a consistent framework that states and tribes can use to efficiently develop their individual implementation plans, long-term strategies, and periodic progress reports. The WRAP recognizes states' and tribes' authority and responsibility to develop, adopt and implement their regional haze implementation plans, and recognizes the Rule as the principal document on which states and tribes should rely.

The Rule requires states to develop implementation plans (SIPs) for addressing regional haze in the Nation's 156 mandatory Class I areas. Additionally, the Rule requires effective management of fire sources. The Rule provides two pathways for western states to follow as they implement the requirements of the Rule: 1) develop their regional haze implementation plans per the nationally applicable provisions of Section 308, or 2) Transport Region States may choose to incorporate the Grand Canyon Visibility Transport Commission (GCVTC) Recommendations into their regional haze implementation plans under Section 309 of the Rule.

It is the position of the WRAP FTS Policy that it is necessary to track fire activity information in the WRAP region using a fire tracking system, which will also provide the information essential to create a fire emissions inventory. The WRAP FTS Policy identifies seven essential components of a fire tracking system that represent the minimum spatial and temporal fire activity information necessary to consistently calculate emissions and to meet the requirements of the Rule. The resulting emissions will be used in modeling exercises to assess fire impacts to regional haze.

An emissions inventory and tracking system for fire are specific requirements under Section 309 and a broader requisite under Section 308 of the Rule. The fire tracking system and WRAP emissions inventory system are regional approaches to the data gathering and tracking initiatives, which are specifically encouraged in the Rule. Therefore, the WRAP is advancing the WRAP FTS Policy for states and tribes under both Sections 308 and 309 to meet the requirements of the Rule.

Tribes are not subject to the same requirements of the Rule as states, but tribes wishing to assume the regional haze requirements outlined in the Rule may, according to the Tribal Authority Rule (TAR), seek approval under 40 CFR 49 to be "treated in the same manner as States." The intent of this Policy is to assist both states and tribes with the development of their regional haze implementation plans (SIPs/TIPs), and therefore, tribes are included in all references to states, except where specific requirements and/or deadlines of the Rule are cited.

Most fire emissions inventory and tracking efforts established to date in the WRAP region have been developed in conjunction with smoke management programs to address public health and nuisance concerns. Fortunately, fire emissions inventory and tracking efforts regardless of the purpose, have some common elements. It is anticipated that the fire tracking system and WRAP emissions inventory system outlined herein will integrate well with current and future fire emissions inventory and tracking efforts.

The WRAP FTS Policy document is comprised of four major sections. Section 1 is the five WRAP FTS Policy Statements. Section 2 provides overall background for the WRAP FTS Policy, including a discussion of the regulatory environment and details of the Rule that are germane to the WRAP FTS Policy. Section 3 is an annotation of each of the five policy statements, further explaining and defining them, and a description of the seven essential fire tracking system components. Finally, Section 4 Appendices include: A) a glossary of terms, B) a website references listing, and C) supporting information on fire tracking systems.

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1. Policy Statements

A. Fire activity information for all fire types is needed in the WRAP region. A fire tracking system that captures this information will form the basis of a fire emissions inventory compiled annually, which is needed to support Regional Haze Rule requirements.

B. A fire tracking system includes the following seven essential components that are necessary in order to consistently calculate emissions and to uniformly assess impacts to regional haze:

1. Date of Burn
2. Burn Location
3. Area of Burn
4. Fuel Type
5. Pre-Burn Fuel Loading
6. Type of Burn
7. "Anthropogenic" or "Natural" Classification

C. A fire tracking system should include additional components as needed to support the development and implementation of annual emission goals and other control measures.

D. A fire tracking system should include a component that addresses the projection of fire emissions, which is necessary to meet the requirements of the Regional Haze Rule.

E. The development of fire tracking systems by states and tribes will be done collaboratively with state, tribal, local and federal land management agencies, and private parties.

2. Background

2.1. Clean Air Act and Grand Canyon Visibility Transport Commission

In 1990, Congress amended the Clean Air Act (CAA), and as part of these amendments created the Grand Canyon Visibility Transport Commission (GCVTC).[1] The GCVTC was charged with assessing the current scientific information on visibility impacts and making recommendations for addressing regional haze in the western United States. The GCVTC signed and submitted more than 70 recommendations to the Environmental Protection Agency in a report dated June 1996 that indicated that visibility impairment was caused by a wide variety of sources and pollutants, including fire on a episodic basis, and that a comprehensive strategy was needed to remedy regional haze.

The second of the GCVTC Recommendations Regarding Fire describes the need for a consistent region-wide emissions tracking system for prescribed fire, wildfire, and agricultural burning.[2]

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[1] The Grand Canyon Visibility Transport Commission (GCVTC) was composed of the governors of eight western states (AZ, CA, CO, NM, NV, OR, UT, WY), four tribes (Acoma Pueblo, Hopi, Hualapai, and Navajo), four Federal land management agencies (Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service), the Columbia River Inter-Tribal Fish Commission, and the Environmental Protection Agency.

[2] Grand Canyon Visibility Transport Commission, Recommendations for Improving Western Vistas, Report to the

2.2. Western Regional Air Partnership

The Western Regional Air Partnership (WRAP) was established in 1997 as the successor organization to the GCVTC. The WRAP is a voluntary organization comprised of western governors, tribal leaders and federal agencies,[3] and is charged "to identify regional or common air management issues, develop and implement strategies to address these issues, and formulate and advance western regional policy positions on air quality."[4] These policies and technical tools are developed through inclusive, stakeholder-based processes and approved by consensus of the WRAP.

WRAP participants include state air quality agencies, tribes, federal/state/private land managers, the EPA, environmental groups, industry, academia and other interested parties. There are over 400 tribes within the WRAP region. The large number of tribes limits the participation of all of them in WRAP activities, and accordingly, in the development of this Policy. Therefore, the tribal representatives involved in the development of this Policy may not represent all tribal concerns.

2.3. Regional Haze Rule

Following the issuance of the GCVTC Report, the EPA issued the Regional Haze Rule[5] (Rule) in July 1999 to improve visibility in 156 national parks and wilderness areas across the country. The Rule outlines the requirements for states and tribes to address regional haze in these mandatory Class I areas. EPA incorporated all of the GCVTC Recommendations into Section 309 of the Rule, which may be used by some of the WRAP states/tribes. The remaining WRAP states must, and tribes may, utilize the nationally applicable Section 308 provisions of the Rule.

Under Sections 308 and 309 of the Rule, states must, while tribes may, address visibility impairment in mandatory Class I areas due to emissions from all sources, including fire activities, which is made possible by an inventory of emissions of pollutants that contribute to visibility impairment. Further, the Preamble to the Rule calls for the tracking of pollutant emissions to supplement the tracking of monitored visibility changes for use in periodically reviewing the progress toward the natural visibility goal.[6] In regard to the requirements for periodic progress reports, both Sections 308 and 309 of the Rule call for:

U.S. EPA, June 10, 1996 (hereafter referred to as "GCVTC Report"), p. 48.

[3] The WRAP membership is comprised of the governors of thirteen western states and thirteen western tribes. The current WRAP members include the States of AK, AZ, CA, CO, ID, MT, ND, NM, OR, SD, UT, WA, and WY and the Tribal Nations of Pueblo of Acoma, Campo Band of Kumeyaay Indians, Cortina Indian Rancheria, Hopi Tribe, Hualapai Nation of the Grand Canyon, Nez Perce Tribe, Northern Cheyenne Tribe, Salish and Kootenai Confederated Tribes, Pueblo of San Felipe, and Shoshone-Bannock Tribes of Fort Hall. Federal WRAP members are the Department of the Interior, the Department of Agriculture, and the Environmental Protection Agency.

[4] WRAP Charter, Purpose, p. 1.

[5] Published in the Federal Register on July 1, 1999, 64 FR 35714.

[6] 64 FR 35725-35726.

> An analysis tracking the change over the past 5 years in emissions of pollutants contributing to visibility impairment from all sources and activities within the State. Emissions changes should be identified by type of source or activity. The analysis must be based on the most recent updated emissions inventory, with estimates projected forward as necessary and appropriate, to account for emissions changes during the applicable 5-year period.[7]

Tribes are not subject to the same requirements of the Rule as states, but tribes wishing to assume the regional haze requirements outlined in the Rule may, according to the CAA, seek approval to be treated in the same manner as states, under the Tribal Authority Rule (TAR), 40 CFR 49.[8] In these cases, EPA still recognizes that "unlike States, tribes are not required by the TAR to adopt and implement CAA plans or programs, thus tribes are not subject to mandatory deadlines for submittal of implementation plans."[9] Although provision for flexibility in the submission of programs and implementation plans for tribes is made under TAR, EPA does "encourage tribes choosing to develop implementation plans to make every effort to submit by the deadlines to ensure that the plans [TIPs] are integrated with and coordinated with regional planning efforts."[10]

EPA recognizes the WRAP as the Regional Planning Organization that is developing the necessary policy and technical tools to implement the Rule in the WRAP region. A WRAP policy, once approved, represents the WRAP's consensus position on the best means for states and tribes to implement the portion of the Rule at issue. The WRAP recognizes states' and tribes' authority and responsibility to develop, adopt and implement their regional haze state and tribal implementation plans, and the seminal guidance to do this is the Rule.[11]

2.3.1. Section 309

Section 309 of the Rule specifically calls for:

> [a] statewide inventory and emissions tracking system (spatial and temporal) of VOC, NO_X, elemental and organic carbon, and fine particle emissions from fire. [12]

Under Section 309, states must, while tribes may, incorporate a fire tracking system and a mechanism to generate the required emissions inventory, based on fire activity information, into their SIPs/TIPs. Further, this is one step of several that will afford states/tribes the demonstration of reasonable further progress through 2018,[13] as required by the Rule. The fire tracking system will provide information critical to the implementation of other requirements under Section 309[14], including the development of an enhanced smoke management program, the establishment of annual emission goals, and the projection of fire emissions.

[7] 64 FR 35769, §51.308 (g) (4) and 64 FR 35772, §51.309 (d) (10) (i) (D).
[8] 64 FR 35759.
[9] 64 FR 35758.
[10] 64 FR 35759.
[11] WRAP Charter, p.1.
[12] 64 FR 35771, §51.309 (d) (6) (ii).
[13] 64 FR 35769, §51.309 (a).
[14] 64 FR 35771, §51.309 (d) (6).

2.3.2. Section 308

Although Section 308 of the Rule does not explicitly address the emissions inventory and tracking necessary for programs related to fire, Section 308 of the Rule does assert that the SIP/TIP must provide for:

> A statewide inventory of emissions of pollutants that are reasonably anticipated to cause or contribute to visibility impairment in any mandatory Class I area. The inventory must include emissions for a baseline year, emissions for the most recent year for which data are available, and estimates of future projected emissions. The State must also include a commitment to update the inventory periodically.[15]

In addition, Section 308 of the Rule states that in establishing its long-term strategy for regional haze,

> The State must document the technical basis, including modeling, monitoring and *emissions information*, on which the State is relying to determine its apportionment of emission reduction obligations necessary for achieving reasonable progress in each mandatory Class I Federal area it affects.[16]

And:

> The State must identify all anthropogenic sources of visibility impairment considered by the State in developing its long-term strategy [for regional haze]. The State should consider major and minor stationary sources, mobile sources, and area sources.[17]

These Rule citations support the need for a fire tracking system that will facilitate the development of a fire emissions inventory and the establishment of long-term strategies for states under Section 308.

3. Annotated Policy

3.1. Introduction

The WRAP FTS Policy is the result of the WRAP region-wide multi-state/multi-tribe planning and coordination effort. This effort is consistent with the direction provided by EPA in the Preamble to the Rule that encourages states to work together to establish common approaches for emissions inventory development and tracking.[18]

[15] 64 FR 35767, §51.308 (d) (4) (v).
[16] 64 FR 35767, §51.308 (d) (3) (iii), emphasis added.
[17] 64 FR 35767, §51.308 (d) (3) (iv). Fire is considered an area source.
[18] 64 FR 35720.

The intent of the WRAP FTS Policy is to assist states (or the delegated authority) and tribes to address emissions inventory and tracking associated with fire in a way that is adequate for implementation plan development, long-term strategies, and periodic progress reports. The WRAP FTS Policy identifies for states and tribes in the WRAP region the essential fire activity information necessary to consistently calculate emissions and to meet the requirements of the Rule. The resulting emissions will be used in modeling exercises to assess fire impacts to regional haze.

Most states/tribes in the WRAP region track fire and its subsequent emissions differently and few, if any, states/tribes address all fire sources. Consequently, fire sources in the WRAP region are tracked and inventoried at various and inconsistent levels, from daily burn activity and emissions information to annual emissions summaries, to no tracking. This variability is a proven obstacle to inter-jurisdictional analysis of fire impacts on visibility within the WRAP region.[19] In addition, transport of fire emissions beyond the WRAP region emphasizes the need for the development and consistent application of a fire tracking system and subsequent emissions inventory mechanism that is predictable and flexible while meeting the requirements of the Rule.

The WRAP FTS Policy has been developed to embody appropriate regulatory and policy requirements and to provide a predictable framework for fire tracking systems that can be reasonably implemented by states and tribes. The WRAP believes that states maintain the ultimate responsibility for the implementation of the fire tracking system. Tribes, or EPA on their behalf, may choose to utilize fire tracking systems as a reasonably severable element in their implementation plans.

The WRAP recognizes states/tribes authority and responsibility to develop, adopt and implement their regional haze state and tribal implementation plans. The WRAP further recognizes that the implementation plans will be revisited and revised, per the schedule specified in the Rule, giving opportunities to refine individual fire tracking systems and subsequent emission inventories to reflect technical advances and policy updates.

3.2. Fire Activity Information

> *Policy Statement A: Fire activity information for all fire types is needed in the WRAP region. A fire tracking system that captures this information will form the basis of a fire emissions inventory compiled annually, which is needed to support Regional Haze Rule requirements.*

3.2.1. Fire Tracking System

A tracking system for fire is a specific requirement under Section 309 and will be needed to support general requirements under Section 308 of the Rule. A consistent fire tracking system based on fire activity information is essential in order to consistently calculate emissions. The resulting emissions will be used in subsequent regional modeling and visibility monitoring data

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[19] This is the result of the findings of the WRAP's 1996 fire emission inventory development and modeling efforts, which were challenged by the dramatic variability in fire activity information found across the WRAP region, and consequently was one of the sources of uncertainty in the resulting emission inventory.

analyses. Therefore, the WRAP FTS Policy is for states and tribes in the WRAP region to track fire activity information in their respective jurisdiction using a fire tracking system, which will also provide the information essential to create a fire emissions inventory.

The ability of a state or tribe to implement a fire tracking system with known fire activity information for all fire sources may require legislative or governmental changes to existing rules, or removal of exemptions from regulation and/or tracking of specific fire sources. Therefore, the WRAP FTS Policy allows for the consideration of direct data collection as well as indirect estimation techniques, where they satisfy the minimum spatial and temporal information necessary to support emissions inventories and modeling for the WRAP region. In addition, the WRAP recognizes that progressive implementation may be necessary to attain a level of data collection that will ensure comparability between the tracking of fire activity information and monitored visibility changes. See Appendix C for general guidance on data collection, and the Fire Emissions Joint Forum (FEJF) of the WRAP will be exploring viable data collection methods at a later date.

3.2.2. Emissions Inventory

Information from the fire tracking system will provide the basis for an emissions inventory, which is a requirement of the Rule under Section 309 and will be necessary under Section 308.

> In reporting and tracking emissions from fire within the State, States may use information from regional data gathering and tracking initiatives.[20]

In keeping with the Rule's Preamble discussion of regional planning organizations and the role of regional planning in such matters as emission tracking and inventory development, the WRAP is developing a regional emissions inventory system.[21] States/tribes may utilize the WRAP emissions inventory system as their emissions inventory mechanism. Fire emissions will be calculated using the WRAP regional emissions inventory system based on fire activity data supplied by the respective jurisdiction. States/tribes may choose to calculate fire emissions internally within their jurisdiction. Both the fire tracking system and the WRAP emissions inventory system are regional approaches that are specifically encouraged in the Rule. Further, these systems will support the fire emissions inventory and modeling needs for regional haze and ambient air quality standards such as those for ozone and particulate matter.

The WRAP's regional emissions tracking and forecasting system for point, area, biogenic, mobile, and fire sources will result in a complete inventory of all emissions of visibility impairing pollutants (i.e., PM_{10}, $PM_{2.5}$, SO_x, NO_x, VOC, ROC, elemental carbon, ammonia) for all sources within the WRAP region. The emission inventories will be both temporally and spatially resolved and will include emissions from both man-made and natural sources. This effort will facilitate the technical and planning efforts of the WRAP states and tribes by compiling the emission inventories necessary for regional modeling efforts to analyze visibility impacts and meet Rule requirements.

[20] 64 FR 35771, §51.309 (d) (6) (ii).
[21] 64 FR 35720.

Stationary Source Milestones and Clean Air Corridors as cited in the Rule will require emissions to be compiled annually by the WRAP. As fire activity and subsequent emissions are highly variable in terms of strength, impact, location and timing, the WRAP FTS Policy specifies that states will and tribes may provide fire activity information to the WRAP on an annual basis.

3.2.3. Applicability

In keeping with the GCVTC Recommendations, the Rule, the WRAP *Policy for Categorizing Fire Emissions*, and recommendations in the *Interim Air Quality Policy on Wildland and Prescribed Fires* (EPA Interim Policy)[22], the WRAP FTS Policy applies equitably across all land types and fire sources. The WRAP FTS Policy calls for the tracking of fire sources on both wildland and agricultural lands regardless of ownership, cause of ignition, or purpose of the fire.

All fire sources are included in the WRAP FTS Policy because it is recognized that all fires (prescribed fire, wildfire, and agricultural burning) have an effect on air quality and contribute to regional haze.[23] Fire sources were among those specifically acknowledged in the GCVTC Report as contributors to visibility impairment on an episodic basis:

> All types of fire (prescribed fire and agricultural burning) must be addressed equitably as part of a visibility protection strategy.[24]

The use of fire by agriculture is well documented and the Agricultural Air Quality Task Force (AAQTF) has recognized that agricultural burning has the potential to impact visibility in mandatory Class I Federal areas.[25] However, the extent of fire use is not well known in some areas, and is the cause of uncertainty as to the contribution of agricultural burning sources on regional haze. Accordingly, the AAQTF's *Air Quality Policy on Agricultural Burning, Recommendation to the U.S. Department of Agriculture* states that "…the contribution from agriculture, specifically the impact of burning practices on regional air quality, must be accurately assessed in relative proportion to the region's total emissions."[26]

Section 118(a) of the Clean Air Act requires that all entities, federal and non-federal, be subject to the same requirements, authorities and processes, and the Rule is clear that all sources, facilities, and property are to be treated equitably.[27] Additionally, stakeholder input garnered in the development process of the WRAP *Policy for Categorizing Fire Emissions* supported consistent consideration of fire between Sections 308 and 309 of the Rule. The WRAP FTS Policy, therefore, will be applicable and useful to all states and tribes in the WRAP region.

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[22] U.S. EPA, Office of Air Quality Planning and Standards, Interim Air Quality Policy on Wildland and Prescribed Fires, April 23, 1998 (hereafter referred to as "EPA Interim Policy").
[23] GCVTC Report, p. 47.
[24] Ibid.
[25] Agricultural Air Quality Task Force, Air Quality Policy on Agricultural Burning, Recommendation to the U.S. Department of Agriculture, November 10, 1999 (hereafter referred to as "AAQTF's Air Quality Policy Recommendation"), Section IV, E.
[26] AAQTF's Air Quality Policy Recommendation, Section VII.
[27] 64 FR 35748.

The WRAP FTS Policy does not apply to Native American cultural non-vegetative burning for traditional, religious, or ceremonial purposes (e.g., cremation, and sweat lodge fires).[28] In addition, the WRAP FTS Policy does not apply to open burning activities on residential, commercial, or industrial property (e.g., backyard burning, garbage incineration, residential wood combustion, and construction debris). However, the WRAP recognizes that the unique air quality circumstances of a state or tribe may require emissions tracking information for these fire source sectors. In addition, these sources may be quantified as area sources within populated areas in other emissions inventory efforts by states, tribes or the WRAP.

3.3. Essential Components of a Fire Tracking System

> *Policy Statement B: A fire tracking system includes the following seven essential components that are necessary in order to consistently calculate emissions and to uniformly assess impacts to regional haze:*
>
> *1. Date of Burn*
> *2. Burn Location*
> *3. Area of Burn*
> *4. Fuel Type*
> *5. Pre-Burn Fuel Loading*
> *6. Type of Burn*
> *7. "Anthropogenic" or "Natural" Classification*

The seven essential components of a fire tracking system identified in this Policy have been selected as the minimum spatial and temporal information to be collected consistently and universally across the WRAP region to ensure comparability between and within states and tribes, and across the WRAP region. The seven essential components are based, in part, upon careful review and consideration of the EPA's *Prescribed Burning Background Document and Technical Information Document for Prescribed Burning Best Available Control Measures*[29] and the National Wildfire Coordination Group's *Smoke Management Guide for Prescribed and Wildland Fire 2001 Edition.*[30] The seven essential components have also been developed based on the experience gained through the FEJF's 1996 and 2018 fire emissions inventory preparation efforts.[31] [32]

The fire tracking system's essential component data will provide the basis for calculating the emissions for fire through the use of an emissions calculation mechanism, such as the WRAP emissions inventory system described above, to integrate the appropriate emissions factors and emission calculation techniques. In order to consistently calculate emissions and ensure the

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[28] WRAP Policy for Categorizing Fire Emissions, November 15, 2001 (hereafter referred to as "WRAP Fire Categorization Policy"), p. 24.
[29] U.S. EPA, Office of Air Quality Planning and Standards, Prescribed Burning Background Document and Technical Information Document for Prescribed Burning Best Available Control Measures, EPA-450/2-92-003, September 1992.
[30] National Wildfire Coordination Group, Smoke Management Guide for Prescribed and Wildland Fire, PMS 420-2, NFES 1279, December 2001 (hereafter referred to as "NWCG Smoke Management Guide").
[31] WRAP Report: 1996 Fire Emissions Inventory (DRAFT).
[32] WRAP Report: Integrated Assessment Update and 2018 Emissions Inventory for Prescribed Fire, Wildfire and Agricultural Burning (DRAFT).

comparability of the subsequent regional modeling analysis and analysis of visibility monitoring data, states/tribes should utilize identical emission factors and calculation techniques in concert with the essential fire activity information as described in this Policy.[33] The FEJF will develop further guidance, beyond that contained in the FTS Policy, for states/tribes to establish quality assurance methods, and the procedure and format for the submittal of fire tracking system information.

There are differences among states and tribes with regard to air quality issues, non-attainment areas, emissions information, fire source sectors, and state legislative or tribal governmental requirements. As a result, a state or tribe may choose to augment the seven essential components with additional information. Appendix C elaborates on additional fire activity and tracking information that a state or tribe may consider useful when developing its fire tracking system.

The essential component information described in this FTS Policy will be necessary to accomplish the emissions inventory task as cited in the Rule. However, the WRAP recognizes that the unique air quality circumstances of states/tribes may call for excluding some fires from tracking by the establishment of a de minimus level, based on number of acres, tons of fuel, or tons of emissions. The spatial and temporal variability of fire and the significance of visibility impacts is highly dependent upon a number of factors such as size, fuel consumption, meteorology, climate and proximity to a Class I area.[34] The WRAP FTS Policy *does not* prescribe a de minimus level to exclude fires from tracking. States or tribes may wish to establish de minimus levels, which should be defined in the SIP/TIP and be based on a source-impact relationship. The FEJF will be assessing potential de minimus levels based on source/impact relationships to assist states and tribes in this endeavor.

3.3.1. Essential Component 1. Date of Burn

It is critical that the temporal resolution of the fire activity information be attributed to a specific day for each specific burn in order to correlate with "best" and "worst" day visibility monitoring data.[35]

3.3.2. Essential Component 2. Burn Location

It is important that the spatial resolution of the fire activity be attributed to a specific location to allow for source/visibility impact relationships to be established.

3.3.3. Essential Component 3. Area of Burn

The level of accuracy of the emission inventory will depend, most significantly, on the ability to estimate the area burned (i.e., blackened acres).[36]

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[33] See footnote 19.
[34] For example, a small agricultural burn (e.g., <2,500 acres at 4 tons/acre consumption or 50 tons PM_{10}) within 50 kilometers upwind of a Class I area could have a greater visibility impact than a large wildland prescribed fire (e.g., >833 acres at 20 tons/acre consumption or 250 tons PM_{10}) within 100 kilometers downwind of a Class I area.
[35] 64 FR 35734.
[36] Peterson, Janice L. 1987. Analysis and reduction of the errors of predicting prescribed burn emissions. Thesis. Seattle: University of Washington. 70p.

3.3.4. Essential Component 4. Fuel Type

Emissions from fire are highly dependent upon the fuel or cover type (e.g., ponderosa pine, juniper, orchard residue, rice straw). It is crucial to provide the predominant fuel or cover type that is burned so that the appropriate emissions factor can be selected to calculate fire emissions. The fuel type will also help refine fuel consumption estimation.

3.3.5. Essential Component 5. Pre-Burn Fuel Loading

The pre-burn fuel loading represents the amount of fuel present at the burn location. For the preparation of the fire emissions inventories, the accuracy of the pre-burn fuel-loading component is vital. The more accurate the pre-burn fuel loading and characteristics of the fuel load (e.g., size class information), the more refined the subsequent emissions estimates will be.

3.3.6. Essential Component 6. Type of Burn

Type of burn represents the predominant configuration of the fuel burned (e.g., pile, windrow, broadcast, underburn). It is important to provide the type of burn so that the appropriate emissions factor can be selected. Type of burn can also provide information for calculating fuel consumption.

3.3.7. Essential Component 7. "Anthropogenic" or "Natural" Classification

The "anthropogenic" or "natural" classification is to be determined per the WRAP *Policy for Categorizing Fire Emissions.*[37] The WRAP will be analyzing daily visibility monitoring data annually for Class I areas and reporting on the causes of haze on an annual basis. This analysis will apportion fire emissions to natural visibility conditions and anthropogenic visibility impairment based on a fire's "anthropogenic" or "natural" classification. The apportionment will enable states and tribes to address natural reductions of visibility from fire as well as to identify those fire emissions that need to be controlled to achieve reasonable progress.

3.4. Annual Emission Goals

> *Policy Statement C: A fire tracking system should include additional components as needed to support the development and implementation of annual emission goals and other control measures.*

Section 309 of the Rule calls for states to establish "annual emission goals for fire, excluding wildfire, that will minimize emission increases from fire to the maximum extent feasible."[38] The *WRAP Policy on Annual Emission Goals for Fire* (WRAP AEG Policy) emphasizes the use of emission reduction techniques (ERTs) as the basis of annual emission goals. States/tribes may need to include additional components in their fire tracking system, beyond the listed essential components, that they deem necessary to support the implementation of annual emission goals

[37] WRAP Fire Categorization Policy, p. 8.
[38] 64 FR 35771, §51.309 (6) (v).

and other control measures. The tracking of additional components such as the ERT used, emission reductions achieved or other information (e.g., fuel moisture) should be tracked at the same temporal and spatial resolution of the essential components to allow for regional modeling.

The FEJF will develop guidance on additional components to support the implementation of annual emission goals and other control measures per the WRAP AEG Policy. In addition, subsequent guidance to Appendix D of the WRAP AEG Policy will be developed by the FEJF to summarize ERT options for common vegetation and crop types for both prescribed fires on wildland and agricultural burning.

3.5. Fire Emissions Projection

> *Policy Statement D: A fire tracking system should include a component that addresses the projection of fire emissions, which is necessary to meet the requirements of the Regional Haze Rule.*

When developing long-term strategies that will meet the reasonable progress requirements for both Sections 308[39] and 309[40], states and tribes must consider the anticipated net effect on visibility due to projected changes in point, area, and mobile source emissions. Fire is an area source. Periodic progress reports are required under both Sections 308 and 309, that specifically cite the need for future projected emissions.[41] Fire projections information also supports the Section 309 requirement for fire programs within a state to evaluate the degree of visibility impairment from smoke for both planning and operational purposes.[42] Additionally, Section 308 of the Rule asserts that implementation plans must provide for estimates of future projected emissions.[43] Therefore, a projected estimate of fire emissions from all fire source sectors will serve as the basis for the projection of visibility conditions due to fire for the most impaired and least impaired days, and will facilitate planning.

> Since the use of fire for resource management is expected to increase substantially, especially on Federal lands, State/Tribal air quality managers will need information to develop potential annual or seasonal air pollutant emissions estimates for SIP/TIP planning.[44]

The fire emissions projection component of a fire tracking system may be developed in a variety of ways to address the Rule requirements for future projected emissions from fire. Fire emission projection may be determined by surveys,[45] use of growth factors, multipliers or other techniques.

[39] 64 FR 35767, §51.308 (d) (3) (v) (G).
[40] 64 FR 35770, §51.309 (d) (2) and 64 FR 35773, §51.309 (g) (2).
[41] 64 FR 35769, §51.308 (g) (4) and 64 FR 35772, §51.309 (d) (10) (i) (D).
[42] 64 FR 35771, §51.309 (d) (6) (i).
[43] 64 FR 35767, §51.308 (d) (4) (v).
[44] EPA Interim Policy, p. 28.
[45] WRAP Report: Integrated Assessment Update and 2018 Emissions Inventory for Prescribed Fire, Wildfire and Agricultural Burning (DRAFT), Appendix A, pp. 61-96.

The *WRAP Policy on Enhanced Smoke Management Programs for Visibility* includes the consideration of regional coordination as a necessary element in an enhanced smoke management program. A fire emissions projection component for the fire tracking system can provide information critical to the implementation of that element. Inclusion of one-year projected estimates of fire emissions on an annual basis can facilitate operational smoke management and regional coordination. One-year projected estimates may also be useful to estimate a preliminary annual emission goal.

The addition of five-year projected estimates of fire emissions into a fire tracking system will aid in regional planning as required by the Rule, as well as in the demonstration of reasonable progress over the periods addressed by the long-term strategy and progress reports. Five-year projected estimates of fire emissions would need to be submitted to support the periodic progress report schedule (i.e., every five years). Neither of these projections should be construed as a limit.[46] The FEJF will develop guidance on the fire emissions projection component to meet the various regulatory needs identified above and to work in concert with the WRAP emissions inventory system.

3.6. Collaborative Development

> *Policy Statement E: The development of fire tracking systems by states and tribes will be done collaboratively with state, tribal, local and federal land management agencies, and private parties.*

In developing a fire tracking system, states and tribes will use a collaborative process, as per the GCVTC Report, which includes state, tribal and federal land management agencies and private parties. Cooperation and collaboration between air regulatory agencies and fire managers is necessary to design an effective and appropriate emission inventory system.[47] There are several efforts underway within federal land management agencies and also within EPA to develop fire tracking systems. State collaboration with these efforts may lead to greater efficiency and less need to develop their own individual fire tracking systems for wildland fire. The use of a collaborative process to develop a fire tracking system and subsequent emissions inventory may promote economic efficiency by identifying mechanisms and infrastructure opportunities to avoid the duplication of time and effort.

Regional haze SIPs/TIPs will be revisited and revised, per the schedule specified in the Rule, thereby providing opportunities to refine the fire tracking system. Future refinements to the fire tracking system may reflect policy changes and/or technical advances pertinent to mechanism, infrastructure, and data collection options. The collaborative process will help to bring these changes and advances to the forefront for use in revising the fire tracking system.

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[46] For clarification on emission limits as they apply to fire, see the WRAP Policy on Annual Emission Goals for Fire.
[47] NWCG Smoke Management Guide, p. 189.

4. APPENDICES

APPENDIX A. GLOSSARY

This glossary is intended to provide readers with several operating definitions to facilitate a consistent review of this Policy. However, this glossary is not intended to be a complete list of all terms and acronyms.

<u>16 Class I Areas on the Colorado Plateau</u> - The Grand Canyon Visibility Transport Commission Report specified 16 mandatory Class I areas on the Colorado Plateau that were adopted into Section 309 of the Regional Haze Rule. The 16 Class I areas are: Grand Canyon National Park, Sycamore Canyon Wilderness, Petrified Forest National Park, Mount Baldy Wilderness, San Pedro Parks Wilderness, Mesa Verde National Park, Weminuche Wilderness, Black Canyon of the Gunnison Wilderness, West Elk Wilderness, Maroon Bells Wilderness, Flat Tops Wilderness, Arches National Park, Canyonlands National Park, Capital Reef National Park, Bryce Canyon National Park, and Zion National Park.

<u>2064 Natural Conditions Goal</u># - The ultimate goal of the regional haze program is the absence of visibility impairment due to human-caused emissions.

<u>AAQTF</u> - Agricultural Air Quality Task Force. A task force to address agricultural air quality issues established by the Chief of the Natural Resources Conservation Service.

<u>Agricultural Fire/Burning</u>* - Any fire ignited by management actions to meet specific objectives (i.e., managed to achieve resource benefits) on agricultural land.

<u>Agricultural Land</u>* - Agricultural land includes croplands, pasture, and other lands on which crops or livestock are produced (PL 104-127, Section 1240A). Rangeland will be included with wildland for the purposes of the Fire Emissions Joint Forum work.

<u>Alternatives to Burning</u> - See Non-Burning Alternatives to Fire definition below.

<u>Anthropogenic Emissions Source Classification (“anthropogenic”)</u># - A categorization that designates which fire emissions contribute to visibility impairment in a Federal Class I area. “Anthropogenic” emissions must be controlled to achieve progress toward the 2064 natural conditions goal for each Federal Class I area in the WRAP region. This classification includes natural and human-caused ignitions.

<u>Area Source</u> - A source category of air pollution that generally extends over a large area. Prescribed burning, field burning, home heating, and open burning are examples of area sources.

<u>Class I Area</u> - See Mandatory Class I Area and Non-Mandatory Class I Area.

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* Operating Definitions from the WRAP FEJF Workplan, February 25, 1999, Section 1.1.
# Operating Definitions from WRAP Policy for Categorizing Fire Emissions, November 15, 2001, Appendix A.

Ecosystem Maintenance# - A prescribed fire or wildfire managed for resource benefits, in an ecosystem that is currently in an ecologically functional and fire resilient condition, that is utilized to mimic the natural role of fire.

Ecosystem Restoration# - The re-establishment of natural vegetation that may be accomplished through the reduction of unwanted and/or unnatural levels of biomass, which may have accumulated due to management action. Prescribed fires, wildfires managed for resource benefits and mechanical treatments may be utilized to restore an ecosystem to an ecologically functional and fire resilient condition.

Emission Factor - A representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant (e.g., pounds of particulate matter emitted per ton of biomass burned).

Emissions Forum - The Emissions Forum is responsible for the oversight of the assembly and quality assurance of the emissions inventories and forecasts to be utilized by the WRAP forums and oversees the development of a comprehensive emissions tracking and forecasting system.

Emission Inventory - A listing, by source, of the amount of air pollutants discharged into the atmosphere.

Federal Class I area - See Mandatory Class I Area.

FEJF - Fire Emissions Joint Forum. The Fire Emissions Joint Forum's mission is to address both policy and technical issues while developing programs and tools relating to prescribed fire and air quality for the Western Regional Air Partnership and related Western Regional Air Partnership forums.

Fire* - When this term appears, it refers inclusively to wildfire, prescribed natural fire/wildland fire managed for resource benefits, prescribed fire, rangeland fire, and agricultural fire.

GCVTC - Grand Canyon Visibility Transport Commission. The GCVTC was authorized under Section 169B(f) of the Clean Air Act and composed of the governors of eight western states (AZ, CA, CO, NM, NV, OR, UT, WY), four tribes (Acoma Pueblo, Hopi, Hualapai, and Navajo), four Federal land management agencies (Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service), the Columbia River Inter-Tribal Fish Commission, and the Environmental Protection Agency. The Commission was established to recommend methods to preserve and improve visibility on the Colorado Plateau, and submitted Recommendations to EPA in June 1996.

Operating Definitions from WRAP Policy for Categorizing Fire Emissions, November 15, 2001, Appendix A.
* Operating Definitions from the WRAP FEJF Workplan, February 25, 1999, Section 1.1.

Land Managers* - When this term appears, it refers inclusively to Federal, state, tribal, and private land managers.

Mandatory Class I Area - In 1977, Congress identified 156 national parks (over 6,000 acres), wilderness areas and national memorial parks (over 5,000 acres), and international parks in existence before August of 1977 that were to receive the most stringent protection from increases in air pollution. Congress also set a visibility goal for these areas to protect them from future human-caused haze, and to eliminate existing human-caused haze, and required reasonable progress toward that goal.

NAAQS - National Ambient Air Quality Standards.

Natural Emissions Source Classification ("natural")# - A categorization that designates which fire emissions can result in a natural reduction of visibility for each Federal Class I area in the WRAP region. This classification includes natural and human-caused ignitions.

Natural Visibility Goal - See 2064 Natural Conditions Goal.

Non-Burning Alternatives to Fire## - Techniques that replace fire as a means to achieve a particular land management objective (e.g., reduction of fuel-loading, manipulation of fuels, enhancement of wildlife habitat, eco-system restoration, etc.) In this Policy, non-burning alternatives do not include techniques used in conjunction with fire. Techniques used in conjunction with fire are referred to as ERTs.

Non-Mandatory Class I Area - Class I areas designated by states or tribes, but are not deemed mandatory by the Clean Air Act. As of January 2002, Class I areas designated by tribes include: Fort Peck Reservation in Montana, Northern Cheyenne Reservation in Montana, Flathead Reservation in Montana, Yavapai-Apache Reservation in Arizona (Class I status under litigation), and Spokane Reservation in Washington.

Pasture Land# - Grazing lands comprised of introduced or domesticated native forage species that are used primarily for the production of livestock. They receive periodic renovation and/or cultural treatments such as tillage, fertilization, mowing, weed control, and may be irrigated. They are not in rotation with crops (Natural Resources Conservation Service National Range and Pasture Handbook, 1997).

Point Source - A source of pollution that is point-like in nature. An example is the smokestack of a coal-fired power plant or smelter.

Prescribed Fire* - Any fire ignited by management actions to meet specific objectives (i.e., managed to achieve resource benefits).

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* Operating Definitions from the WRAP FEJF Workplan, February 25, 1999, Section 1.1.
# Operating Definitions from WRAP Policy for Categorizing Fire Emissions, November 15, 2001, Appendix A.
Glossary Definition from WRAP Policy on Annual Emission Goals for Fire, Appendix A.

Rangeland# - Land on which the historic climax plant community is predominantly grasses, grass-like plants, forbs, or shrubs. Includes lands re-vegetated naturally or artificially when routine management of that vegetation is accomplished mainly through manipulation of ecological principles. Rangeland includes natural grasslands, savannas, shrub lands, most deserts, tundra, alpine communities, coastal marshes and wet meadows (Natural Resources Conservation Service National Range and Pasture Handbook, 1997).

Regional Planning Organization - An organization that will first evaluate technical information on regional haze and related issues to better understand how their states and tribes impact national park and wilderness areas (Federal Class I areas) across the country. The organization will then pursue the development of regional strategies to reduce emissions of particulate matter and other pollutants leading to regional haze. The five Regional Planning Organizations that receive funding from EPA to address regional haze and related issues are: Central States Regional Air Partnership (CENRAP) for the central states, Midwest Regional Planning Organization for the mid-western states, Ozone Transport Commission (OTC) for the northeastern states, Visibility Improvement State and Tribal Association of the Southeast (VISTAS), and Western Regional Air Partnership (WRAP) for the western states.

Rule - Regional Haze Rule. Regulations published in the Federal Register on July 1, 1999 (64 FR 35714) that require states to establish goals for improving visibility and to develop long-term strategies for reducing emissions of pollutants that cause visibility impairment.

Silviculture# - The theory and practice of controlling forest establishment, composition, and growth. The art of producing and tending a forest.

SIP - State Implementation Plan. Plans devised by states to carry out their responsibilities under the Clean Air Act. SIPs must be approved by the U.S. Environmental Protection Agency and include public review.

Smoke Effects* - The effects on visibility (both plume blight and regional haze), public nuisance, and the health-based NAAQS due to emissions from fire.

TIP - Tribal Implementation Plan. Plans devised by tribes to carry out their responsibilities under the Clean Air Act. TIPs must be approved by the U.S. Environmental Protection Agency and include public review.

Transport Region State - One of nine states that make up the Grand Canyon Visibility Transport Region: Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Wyoming.

Wildfire* - Any unwanted, non-structural fire.

Operating Definitions from WRAP Policy for Categorizing Fire Emissions, November 15, 2001, Appendix A.
* Operating Definitions from the WRAP FEJF Workplan, February 25, 1999, Section 1.1.

Wildfire Managed for Resource Objectives[#] – The management of naturally ignited fires, regardless of land type or ownership, to accomplish specific, pre-stated resource management objectives in predefined geographic areas with or without a plan in place. This term is considered to be analogous with the terms Wildland Fire Managed for Resource Benefits and Prescribed Natural Fire that are used in regulations and policies regarding Federal wildlands.

Wildland* - An area where development is generally limited to roads, railroads, power lines, and widely scattered structures. The land is not cultivated (i.e., the soil is disturbed less frequently than once in 10 years), is not fallow, and is not in the USDA Conservation Reserve Program (CRP). The land may be neglected altogether or managed for such purposes as wood or forage production, wildlife, recreation, wetlands, or protective plant cover (EPA Interim Air Quality Policy on Wildlands and Prescribed Fires). The land is not "agricultural land" as operationally defined above. Silvicultural land and rangelands (per the FEJF charge), woodlots, and private timberlands will be included with wildlands for the purposes of the FEJF work.

Wildland Fire[#] - All types of fire (see definition of fire above), except fire on agricultural land.

Wildland Fire Managed for Resource Benefits/Prescribed Natural Fire* - These terms both have current use in regulations and policies. They are considered to be synonymous and are used interchangeably in this [FEJF] workplan. These terms refer to the management of naturally ignited fires to accomplish specific, pre-stated resource management objectives in predefined geographic areas outlined in the fire management plan.

WRAP Region - The WRAP region includes over 400 tribes and the states of Alaska, Arizona, California, Colorado, Idaho, Montana, North Dakota, New Mexico, Oregon, South Dakota, Utah, Washington, and Wyoming.

WRAP - Western Regional Air Partnership. The WRAP is a collaborative effort of tribal governments, state governments and Federal agencies to promote and monitor implementation of Recommendations from the Grand Canyon Visibility Transport Commission. The WRAP may also address other common western regional air quality issues as raised by its membership. The activities of the WRAP are conducted by a network of committees and forums, composed of WRAP members and stakeholders who represent a wide range of social, cultural, economic, geographic and technical viewpoints. The WRAP membership is comprised of the governors of thirteen western states and thirteen western tribes. The current WRAP members include the States of AK, AZ, CA, CO, ID, MT, ND, NM, OR, SD, UT, WA, and WY and the Tribal Nations of Pueblo of Acoma, Campo Band of Kumeyaay Indians, Cortina Indian Rancheria, Hopi Tribe, Hualapai Nation of the Grand Canyon, Nez Perce Tribe, Northern Cheyenne Tribe, Salish and Kootenai Confederated Tribes, Pueblo of San Felipe, and Shoshone-Bannock Tribes of Fort Hall. Federal WRAP members are the Department of the Interior, the Department of Agriculture, and the Environmental Protection Agency.

Operating Definitions from WRAP Policy for Categorizing Fire Emissions, November 15, 2001, Appendix A.
* Operating Definitions from the WRAP FEJF Workplan, February 25, 1999, Section 1.1.

APPENDIX B. WEBSITE REFERENCES

This appendix is intended to provide readers with several website addresses that were used to locate supporting information for the development of this Policy.

— Western Regional Air Partnership (WRAP) website
(http://www.wrapair.org)

— U.S. Environmental Protection Agency's, Office of Air Quality Planning and Standards, Visibility website
(http://www.epa.gov/oar/visibility)

— Agricultural Air Quality Task Force website
(http://fargo.nserl.purdue.edu/faca)

— GCVTC Recommendations for Improving Western Vistas, June 10, 1996
(http://www.wrapair.org) Go to the About WRAP link, Go to the GCVTC link

— Regional Haze Rule, 40 CFR Part 51, July 1, 1999
(http://www.epa.gov/ttn/oarpg/t1/fr_notices/rhfedreg.pdf)

— Tribal Authority Rule, 63 FR 7253, February 12, 1998
(http://www.epa.gov/fedrgstr/EPA-AIR/1998/February/Day-12/a3451.htm)

— Western Regional Air Partnership Charter, Revised November 29, 2001
(http://www.wrapair.org/about/index.html) Go to the Charter link

— WRAP, Fire Emissions Joint Forum Charge, July 29, 1998
(http://www.wrapair.org/forums/fejf/index.html) Go to the FEJF Charge link

— Workplan, WRAP – Fire Emissions Joint Forum, February 25, 1999
(http://www.wrapair.org/forums/fejf/index.html) Go to the FEJF Workplan link

— Policy for Categorizing Fire Emissions, Approved by Consensus by the Western Regional Air Partnership, November 15, 2001
(http://www.wrapair.org/forums/fejf/index.html) Go to the Natural Background link

— WRAP Policy on Enhanced Smoke Management Programs for Visibility, Approved by Consensus by the Western Regional Air Partnership, November 13, 2002
(http://www.wrapair.org/forums/fejf/index.html) Go to the Enhanced Smoke Mgmt. Programs link

— WRAP Policy on Annual Emission Goals for Fire, Approved by Consensus by the Western Regional Air Partnership, April 2, 2003
(http://www.wrapair.org/forums/fejf/index.html) Go to the Annual Emission Goal link

— WRAP Report: Integrated Assessment Update and 2018 Emissions Inventory for Prescribed Fire, Wildfire and Agricultural Burning (DRAFT)
(http://www.wrapair.org/forums/fejf/index.html) Go to the Emissions link

— WRAP Report: 1996 Fire Emissions Inventory (DRAFT)
(http://www.wrapair.org/forums/fejf/index.html) Go to the Emissions link

— WRAP Report: Non-Burning Management Alternatives on Agricultural Lands in the Western United States, Final, May 15, 2002
(http://www.wrapair.org/forums/fejf/index.html) Go to the Non-Burning Alt. on Agricultural Lands link

— WRAP Report: Comprehensive Manual on Non-Burning Alternatives (DRAFT)
(http://www.wrapair.org/forums/fejf/index.html) Go to the Non-Burning Alt. on Wildlands link

— U.S. EPA, Interim Air Quality Policy on Wildland and Prescribed Burning, April 23, 1998
(http://www.epa.gov/ttn/oarpg/t1/memoranda/firefnl.pdf)

— U.S. EPA, Prescribed Burning Background Document and Technical Information Document for Prescribed Burning Best Available Control Measures, September 1992
(http://www.epa.gov/cgi-bin/claritgw?op-Display&document=clserv:epa-cinb:1681;&rank=4&template=epa)

— National Wildfire Coordination Group, Smoke Management Guide for Prescribed and Wildland Fire, PMS 420-2, NFES 1279, December 2001.
(http://www.nwcg.gov/pms/pubs/SMG-72.pdf)

— Smoke Management Program Surveys
1) Wildland Smoke Management Program Survey, January 26, 2001
2) Boulder Wildland Smoke Management Program Survey, February 2, 2001
3) Agricultural Burning Smoke Management Program Survey, March 30, 2001
4) Institute for Tribal Environmental Professionals (ITEP) Tribal Smoke Management Program Survey, *An Assessment of Tribal Air Quality Data and Programs in the Western United States*, September 2001
(http://www.wrapair.org/forums/fejf/index.html) Go to the Basic Smoke Mgmt. Programs link

APPENDIX C. SUPPORTING INFORMATION

This appendix is intended to provide readers with supporting information on fire tracking systems, but does not specifically address all sections of the WRAP FTS Policy.

1. Essential Components

The FEJF will develop further guidance, beyond that contained in the FTS Policy, for states/tribes to establish quality assurance methods, and the procedure and format for the submittal of fire tracking system information. The following is supporting information on the fire tracking system essential components.

1.1. Essential Component 1. Date of Burn

For the purposes of the fire tracking system, the date of burn represents the fire activity (i.e., area burned) on any specific day for each burn. For a multiple day burn, multiple entries should correspond to the fire activity on each given day.

1.2. Essential Component 2. Burn Location

For each burn, the location should be provided to the nearest mile.

1.3. Essential Component 3. Area of Burn

Blackened acres should be determined post-burn. In a pile burn, the area burned should be represented by the pile dimensions as well as the number of piles consumed.

1.4. Essential Component 4. Fuel Type

The appropriate emissions factor choice can become complicated when the fire consumes multiple fuel or cover types (e.g., grass and sage). Therefore, for the purposes of the fire tracking system, the fuel type would optimally represent the predominant fuel or cover type consumed in the fire. If additional fuel types beyond the predominant type for a given burn are included in the fire tracking system, the area burned for each fuel type would need to be clearly delineated to allow for subsequent emissions calculations.

1.5. Essential Component 5. Pre-burn Fuel Loading

The pre-burn fuel loading should be expressed as the weight of fuel per unit area in tons per acre. The consumption of the fuel will be calculated as part of the WRAP emissions inventory system in order to reduce the propagation of field estimation errors.

1.6. Essential Component 6. Type of Burn

Type of burn represents the predominant configuration of the fuel burned (e.g., pile, windrow, broadcast, underburn). If available, identification of pile type (i.e., hand-piled or machine-piled) will enhance the quality of the subsequent emissions calculation. Determining the Type of Burn can be complicated when a burn project includes multiple fuel configurations. For the purposes of the fire tracking system, the predominant burn type should be reported. If additional fuel configurations for a given burn are provided in addition to the predominant fire type, each type of burn should have an area burned and fuel type to allow for subsequent emissions calculations.

1.7. Essential Component 7. "Anthropogenic" or "Natural" Classification

The "anthropogenic" or "natural" classification applies as it is defined by the WRAP *Policy for Categorizing Fire Emissions*, which was developed to clarify the complex relationship between what is considered a natural source of fire and what is considered a human-caused source, as acknowledged in the Rule.[48] The appropriate classification is typically determined prior to the initiation of the fire.[49]

2. Optional Components

To support the integration of the fire tracking system with other policy and technical tools being developed by the WRAP, there are four optional components of a fire tracking system that states/tribes should consider in the development of their fire tracking system. The four optional components include Daily Tracking, Fuel Consumption, Non-Burning Alternatives and Additional Fire Tracking Information.

2.1. Daily Tracking

Smoke management is a key component in both Sections 308[50] and 309[51] of the Rule to address visibility impacts from fire. To meet the smoke management requirements for Section 309, and potentially as a tool for Section 308, the WRAP has developed its *Policy on Enhanced Smoke Management Programs for Visibility* (WRAP ESMP Policy).

The WRAP ESMP Policy recognizes that the more intensive levels of smoke management necessitate daily inter- and intra-jurisdictional coordination for approved burns. These types of smoke management programs may rely upon real-time meteorological data and daily fire activity information available to cross-jurisdictional authorities, as well as a permitting system to avoid cumulative smoke impacts and to assist in regional coordination.

To provide information critical to the implementation of daily tracking, it is recommended that the pre- and post-burn information be collected on a daily basis for the essential components, as identified in this Policy. Additional daily tracking components, such as burner contact information, may need to be identified by states/tribes to satisfy the information necessary for daily coordination.

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[48] 64 FR 35735.
[49] WRAP Fire Categorization Policy, p. 12.
[50] 64 FR 35767, §51.308 (d) (3) (v) (E).
[51] 64 FR 35771, §51.309 (d) (6) (i) and §51.309 (d) (6) (iv).

2.2. Fuel Consumption

Pre-burn fuel loading is a key component for the calculation of fire emissions, which can be refined to a large extent based on the fuel that is actually consumed by the fire (i.e., fuel consumption). The quantity of fuel actually burned in a fire will depend on the pre-burn fuel loading and fuel moisture condition, the type of fuel, climatic and meteorological factors, and the intensity of the fire. Accuracy and precision is improved with fuel consumption estimates; however, this parameter can be difficult to estimate. For example, in wildlands the fuel consumed is often not confined to the fuels on the surface, but may include vegetation canopies and/or organic soil layers. These fuels may dominate the mass of the fuel consumed, but have often been neglected in biomass burning inventories.

Information that specifies the quantity (i.e., percentage) of the pre-burn fuel load consumed by the fire will enhance the accuracy of the emissions estimate and can be provided in the fire tracking system as an optional component labeled Fuel Consumption. Inaccuracy in Fuel Consumption can lead to the assumption that all of the pre-burn fuel load is consumed, resulting in higher than actual emissions.

A number of different options are available to develop the fuel consumption information necessary to calculate fire emissions. Fuel consumption can be determined through 1) expert opinion, 2) empirical models, 3) computer simulations (e.g., Consume[52]), or 4) other on-site measurements. Field estimates do not always provide precise estimates. When available, the most accurate methods to determine fuel consumption are the use of computer simulations. Ocular estimates are an option, but are not preferred due to field variability.

2.3 Non-Burning Alternatives

Consistent with the *WRAP Policy on Annual Emission Goals for Fire*, non-burning alternatives are techniques that replace fire as a means to achieve a particular land management objective. These techniques could be tracked in a fire tracking system, although the temporal scale will not coincide with the listed essential components. Information may be available from some burners to track parameters such as the area where non-burning alternatives were used, the fuels that were addressed and the specific technique(s) applied. Determining an acceptable method for calculating emissions averted through the use of the non-burning alternatives would most appropriately be developed collaboratively.

2.4. Additional Fire Tracking Information

There are differences among states and tribes with regard to air quality issues, emissions information, fire source sectors, and state legislative or tribal governmental requirements. As a result, a state or tribe may select various degrees of fire tracking information; this may include additional parameters for different fire source sectors and/or smoke effects (i.e., plume blight, regional haze, public nuisance, and health-based NAAQS), depending upon their projected or actual impacts.

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[52] Pacific Northwest Research Station, Forestry Sciences Laboratory, Consume Software, Version 2.1.

Additional fire tracking information that a state or tribe may consider adding to a fire tracking system includes, but is not limited to, a) fuel moisture, b) purpose of burn, c) plume rise, and d) burn identification code.

3. Data Collection Methods

The ability of a state/tribe to implement the fire tracking system with known essential post-burn activity information for all fire sources may require legislative or governmental changes to existing rules or removal of exemptions from regulation, and/or new tracking of specific fire sources. Therefore, consistent with the WRAP's Charter, the FTS Policy allows for the consideration of direct data collection as well as indirect estimation techniques, where they satisfy the minimum spatial and temporal information necessary to support emissions inventories and modeling for the WRAP region.

There are many ways to obtain the necessary data from a category of fires. Primary activity data may be collected by the manager responsible for fire operations and forwarded to a data collection point, or an agent of the permitting or regulating authority may collect the data. Data might be collected for each operation, or a statistical sample gathered from each category of fire, as defined by unique combinations of essential information components. The information might be observed directly, or inferred from relevant parameters that can be collected more easily or more accurately than direct observations. The FEJF will be exploring viable data collection methods at a later date.

3.1. Direct Data Collection

Direct data collection methods cover a wide range, from something as simple as an individual burner tracking the information in a log book to something as complex as a centralized burn authority tracking the information in a database. The burner should ensure that the data and information submitted to the oversight authority via direct data collection methods is accurate, timely, and complete.

According to EPA's Interim Policy, "Federal land management agencies currently collect data on wildland and prescribed fires, however, no standard reporting format is followed."[53] The data collected by land management agencies is usually limited to the time and approximate location of the fire, fire perimeter area, and a qualitative description of fuels at the point of ignition.

The WRAP's 1996 fire emissions inventory preparation effort demonstrated that the data collected by land management agencies for wildland and prescribed fires is insufficient to support the development of a consistent emissions inventory. Although current land management agency data collection efforts do not consistently track all of the essential components identified herein, the feasibility of modifying the current tracking system to maximize economic efficiency and meet the needs of both land management and regulatory agencies should be evaluated. The modification of current land management agency data collection efforts may prove to be the most effective and economically efficient method for the tracking of wildland and prescribed fires in the WRAP region.

[53] EPA Interim Policy, p. 29.

3.2. Indirect Estimation

Direct data collection methods have historically been the primary means of data collection for fire tracking systems. However, emerging technologies may potentially allow for some of the fire tracking system essential component information to be addressed via indirect estimation techniques. Indirect estimation techniques have varying degrees of complexity and accuracy, and range from an annual burner survey for a particular fire source sector, to statistical methods, to daily remote sensing. Remote sensing might be considered for areas or fire sectors where no previous tracking for fire sources has been established.

Appendix A-10f. WRAP report "Nonburning Alternatives for Vegetation and Fuel Management"

Summary

Past practices of fire suppression in the western United States have resulted in the overaccumulation of timber and undergrowth in forest and rangeland habitats. This overaccumulation of biomass has caused a degradation of forest habitat, wildlife habitat, forest health, and biodiversity; has reduced watershed water quality and quantity; has led to spiraling costs of fire suppression and elevated risks to both public and firefighters; and has increased the occurrence of catastrophic wildfires. For several decades, prescribed burning has been the preferred method for addressing fuel load management; however, it also results some adverse impacts. Specifically, in the context of this document, prescribed fire produces emissions that contribute to the increasing air quality problems in the western United States.

In response to this problem, Congress in 1991 created the Grand Canyon Visibility Transport Commission (GCVTC) to advise the U.S. Environmental Protection Agency on strategies for protecting visual air quality at national parks and wilderness areas on the Colorado Plateau. The GCVTC conducted an extensive review of information relating to the problem, collaborating with governmental, business, tribal, and environmental interests and, in June 1996, approved its final report to the EPA. The report made more than 70 recommendations for improving visibility in 16 national parks and wilderness areas on the Colorado Plateau.

The Western Governor's Association (WGA), in conjunction with federal, state, tribal, and local entities, formed a voluntary organization of western states, tribes, and federal agencies. The purpose of the Western Regional Air Partnership (WRAP) is to build on the work of the GCVTC in developing and planning programs that can contribute to reducing emissions and improving visibility throughout the West. Participating states are Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. Participating tribal nations include Pueblos of Acoma, Campo Band of Kumeyaay Indians, Cortina Indian Rancheria, Hopi Tribe, Hualapai Nation of the Grand Canyon, Jicarilla Apache Tribe, Northern Cheyenne Tribe, Salish and Kootenai Confederated Tribes, Pueblo of San Felipe, and Shoshone-Bannock Tribes of Fort Hall. Representatives of other tribes participate on WRAP forums and committees. Participating federal agencies are the Department of the Interior (National Park Service and U.S. Fish and Wildlife Service), the Department of Agriculture (U.S. Forest Service), and the EPA.

The WRAP is composed of a planning group, a technical group, and several forums tasked with the development of technical and policy options for specific

areas of interest. The Fire Emission Joint Forum (FEJF) is responsible for making recommendations on strategies and methods to manage emissions from prescribed fire. Among the many tasks with which FEJF was charged was the responsibility of investigating the appropriate use of nonburning alternatives to prescribed fire on wildlands.

The use of alternatives to prescribed burning, when such alternatives are feasible, result in fewer emissions than burning. However, practices vary widely from state to state, obstacles are numerous, and there is limited awareness of the existence of viable alternatives to burning. Accordingly, WGA retained Jones & Stokes to conduct a series of interviews with landowners, land managers, and stakeholder group members to examine the use of nonburning alternatives on wildlands. Information developed during the course of the interviews was used to:

- identify nonburning alternatives,
- establish criteria for the use of nonburning alternatives,
- identify barriers to the use of nonburning alternatives,
- investigate approaches to overcome these barriers,
- examine current accountability mechanisms, and
- develop recommendations to promote the use of nonburning alternatives.

This document represents the compilation of the work done during the course of the interviews and other data collection. The objectives of this document are: (1) to provide landowners and land managers with a comprehensive reference document that describes alternatives to prescribed burning; (2) to provide decision makers with the tools necessary to develop cogent nonburning strategies for vegetation and fuel load management; and (3) to assist air quality regulators, environmental organizations, and the general public in understanding the environmental, economic, and practical advantages of nonburning alternatives.

Chapter 1
Introduction

The 2000 fire season was the worst in 50 years. The scale and intensity of the 2000 fire season capped a decade that was characterized by a dramatic rise in the number of large wildland fires, the costs associated with fire suppression, and the values at risk in the wildland-urban interface. In the 2000 fire season, approximately 123,000 fires burned more than 8.4 million acres. More than $2 billion from federal accounts was spent suppressing wildland fires. This amount does not include state and local firefighting suppression costs; direct and indirect economic losses to communities; loss of private, state, and federal resources; or damage to ecosystems.

In August 2000, President Clinton directed the Secretaries of Agriculture and the Interior to develop a response to severe wildland fires, reduce fire impacts on rural communities, and ensure sufficient firefighting capacity in the future. Congress in turn mandated implementation of a National Fire Plan (NFP) through legislation and appropriations. The NFP addresses conditions that have evolved over many decades and cannot, consequently, be reversed in a single year; these conditions will require consistent and ongoing future management efforts. The NFP is a long-term commitment based on cooperation and communication among federal agencies, states, local governments, tribes, and other interested parties.

The 2002 fire season was the second worst season in the past 50 years; approximately 6.7 million acres burned in more than 68,000 fires. Colorado, Arizona, and Oregon all suffered the largest fires recorded in the past century. Early in the season, about 45% of the country reported moderate to extreme drought conditions; nearly 50% remained in conditions of moderate to extreme drought as the season ended. Clearly, with the worst and second-worst seasons in half a century occurring only 2 years apart, the problem of catastrophic wildfire is becoming increasingly critical.

Fire in the West

For thousands of years, periodic fires, ignited by lightning or Native Americans, shaped the ecosystems of the western United States; forests and other western ecosystems supported an abundance of fire-tolerant or fire-adapted species. The historical fire regimes exerted profound influence on the accumulation of fuels, nutrient cycling, patterns of vegetation growth, and distribution of natural communities. Because of the range of these influences, the fire-suppression activities of the twentieth century have had widespread effects, particularly on those systems that were most adapted to or dependent upon their historical fire regimes.

Fire suppression can lead to marked changes in stand density. The increase of small- and medium-size classes of shade-tolerant and fire-sensitive species that can result from suppression is of particular concern. This change produces an increase in the amount and continuity of live fuels near the forest floor that can act as ladder fuels (i.e., fuels that can conduct fire from ground-level or surface fuels into the forest canopy). Moreover, harvest practices of the twentieth century have typically removed the larger overstory trees, accelerating growth in the dense understory and increasing the homogeneity of the fuel structure. The lack of fire has also caused dead fuels on the forest floor to accumulate in excess of their presuppression levels.[1]

In general, today's typical forest stand is denser, contains more ladder fuels, and has a higher surface fuel load than historic forest stands. Contemporary forests contain a greater abundance of species that would historically have been excluded by fire (i.e., nonclimax or invasive species). Nonforest ecosystems have been similarly modified by fire suppression activities.

Restoring the Balance

Only in the past few decades has it become widely understood that the historical practice of fire suppression has had costly and potentially catastrophic repercussions. This new awareness has prompted a strong movement towards the use of prescribed burning, the intent of which is to reduce the risk of catastrophic wildfire and to restore wildland conditions to a more natural fire regime. However, because of the cumulative impacts of prescribed burning on air quality—already compromised by automotive and industrial emissions—as well as on other environmental resources, there is a strong case to be made for the use of nonburning alternatives that have the potential to achieve many of the same results as prescribed burning but without the adverse effects.

Under the auspices of WGA, WRAP, and FEFJ, Jones & Stokes has prepared this manual to foster a greater understanding of the benefits and mechanics of nonburning alternatives. Early in the process, it became clear that a great many answers to the complex issues involved in vegetation and fuel load management already exist, and that the judicious compilation of available knowledge and resources could provide a user-friendly roadmap to the arduous undertaking of developing site-appropriate strategies. Accordingly, Jones & Stokes conducted extensive interviews with a wide array of individuals involved in vegetation, fuel

[1] Sierra Nevada Ecosystem Project, Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options (Davis: University of California, Centers for Water and Wildland Resources, 1996).

load, and land management. Interviewees included federal land managers, state land managers, tribal land managers, researchers, timber industry representatives, and environmental interest group representatives.

How to Use This Manual

Because of the enormous complexity of the issues involved and the rather daunting variability of conditions throughout the western United States, it was not possible to create an exhaustive "how-to" manual that would address all the contingencies that might face decision makers. Accordingly, this document has been developed to address the categories of considerations that decision makers are likely to confront, the range of options available for development of nonburning fuel management strategies, and the approaches to finding the best solutions to each land manager's particular situation. It must be understood that every situation is unique, and that a "one-size-fits-all" approach to development of a strategy for management of fuel loads is never appropriate. It is therefore the intent of this manual to provide decision makers (e.g., resource managers, landowners) with the tools to reach an informed decision.

Chapter 2 (*Vegetation Management: To Burn or Not To Burn*) considers the scope of variables that must be weighed in developing a vegetation or fuel load management strategy. Chapter 3 (*Nonburning Alternatives: Variables, Criteria, and Definitions*) provides an overview of the concepts and vocabulary of vegetation and fuel load management, and summarizes the options available for nonburning treatment programs. Chapter 4 (*Getting to Work: How to Build a Nonburning Strategy*) guides the decision maker through the technical and nontechnical considerations one must navigate in designing a vegetation or fuel load management program. Chapter 5 (*Conclusions and Recommendations*) explores means by which the increased acceptance of nonburning alternatives might be promoted. Appendix A presents a sample worksheet for evaluating the options that might be appropriate for any given set of circumstances, as well as an example of the chain of reasoning used to develop a similar site-specific evaluation tool. Other appendices provide [. . . .]

Chapter 2

Vegetation Management: To Burn or Not To Burn

The Rationale for Treatment

As discussed in Chapter 1 (*Introduction*), the need for management activities to correct the results a century of fire suppression is clear. In considering the approach to developing management strategies, it might be useful to review the concept of fire and fire management in its broadest theoretical context.

Fire in the most basic sense is a chemical reaction, involving the rapid oxidation of combustible material and characterized by the release of energy in the form of heat and light. The familiar diagram known as the *fire triangle* [Figure 2-1; Fire Triangle] illustrates the three components essential to the oxidation process we know as fire: fuel, heat, and oxygen.

In the context of wildland fire, fuel is in reality the only one of these components over which humans can hope to exert any meaningful control. The characteristics of the fuel, considered in the context of topography and climate, determine the manner in which fire is likely to ignite, develop, and spread. This process of ignition, development, and movement through the habitat is termed *fire behavior*.

The approach to reduction of fire risk through management activities involves implementing actions that will modify the behavior of fire. The attributes of fuel that management activities can effectively address are, for all intents and purposes, limited to the quantity and arrangement of the fuel load. On the most basic level, vegetation and fuel load management entails disarranging or reducing the quantity of the fuel load to impede fire's ability to pass through the habitat. Continuity of the fuel load can be disrupted vertically or horizontally; firebreaks can be created; fuel can be removed off site. The optimum strategy is governed by numerous variables, and the body of knowledge concerning fire ecology and fire management is continually expanding. The mechanics of fuel load management are discussed in greater detail in Chapter 3 (*Nonburning Alternatives: Variables, Criteria, and Definitions*) and Chapter 4 (*Getting to Work: How to Build a Nonburning Strategy*).

Development of a reasonable vegetation and fuel load management strategy must be predicated upon an understanding of the *desired future condition*. The desired future condition, in turn, requires an understanding of the disparity between historic conditions (i.e., the conditions that existed before fire suppression activities or other land use practices altered the vegetative conditions of the area under consideration) and current conditions. The management strategy, then, is the roadmap for moving from current conditions to the desired future condition.

Typically, the objective of the management strategy is either to restore forest health or to protect human life and property. While these objectives frequently overlap, such is not always the case. Restoration of forest health generally entails returning the habitat to its *historic fire regime*, defined by the natural patterns of frequency, predictability, seasonality, intensity, duration, and scale with which fire historically passed through the habitat. Protection of human life and property is frequently addressed by restoring the historic fire regime; however, some habitats are naturally subject to severe fire regimes. In such cases, additional treatment may be necessary to attain the desired future condition.

Fire regimes have been classified into five groups; these are summarized in Table 1.

Table 1. Fire Regimes

Classification	Fire Return Interval	Severity	Example Habitats
Group I	0–35 years	Low	Ponderosa pine, other long needle pine species, and dry site Douglas-fir
Group II	0–35 years	Stand replacement	Drier grasslands, tall grass prairie, and some Pacific chaparral ecosystems
Group III	35–100+ years	Mixed	Interior dry site shrub communities such as sagebrush and chaparral ecosystems
Group IV	35–100+ years	Stand replacement	Lodgepole pine and jack pine
Group V	>200 years	Stand replacement	Temperate rain forest, boreal forest, and high elevation conifer species

A corollary descriptor of fire conditions describes a fire regime's extent of deviation from historic conditions. These *condition classes* also measure general wildfire risk; however, it is important to understand that the criterion of fire risk is based upon the loss of key components of the ecosystem. For example, a habitat with a naturally severe (i.e., stand-replacing) fire regime, while potentially posing a serious risk to human property, might be considered to have low risk because the ecosystem is adapted to fire and would be likely to reestablish in accordance with historic patterns.

- Condition Class 1: Fire regimes in this condition class are mostly within historical ranges. Vegetation composition and structure are intact. The risk of losing key components of the ecosystem from fire is low.
- Condition Class 2: Fire regimes in this condition class have been moderately altered from their historic range, either by increasing or decreasing the fire frequency. The risk of losing key components of the ecosystem from fire is moderate.
- Condition Class 3: Fire regimes in this condition class have been significantly altered from their historical return intervals. Vegetation composition, structure, and diversity have been significantly altered. The risk of losing key components of the ecosystem from fire is high.

As mentioned above, treatment of a habitat may be appropriate to restore a habitat's health as well as to protect human resources. Accordingly, areas in any of the condition classes may be suitable candidates for treatment. Conditions that indicate the need for treatment may be divided into two broad categories

- An ecosystem in which the fire regime has been altered, increasing the risk of fire that could result in loss of ecosystem elements as well as in destruction of human life or property.
- An ecosystem in which the fire regime is naturally severe and requires treatment to protect human life or property.

When an ecosystem has been altered from its historic regime, efforts to restore that regime are indicated; in other words, the management objective is to modify a condition class 2 or 3 ecosystem into a condition class 1 system. If ecosystem health is the object, such a strategy is considered to be a restoration activity.

However, whether or not the fire regime has been altered, risk of wildfire must be addressed in areas near human resources. In the case of condition class 1 habitats (presumably those with naturally severe fire regimes), the treatment would assume a different strategic character than a restoration activity; for example, treatment might entail creation of fire breaks or home protection zones.

An Overview of Prescribed Burning

If one accepts the proposition that the restoration of natural fire regimes is a legitimate management objective for the preponderance of western wildlands, then it is important to understand the distinction between prescribed burning and natural fire. Although prescribed burning has been widely used in recent decades as a vegetation and fuel load management tool, and despite the acknowledged virtue of prescribed burning to restore natural fire regimes, the mechanisms of prescribed burning and natural fire are widely divergent. For instance, naturally occurring wildfires tend to occur during fire season (i.e., summer through fall), while prescribed burning is generally implemented under precisely those conditions that would most likely preclude the spread of a naturally occurring fire. This difference in timing is a necessary precaution against the risk of escape; indeed, the disparity between natural and prescribed fire is intimately linked with the fact that it is the unnatural conditions created by past management decisions that necessitates treatment in the first place. It should be borne in mind throughout the ensuing discussions that *those areas that are most difficult to treat are the areas in greatest need of treatment*.

The Functions of Fire

Naturally occurring fire in western ecosystems serves several ecosystem functions. Fire can eliminate invasions of species from outside the ecosystem, thin vegetation to facilitate establishment of young plants, eliminate fuel loads before they attain potentially catastrophic proportions, and recycle nutrients. Fire is an integral component of many western habitat types.

Prescribed fire can accomplish many of the same functions as naturally occurring fire; however, as discussed above, the context of prescribed fire differs from that of naturally occurring fire. Because of its controlled nature, prescribed fire does not entirely duplicate the ecological function of fire in the west, nor does it necessarily address all hazardous fuel conditions.

As suggested by the interviews and literature reviews conducted for preparation of this document, the reasons for implementing prescribed burning can be assigned to three broad categories: hazardous fuels reduction, habitat management, and ecological restoration. The functions listed below are those that land managers are most likely to cite for using prescribed fire.

- Reduction of fine fuels.
- Reduction of surface fuel loading.
- Mortality of ladder fuels.
- Release of nutrients.
- Improvement of wildlife habitat through stimulating regrowth and seeding.
- Control of some invasive species, pests, and diseases.

Use of prescribed fire in wildlands falls into two broad categories.

- **Vegetation management.** Objectives include the reintroduction of fire into fire-adapted ecosystems, stimulation of regrowth of species desired for browse, creation of openings for early successional species, control of invasive species, and nutrient recycling.

- **Fuels management.** Objectives include cleaning up post-silvicultural residues, maintenance or creation of fuel breaks to protect resources, and preventing losses from catastrophic wildfire.

These objectives are not mutually exclusive, and often several objectives can be achieved through a single treatment strategy. For example, treatments designed to make natural stands of forestland more fire resistant can facilitate the return of fire into the ecosystem while protecting houses or other adjacent resources.

Challenges to Burning

Because fire is such an integral component of many western ecosystems, and because a key objective of many vegetation and fuel management programs is to restore habitats to an approximation of the ecosystem's natural fire regime, it is often assumed that prescribed burning is the most natural method to achieve such an objective. However, as mentioned above, the conditions under which prescribed burns are implemented differ significantly from the conditions under which naturally occurring fires enter the ecosystem. For example, naturally occurring fires are likeliest during the summer or fall under conditions of low humidity, high temperatures and, frequently, high winds; prescribed burns, to the contrary, are generally implemented under carefully monitored conditions of specific levels of fuel moisture, higher atmospheric humidity, moderate temperatures, and relatively low winds to minimize the risk of escape.

Despite the virtues of prescribed burning for vegetation and fuel load management activities, it must be recognized that fire carries negative impacts and risks as well. Disadvantages of burning include:

- smoke and other emissions that contribute to air quality problems and visibility impacts,
- potential loss of resources from escapes, and
- loss of material that might otherwise be utilizable.

Some of these impacts violate the regulatory requirements of the Clean Air Act, while others entail risk to resources and to the safety of landowners and firefighters. Moreover, there are logistic disadvantages to the use of burning, many of which can be avoided by the use of nonburning alternatives.

Air Quality

The Clean Air Act (CAA) of 1970 established national ambient air quality standards (NAAQS) for six pollutants, known as *criteria pollutants*: carbon monoxide (CO), ozone, particulate matter with a diameter less than 10 microns (inhalable particulate matter or PM10), nitrogen oxides (NO_x), sulfur dioxide (SO_2), and lead. Most standards were set to protect public health; however, for some pollutants, standards are based on other values, such as protection of crops, protection of materials, and avoidance of nuisance conditions. Except for ozone, NAAQS represent short-term (24 hours or less) concentrations that may be exceeded no more than once per year and annual concentrations that may never be exceeded. NAAQS for ozone may be exceeded no more than 3 days in 3 years.

In July 1997, EPA promulgated a NAAQS for PM2.5, making it the seventh criteria pollutant. EPA asserts that these fine and ultrafine particles are closely related to significant adverse health effects. Accordingly, EPA has established a 24-hour average limit of 65 micrograms per cubic meter and an annual average limit of 15 micrograms per cubic meter. Controls for PM2.5 will probably not be established until 2005–2008.

The smoke released by wildland fires contains large quantities of fine particulate matter, as well as many of the same chemical constituents found in urban smog. Wildfire smoke also contains organic compounds, known as polycyclic aromatic hydrocarbons, some of which are toxic and potentially carcinogenic. Because fine particles are readily inhaled and retained in the lungs, and because wildfires release *fine* and *medium* (i.e., <2.5 micron and 2.5–10 micron) particles, these emissions represent a potential to human health and the environment.

Moreover, authorities estimate that every 1,000 acres that burn in a wildfire generate a quantity of fine particulate emission equivalent to that produced by all the motor vehicles in southern California in a day. Accordingly, the contribution of prescribed burning to preexisting air quality conditions can be seen to be significant.

Risk of Escape

Fire by its very nature is characterized by an inherent lack of control. This is of particular concern when using fire as a vegetation or fuel load management tool (remember: *those areas that are most difficult to treat are the areas in greatest need of treatment*). While this characteristic of unpredictability can contribute to results that mimic natural processes, it can also have serious consequences in the real world of land ownership boundaries, adjacent infrastructure, unnatural fuel load conditions, and political and financial liabilities.

The difficulty of confining fire to a prescribed area bears an associated risk; the degree of this risk is influenced by the nature of adjacent resources that might be susceptible to damage or loss, as well as by the kinds of conditions that influence fire behavior (e.g., weather, topography, fuel characteristics). In recent years several large wildfires have begun as prescribed burns, but upon escaping control they destroyed infrastructure, natural resources, watersheds, and people's homes. In addition to the costs of these losses, a huge amount of money was expended in fighting the fires. Financial liability can fall in many directions depending on location and jurisdiction; whoever must bear the cost, it is clear that escape of prescribed fire carries the potential for serious calamity.

Loss of Materials

Burning of material that might be used as a source of fiber for pulp, particleboard, or energy generation may not be the most efficient or judicious use of our natural resources. The demand for wood and wood products is becoming increasingly difficult to satisfy due to limitations of timber harvest activities on National Forest System lands. Additionally, the use of such submerchantable material might also offset the demand for material that is traditionally derived from large, merchantable trees harvested on public as well as private lands.

Logistic Disadvantages

Because of concerns associated with the risks of escape, prescribed burning is necessarily constrained by rigorous conditions. For instance, burn plans specify very precise parameters of humidity, wind conditions, temperature, and moisture content of both live and dead fuel within which the burn may be implemented. These parameters, as well as regulatory restrictions, can narrow the window of feasibility for a particular burn plan to as little as several days in an entire season. If for some reason those days are precluded, the window might close until the next season. As such opportunities are missed, fuel conditions can continue to worsen. Furthermore, the local air quality management agency may impose stringent requirements to ensure acceptable levels of emissions. For example, the presence of a stable air mass, which is the safest condition under which to initiate a burn, is also the least desirable condition for air quality concerns. Constraints such as these can combine and overlap to frustrate the most well-conceived projects.

It should be remembered that many areas in greatest need of treatment are areas of condition class 2 or 3; in such areas the vegetation structure and composition have been so modified that fire cannot likely be introduced under uncontrolled conditions. By definition, areas of these condition classes are at risk of losing ecosystem components in the event of fire. Consequently, treatment necessitates a managed burn that is cooler—that is, less intense—than a naturally occurring fire would be. While such a managed burn poses less risk of escape than a naturally occurring fire would pose, it is also unlikely to achieve the desired future condition of the treatment area; to the contrary, such a burn is an intermediate step, presumably establishing conditions that would permit a subsequent entry, or entries, with fire to attain the desired condition. Each entry entails repeated risk of escape as well as additional emissions of pollutants.

Evaluating Nonburning Alternatives

In view of the disadvantages to prescribed burning discussed above, there are strong arguments to be made in favor of a careful evaluation of nonburning alternatives when developing a vegetation or fuel load management strategy. Specific nonburning alternatives are discussed in greater detail in Chapter 3 (*Nonburning Alternatives: Variables, Criteria, and Definitions*); for the purpose of the current discussion, nonburning alternatives can be broadly defined as treatments employing manual, mechanical, chemical, or animal (i.e., managed livestock grazing) methods to address management of vegetation or fuel loads.

Nonburning alternatives must, if they are to be satisfactory treatments, mimic at least some of the effects for the achievement of which prescribed burning is typically implemented. Table 1-2 shows a comparison between the effects of potential nonburning alternatives and the effects of prescribed fire.

In assessing nonburning treatments and the relative reasonableness of various alternatives, one must consider a spectrum of criteria to evaluate the potential impacts on fuels, the environment, and society. Often, an initially promising idea can have unforeseen consequences. The practice of fire suppression is a case in point: for many years, fires were suppressed with the objective of protecting forest resources. However, as current understanding teaches, this practice has instead produced an increase in catastrophic wildfire, thereby threatening the very resources it was intended to protect.

Accordingly, it is important to evaluate the *reasonableness* of potential nonburning alternatives. Reasonableness can be taken to reflect the likelihood of a treatment to achieve desired results; the relative absence of risk that unanticipated adverse effects will ensue; and the alternative’s conformance to practical, technical, political, and economic constraints.

A variety of criteria can be applied during the evaluation process. This document emphasizes those criteria that identify generalized effects of specific treatment types. Criteria that can be evaluated only when considering site-specific information are not useful for the generic assessment of reasonableness that falls within the purview of this document. For example, potential impacts on wildlife, while extremely important to consider, are far too site-specific to address generally. All treatment types impact wildlife habitat; the degree and character of the impact, however, varies with existing conditions, desired future conditions, and the community of species that occurs on the target site.

A myriad of factors must be considered in developing any vegetation or fuel load management strategy. This document adopts a simple division of the issues that land managers must address; however, as in all activities involving resource management, it is important to remember that the different issue areas are interconnected and that systems of organization are merely tools for the convenient processing and assimilation of information. The four issue areas used in this manual are:

- technical considerations,
- environmental considerations,
- economic considerations, and
- sociopolitical considerations.

The evaluation of nonburning alternatives should include a comparison of the effects of the nonburning treatment method under consideration with the effects that would be achieved through the use of burning.

Finding Innovative Solutions

The interviews conducted in preparation of this report suggested three broad trends regarding the choice of prescribed burning versus that of nonburning alternatives. Respondents inclined towards burning when cost was the determining factor; nonburning alternatives gained support in situations where burning could not be conducted safely, such as in the urban-wildland interface and in areas where pretreatment activities must be carried out prior to burning. Another consideration was the potential marketability of materials on the site.

Traditionally, vegetation and fuel load management has been accomplished by one of two methods: harvesting and burning. Each method has gained staunch adherents and dedicated opponents; consequently, the entire issue has become tangled in emotional response and highly charged rhetoric. Nevertheless, it is generally understood that action must be taken to address a problem that has been a century and more in the making and that is becoming yearly more critical. It will be necessary for groups on all sides of the issue to suspend their preconceptions and examine possible alternatives objectively if the fuel load crisis is to be addressed in a safe and timely manner. It must be borne in mind that the situation as it exists in much of the western wildland habitats is *not* a natural situation; it will, consequently, require decisive actions to correct it. However, with creative thinking, good will, and clear intentions, there is no reason that all parties concerned cannot arrive at mutually acceptable approaches to address acknowledged problems.

Chapter 3

Nonburning Alternatives: Variables, Criteria, and Definitions

The task of restoring natural communities to a semblance of historic conditions is one that cannot be accomplished by the simple reintroduction of fire into the ecosystem. In many western ecosystems, in fact, such a reintroduction is no longer an option due to the overaccumulation of fuel loads. While it is important to recognize that fire is an integral component of ecosystems in the western United States, it is equally important to recognize the merits of nonburning alternatives to address vegetation and fuel load management issues. At the same time, it must be emphasized that implementation of a nonburning alternative does not preclude subsequent use of burning; indeed, prescribed burns are often predicated on preliminary nonburning pretreatments.

The need to reduce fuels increases every year, and proper use of mechanical equipment or other nonburning alternatives can be instrumental in reducing the impact of wildfires in the west. Many of these alternatives have a broader window of opportunity and a much lower level of associated risk than prescribed fire.

In developing the appropriate strategy for any proposed treatment area, it is necessary to proceed through a multilayered evaluation of the issue areas introduced in the previous chapter. Moreover, it is critical to establish the criteria by which one must evaluate various treatment options in order to make an informed decision. Again, it must be emphasized that every situation is unique and that superficially similar treatment areas may be subject to markedly differing constraints. Preparation of a worksheet or checklist similar to that presented in Appendix A should assist decision makers in reaching an informed decision regarding the most appropriate treatment method for the area under consideration.

Technical Considerations

Technical considerations entail the activities that can be conducted within the parameters of physical conditions (e.g., topography, habitat type, fuel conditions), regardless of other considerations. For example, if the terrain is too steeply sloped to use heavy equipment safely, then the range of treatment options that depends on the use of such equipment is clearly excluded.

When options have been screened on the basis of feasibility, it is important to consider the effects that the various treatment options will have on fuels and fire behavior. The evaluation of nonburning alternatives should address:

- changes to be made to the fuel structure;
- whether the treated area will exhibit increased resistance to fire;
- a comparison between the anticipated results of the nonburning alternative with the results of prescribed burning.

Land managers should become conversant with the habitat types in their areas of responsibility, as well as with the basic concepts and common terminology relating to fuel structure and characteristics. Only with a basic working knowledge of the technical aspects of fuel load management can reasonable strategies be developed.

Physical Conditions

Habitat Types

As Map 1 shows, the western United States is a complex amalgam of vegetative communities. These communities have evolved in response to varied characteristics of topography, climate, soil conditions, hydrologic regime, and other physiographic as well anthropogenic conditions. Each community is characterized by a suite of fuel conditions and fire-related traits and responses. For the purposes of the generalized approach of this document, many of these communities can be grouped into broad categories that share common fuel characteristics and types of resources that can be exploited for similar uses.

Map 2 shows the simplified categories that this document uses to address the issues of vegetation and fuel load management. The habitat categories that might be candidates for vegetation and fuel load management strategies are:

- grassland,
- shrubland, and
- forested habitat.

These three habitat categories can be roughly correlated with appropriate equipment types and material resources with utilization potential. As has been discussed elsewhere, site-specific characteristics will have to be addressed in some detail for each proposed treatment project.

Grassland: The dominant fuel type and predominant carrier of fire is grass or forbs. This category includes many oak woodland and savanna communities; because these communities generally exhibit no vertical continuity of fuels, fire is usually limited to surface grasses.

Shrubland: The primary carrier of fire in these vegetation types is a fairly contiguous shrub layer. Fire behavior tends to be more intense than in grassland habitats because the vegetation is typically characterized by greater height and density, larger diameter stems, and (frequently) higher levels of volatility resulting from resins and oils. Surface fuels are limited because the shrubs' density inhibits growth of other plants and the vegetation type does not produce large quantities of litter. Some trees can be present, but not usually in sufficient density to inhibit the growth or continuity of the shrubs.

Forested habitat: The primary carrier of fire in this vegetation type is litter from the trees in the form of needles/leaves and dead branches. Younger trees, shrubs, or low branch growth can provide vertical continuity of fuels. In the case of severe wildfire, dense canopies can become carriers.

[2 Sets of photos showing historical changes in fuel conditions]

[1 photo of excessive fuel load in grass]

[2 photos of excessive fuel loads in shrub]

[3 photos of excessive fuel loads in forest]

Fuels

Fuels can be defined as both living and dead vegetation that is available to burn during a fire. The difference between vegetation type and fuel is that while a vegetation community is defined by species composition, a fuel type is determined by how a given area will burn. The manner in which a given area will respond to fire is a function of the continuity of living and dead vegetation, the height and layers of vegetation, the volume and availability of different sizes of fuels, and weather conditions.

Three categories of fuels are critical in understanding fire behavior and the theory of vegetation and fuel load management:

- surface fuels,
- ladder fuels, and
- aerial fuels.

The role of each category in fire behavior must be understood, and the treatment selected must be appropriate to the category or categories of fuels that represent the primary risk in the treatment area.

Surface fuels are those fuels that are in contact with the surface of the ground. They can, depending upon the particular vegetation community, extend up to 5 feet above the ground. Surface fuels include detritus such as fallen leaves or needles, twigs, bark, cones and small branches, heavier branchwood, and downed logs. Surface fuels can also include understory growth such as grasses, forbs, low and medium shrubs, and tree seedlings. These fuels are important because they are the primary carrier of fire. Their specific characteristics influence such aspects of fire behavior as rate of spread, flame length, and residence time.

Ladder fuels include taller surface fuels. These fuels generally lie between 5 and 15 feet above the ground. They provide vertical continuity between vegetation layers, conducting fire from surface fuels into the crowns of shrubs or trees. Ladder fuels can initiate and spread crown fires, which lead to increased resource damage, pose high levels of risk, and are very difficult to contain.

Aerial fuels include both live and dead material in the forest or shrubland canopy. These fuels are typically more than 15 feet above the surface. They include tree branches, twigs and cones, snags, moss, and high brush. Aerial fuels are the fuels available for supporting a crown fire.

All fuel types have characteristics that are important to evaluate when developing the most appropriate strategy for any given area. These characteristics include fuel volume, fuel size, arrangement and continuity of fuels, and fuel compactness.

Fuel volume is the quantity of a given fuel type, typically measured in tons per acre. This measure is meaningful only if is contextualized; for instance, it can be compared with a historical or natural condition, or a desired target volume.

Fuel size affects the rate of spread and residence time of fire. The size of the material determines the speed of ignition and rate of consumption. For example, in selecting kindling for a cooking fire, smaller, lighter materials are used to start the fire and to generate enough heat to ignite the larger, longer-lasting material. Fuels are normally categorized into two size classes: fine and heavy. Fine fuels are generally those less than ¼ inch in diameter; these include grasses, pine needles, twigs, and smaller branches. Heavy fuels have larger diameters, are more difficult to ignite, and are consumed much more slowly. In general, fine fuels determine how easily a fire ignites and how fast it spreads, and heavy fuels determine how long the fire persists in a given area (residence time).

Arrangement and continuity describe how fuels lie in relation to one another on both horizontal and vertical axes. On the horizontal axis, conditions are described as patchy or uniform. On the vertical axis, conditions are described in terms of the presence and condition of ladder fuels. Uniform distribution of fuels facilitates a complete, rapid burn. Laddering creates conditions for fire to spread into the crowns, where it can move faster and be more difficult to control.

Fuel compactness generally refers to surface fuels. Fire burns more rapidly in loosely compacted fuels because of the availability of oxygen. Compacted fuels, such as piled logging debris or duff, burn more slowly due to lack of available oxygen.

Topography

Topography is the relief of the proposed treatment area. It describes the angle of slopes, the narrowness of canyons, and the elevational variations within a given area. Topography affects fire behavior in several ways; it can influence regional airflow patterns, and fire itself can respond to steep slopes because of heat's propensity to rise. Moreover, the character of the terrain serves as a criterion to evaluate the reasonableness of treatment options. For instance, slopes steeper than 40% are considered (in the context of this document) too steep to use mechanical equipment safely; accordingly, mechanical treatment must be excluded as a treatment option.

Accessibility

Accessibility generally addresses the existence of roads in or near the treatment area as well as the degree to which the area admits movement within it. Roads are necessary for transportation of mechanical equipment, workers, and any materials that may be transported offsite for utilization or disposal. While presence of a road system does not automatically qualify a mechanical treatment option as reasonable, the absence of roads generally precludes mechanical treatment as a viable option. Moreover, particularly rugged terrain or extremely dense vegetation must be considered in determining whether specific kinds of equipment, or even work crews, can navigate the treatment area.

Theory of Fuel Load Management

The fundamental objective in developing a vegetation and fuel load management strategy is to modify the behavior of fire that may enter the proposed treatment area. As discussed in Chapter 2 (*Vegetation Management: To Burn or Not To Burn*), the fuels can be modified by either removing them or redistributing them.

Initial activities are generally directed towards the surface and ladder fuels, because these are the fuel types where fires typically ignite and spread. Treatment of surface fuels can reduce risk of ignition, particularly in areas of high levels of human use or where the surface fuels exhibit a high degree of continuity. Treatment of ladder fuels helps to decrease the risk of a more dangerous crown fire. However, the sequence and methods of treatment are wholly dependent on site-specific conditions.

In any case, the initial target of any treatment program will typically be the fine fuels, because these pose the highest risk for ignition and spread of fire. Whether material is modified and left on site or removed depends upon site-specific conditions, both technical and financial; however, it should be borne in mind that fuels left on site remain fuels, and may require additional treatment to achieve the desired future condition. For example, if ladder fuels require aggressive treatment and are cut and scattered on site, they are merely transformed into surface fuels. Depending on the preexisting conditions, additional treatment might be required to alleviate the resultant excessive surface load.

Treatment Options

Four categories of treatment options are available: manual/hand, mechanical, grazing, and chemical. These four categories are not mutually exclusive, and treatments frequently entail a combination of methods. Each category includes specific techniques appropriate to various conditions and situations.

Manual/Hand

Hand work involves picking up and moving limbs and brush, as well as cutting downed and standing materials using hand tools or chainsaws. The required levels of skill range from unskilled to skilled (e.g., the ability to use a chainsaw safely). Manual methods usually entail a fairly large crew. Constraints on manual methods are: fuel size (up to 9 inches in diameter); accessibility of the site (e.g., slope, density of understory, rocks, safety); limited opportunity to utilize materials; slow production rate (defined as the acreage that is treated per unit of time—for example, acres per day); and needs (support, safety, sanitation) of personnel.

Manual work—lifting, cutting, and carrying forest materials—is generally limited to materials of roughly 9 inches or less in diameter. Larger materials can be handled, but efficiency, production rate, and safety decrease rapidly as size increases. If the fuels requiring treatment exceed the 9-inch-diameter threshold, hand work is not a good option.

Although hand crews are not subject to the same constraints of access and mobility as mechanical equipment, such constraints must nevertheless be considered. Steeper slopes become decreasingly efficient and increasingly hazardous. Density of vegetation can impede access to the work site and movement within it.

Hand work rarely generates material for utilization. It is difficult and inefficient to carry material to a location where it can be transported off site. Firewood is often collected manually, but most other types of utilization require machinery to enter the area being treated.

Hand treatments usually address rearrangement as opposed to removal of fuels. While this can be an effective treatment in certain conditions, it is typically a short-term solution. Alternatively, it can be used as a primary treatment that is followed by burning to consume residual material; the site is subsequently managed by prescribed maintenance burns.

Production rate is determined by the structure of the fuels being treated; for example, a dense stand takes much longer to treat than an open stand. Moreover, a fairly large workforce is required to treat areas in excess of a few acres; a larger workforce, if it is to be efficient, requires close coordination and a structured organization system.

Advantages of hand work include the low level of ground disturbance, the ability to work on steeper slopes than is feasible for many kinds of mechanical equipment, and the ability to treat sensitive habitats such as riparian areas.

Cut and Scatter

Hand crews cut and scatter material to change the vertical and horizontal continuity of the fuel load. This technique increases the surface fuel load by redistributing ladder fuels onto the ground surface. It is appropriate where stand density is generally low and existing surface fuels are shallow. An upper depth limit for scattered material is generally prescribed.

Pile

Cut material can be piled either by hand or using mechanical equipment. As in the cut and scatter method, the fuel load is redistributed rather than reduced. Piling of materials disrupts horizontal continuity to a greater degree than does scattering; it is frequently used as a secondary treatment for material left from a primary treatment method. Piling can be used in denser stand conditions than can scattering because the piles can be situated to avoid fuel loading problems. Because continuity of the surface load is disrupted, increased surface loading is of less concern than it is with the scatter method. However, there are drawbacks to the piling of cut material: piled material decomposes more slowly than scattered material, piling can be quite labor intensive, and dense stand conditions can result in a high number of piles.

Mechanical

Mechanical treatments employ equipment as the primary method of modifying or removing fuels. Mechanical treatments include mowing and masticating as well as traditional harvest operations. A common feature of mechanical treatments is the need for access. Generally, treatment areas must be within approximately ¼ mile of an existing road system.

In general, mechanical equipment consists of two components: the *prime mover* and the *head*. The prime mover is the power source and carrier; it can be rubber tired, rubber tracked, steel tracked, or stationary. The head is attached to the prime mover; heads can be fixed mounted, limited movement mounted, or attached to an articulating arm. A wide variety of permutations are available for use on different kinds of terrain and to address different fuel types and structures; a detailed catalogue of specific equipment types is provided in Appendix __.

In recent years the array of equipment available for vegetation and fuel load management has expanded dramatically. Many innovative methods and designs have evolved from technology that was developed for the logging and heavy construction industries. For example, an excavator developed for heavy construction is often employed as the prime mover for a head designed to shred or chip large-diameter fuels.

Pile

Material can be piled mechanically as well as by hand. See the discussion above for a description of this technique's advantages and disadvantages.

Fuel Modification

In this suite of techniques, machinery is used to process the material into smaller pieces that can then be redistributed on the ground surface or removed from the site. Because materials processed in this fashion can be much more densely packed than materials that are scattered by hand or piled, the available oxygen supply is reduced, thereby inhibiting spread of fire and flame height.

Fuel modification falls into three broad categories. The first, *Masticate/Mow*, involves the reduction of material on site and in place; such material is intended to be left. The second, *Chip/Grind*, involves a piece of equipment into which material is placed for processing, and from which material is discharged through a chute. Chip/grind methods are more appropriate for biomass removal because the system lends itself to placing processed material directly into a conveyance vehicle. The third, *Crush*, involves crushing and compaction of smaller materials (e.g., brush, slash, small trees) on site.

Masticate/Mow

Mastication involves the processing of standing or downed material where it occurs; generally a blade or other mechanism is applied to the fuel. This approach is suitable for denser stand conditions than is scattering or piling, and the redistributed fuel load decomposes more rapidly than scattered or piled materials. It is most appropriate for treating both green and dead ladder fuels and the higher surface fuels; however, it should be borne in mind that mastication is generally constrained from operating with a foot or two from the ground. Like other mechanical treatments, mastication is restricted to areas with suitable access and slopes less than 40%. The distribution of masticated material may inhibit plant growth. The effects of fire on areas that have been treated with mastication are not well documented; it is possible that such areas may be subject to increased residence time if fire does occur.

Mowing is primarily appropriate to treat grassland and light shrubland habitats. It is grouped with mastication because, like mastication, mowing processes the vegetation material on site and in place.

Chip/Grind

Chipping/grinding, like mastication, reduces materials into small pieces. However, as mentioned above, in this group of methods, material is placed into a piece of equipment and discharged, often through a chute; because of this feature, material can be processed more selectively and transported off site for either disposal or utilization. Chipping/grinding can be employed in conjunction with other treatment methods, both manual and mechanical, that create smaller materials as a byproduct (e.g., tree removal, hand cut and pile). It is the method of choice when utilization of biomass is an option.

Crush

Crushing is another form of mastication; this technique is useful primarily in shrubland habitats dominated by brittle species, such as some of the manzanitas. Some specialized applications have been developed facilitating treatment on steep slopes, making this option particularly suited for habitat types that occur in arid and semi-arid portions of southern California.

Tree Removal

Numerous approaches to tree removal have been developed as the timber industry has evolved to operate in a variety of habitats and under myriad political and economic constraints. This document addresses three broad categories of tree removal for possible inclusion in development of nonburning fuel management strategies: bole removal, whole tree yarding, and cut-to-length logging.

Bole Removal

This is traditional harvesting. Trees can be felled either by hand or mechanically; the bole is then removed by a variety of mechanical systems, depending on the conditions, and transported off site for processing. Bole removal eliminates the vertical continuity of the fuel load, but increases surface fuels with the addition of leaf/needle and limb materials. Overall biomass is reduced. Bole removal, because of its dependence on mechanical equipment, is restricted to areas near roads and on relatively shallow slopes. Moreover, this technique removes that portion of the forest structure that is at least risk from fire, while leaving the components normally addressed by fuel management programs (i.e., leaf/needle and limb material). However, a wide variety secondary treatments can succeed bole removal as fuel management activities. The critical point is that the subsequent treatments determine the efficacy of bole removal as a component of a fuel management activity. Accordingly, although bole removal in and of itself can in some instances be employed to accomplish specific fuel management objectives (e.g., creation of firebreaks, home protection, disruption of canopy continuity), it is not generally accepted as a vegetation or fuel load management technique, and is not addressed as such in this document.

Whole Tree Yarding

Trees can be felled either by hand or mechanically; the entire tree is then brought intact to a staging area, where it is processed into a variety of products. This method removes the vertical continuity of the fuel load, removes biomass, and adds very little to the surface fuel load; moreover, the removal of leaf/needle and limb material is more important than bole removal in the context of fire behavior. Material more than 9 inches in diameter can be utilized. However, because branch scarification resulting from removal of larger diameter materials (e.g., >18–24 inches, depending on species) can damage soils and adversely affect water quality, this technique is only appropriate for trees of moderate diameter (e.g., 9 to approximately 18 inches).

Cut-to-Length Logging

Cut-to-length logging utilizes specialized equipment to cut and process entire trees on site in the forest. While much of the biomass either remains onsite or must be addressed through secondary treatments, an important advantage of this technique is its efficacy in treating material of very small diameter. Moreover, the nature of the equipment renders it less likely to inflict ground damage in treatment areas, and the removal of small, dense trees can be conducted to improve health and vigor of remaining trees. While cut-to-length logging is more expensive than whole tree yarding, it is suitable for stand conditions that preclude use of the latter method.

Chemical

Chemical treatments entail the application of herbicides. It should be emphasized that chemical treatments do not remove fuels, but either kill existing vegetation or inhibit growth. In general, chemicals are appropriate to treat flashy, understory growth such as the weedy vegetation under power transmission lines or along railroad rights-of-way. Alternatively, chemical treatments can be used in conjunction with other treatment types, including prescribed burning, to extend the period between necessary management activities.

A widely-used chemical treatment in vegetation and fuel management programs is called *brown-and-burn*. In this technique, pesticides are used to kill target species of understory vegetation, converting live fuel to dead fuel. The chemical treatment can be applied in spring, when nontarget species remain green, thereby facilitating a prescribed burn to remove the vegetation that has been rendered flammable. However, because this technique is properly a preburning procedure, it cannot be considered a nonburning alternative.

The utility of the growth-inhibiting function of chemical treatment types is exemplified in the maintenance of *defensible fuel profile zones* (DFPZs). DFPZs are shaded firebreaks, typically along ridgetops, where mechanical or manual treatments have been applied to reduce fuel loads and create an area where, in the event of a wildfire, the decreased fuel load will retard the spread of the fire and fire crews can work at containment and control of blaze. Periodic chemical treatments could be used to maintain the desired fuel characteristics within the DFPZ, obviating mechanical or prescribed burning treatments for many years.

The drawbacks to chemical treatment methods include very stringent regulatory requirements, the possibility of adverse impacts on water quality, destruction of species that are not target species, toxicity levels, and negative public opinion.

Because chemical treatments have limited efficacy in directly addressing existing fuel load management problems, they are not discussed further in this document. However, under certain site-specific conditions they remain potentially useful options.

Grazing

Grazing involves the use of livestock—primarily cattle and goats—to manage the growth and composition of brush and grasses. While it is of limited utility in forested habitats, it can be an effective technique in rural residential areas, in the urban-wildland interface, and in selected grassland and shrubland habitats. Moreover, research has shown that in some habitats, carefully managed grazing programs can be used to restore degraded ecosystems to historical conditions. For example, in dry rangeland areas, grazing has been used to convert nonnative annual grassland habitat to perennial bunchgrass communities. While the applications of grazing are limited within the scope of habitats addressed in this document, it is nevertheless a technique that enjoys little political resistance and requires a minimum of financial investment.

Environmental Considerations

The primary goals of promoting nonburning alternatives for wildland regions are to avoid the environmental impacts of burning on visibility and air quality and to eliminate the risk of escapes, which can threaten human life and property as well as natural resources. While nonburning alternatives may achieve the desired results in terms of air quality, attention must be given to other environmental impacts. For example, use of heavy equipment on sensitive soils can result in soil compaction, and the resultant erosion can lead to ecosystem damage as well as degradation of water quality. Consideration of such potential impacts should constitute part of any analysis of alternatives.

The criteria by which to evaluate potential environmental impacts are frequently too site-specific to fall within the scope of this document. However, environmental impacts should be examined in the context of the resource areas listed below. It should be borne in mind that any given criterion might be decisive in a given situation; in a different situation, however, the same criterion might be irrelevant.

- **Adverse impacts on air quality.** Although a primary motivation for selecting nonburning over burning treatment options is the vast reduction of adverse impacts on air quality, it must nevertheless be understood that even nonburning alternatives may create some adverse effects. For instance, mechanical equipment produces vehicular emissions, and the movement of heavy equipment can give rise to fugitive dust emissions. These effects should be considered during any environmental review process necessary to approve a vegetation and fuel management plan.
- **Soil compaction.** Soil compaction is of particular concern when conducting mechanical treatments. Passage of heavy equipment can compact soils; compaction can impede permeability, which in turn can reduce groundwater recharge and increase surface runoff. Moreover, the removal of air spaces in the soil can impair the soil's ability to support root development.
- **Water quality degradation.** Soil compaction can increase runoff, posing potential threats to water quality. Additionally, removal of vegetative growth can, by eliminating demand for surface and shallow subsurface water, also increase surface runoff. Increased surface runoff can exacerbate erosion, degrade riparian habitats, and discharge damaging quantities of sediment into watercourses.
- **Removal of nutrients from site.** An important component of any ecosystem is the recycling of nutrients back into the soil. In fire-adapted habitats, periodic naturally occurring fire is a significant mechanism of nutrient recyling; the complex processes of decay and deterioration are also important. Prescribed burning can mimic the role of naturally occurring fire in nutrient recycling; however, nonburning alternatives that remove substantial quantities of biomass can interrupt this cycle. It is important to

consider the impacts of various treatment options on nutrient recycling when developing a vegetation or fuel management strategy.

- **Undesirable impacts on wildlife habitat.** Many materials that constitute potentially problematic fuels can also serve as important components of wildlife habitat. For example, snags provide breeding habitat for a variety of species; surface vegetation provides cover for birds, mammals, reptiles, amphibians, and invertebrates; and surface litter can provide an important substrate for small vertebrates and invertebrates. Although any habitat modification can adversely affect wildlife habitat, well-designed vegetation and fuel management programs should, in the long term, have generally beneficial effects on habitats on the landscape scale.
- **Threatened and endangered species.** While it must be accepted that any habitat modification will affect plant and wildlife habitat, particular care must be given to habitat that supports or that could support threatened or endangered species. In some cases, even seemingly insignificant modifications can have far-reaching effects on certain species. A careful review should be made of special-status species that could occur in the treatment area, and a thorough evaluation of the impacts of alternative treatments on such species should be conducted.
- **Augmented spread of undesirable species.** Many invasive plant species exploit areas of soil disturbance; such areas can be created by implementation of various treatment methods, especially mechanical methods. Additionally, equipment can transport seeds of invasive species on tires and treads. Practices and procedures incorporated into the vegetation and fuel management plan can reduce the effects of this impact.
- **Augmented disease/pest impacts.** The process of cutting trees and brush precipitates vegetative production of pheromones that serve as attractants to pests such as woodboring beetles. An influx of such pests can cause damage to remaining vegetation, particularly if stands have been compromised by earlier conditions. This potential impact must be carefully addressed in the development of a vegetation and fuel management strategy.
- **Adverse impacts on cultural resources.** The potential of inflicting adverse impacts on cultural resources is largely associated with mechanical treatment options—that is, the risk of mechanical equipment crushing resources that may be present on or immediately beneath the surface. The environmental review process to which most treatment plans (particularly those on public lands) are subject should address the likelihood of such resources being present in the treatment area.

Economic Considerations

Conventional wisdom suggests that, as a rule, nonburning alternatives are more expensive than burning. While there are arguments both to support and to refute this contention, there is another perspective that is perhaps more pressing to consider: namely, that the fuel load crisis facing western wildlands is far too acute to relegate to the marketplace. The management actions that are the subject of this report comprise a response to conditions that have resulted from more than a century of unfortunate management decisions. The condition of the western wildlands will not dissipate if left to its own devices, and each year that passes without significant action to address the problem increases the extent and risk of catastrophic wildlife. While any revenues that can be generated from vegetation and fuel management activities should be welcomed as offsets to the costs, the driving intent of such programs should not be financial but rather should be based upon the desired future conditions of the wildland habitats subject to the management actions.

In examining the question of burning versus nonburning treatments, several financial considerations come to light. First is the direct cost of the treatment method; as stated above, it is generally accepted that burning is less expensive than nonburning alternatives. Second, though, one should consider the indirect costs; for example, the societal costs of impaired air quality in increased health care expenditures, reduced tourist revenues, and resource loss. Third, and perhaps most compelling, is the risk of escape which, as has been discussed previously, can lead to catastrophic and unanticipated costs.

However, such a discussion is beyond the scope of this document, and would likely require intensive data collection and analysis. Accordingly, this report focuses on those financial considerations associated with fuel treatment. These considerations are cost per unit of production, production rate, labor requirements, skill requirements, risks of collateral damage, and the potential generation of revenue from materials produced through the treatment method selected.

Because nonburning alternatives may be more expensive and logistically complex than burning, they can present greater challenges in securing financing. The potential of an alternative to generate revenues, the availability of funding mechanisms, and access to professional advice and guidance should be examined during development of the most appropriate fuel management strategy. After considering the types of fuels present and the treatment options available, the land managers must then consider funding sources and access to technical assistance or expertise.

Costs of Treatment

As discussed above, the direct costs of nonburning alternatives tend to exceed those of prescribed burning. Hand crews can be less expensive than other options, but they tend to be most useful in treating rather restricted areas. The cost of mechanical treatments vary widely; regional availability of equipment and personnel can vary tremendously depending upon a given area's economic base. Techniques such as mastication that require specialized equipment and produce no utilizable material tend to be the most costly, but even conventional tree removal techniques can be prohibitively expensive if it is necessary to transport equipment and personnel from out of state.

Infrastructure Conditions

Infrastructure essentially refers to existing facilities, equipment, labor, and transportation that might be available to implement a desired treatment option. Accordingly, the economic implications of infrastructural constraints are site-specific; if the treatment area is in a region that traditionally supports—or until recently did support—a forest products industry, then the infrastructure will likely be available to support mechanical nonburning alternatives. Perhaps the most critical consideration in this context is the cost of transporting either labor and equipment to the treatment area or generated materials to the facilities necessary to process them. This is discussed at greater length in Chapter 4 (*Getting to Work: How to Build a Nonburning Strategy*).

Utilization

Definition of Utilization

Vegetation management activities associated with fuel reduction can result in the generation of usable materials, which in turn can be sold for profit. For the purposes of this document, *utilization* refers to the use of materials that are generated by treatment activities.

When evaluating the feasibility of utilization as a component of a treatment option, it is necessary to consider the costs of generating the material and transporting it off site, the cost of remanufacturing the material into a form that generates revenue, and the potential of selling the product to the end user. Another consideration can be additional support outside of market interactions, generally referred to as subsidies or price supports; these can be used to offset costs when market prices do not equal production costs. The feasibility of utilization is determined by these costs and by market conditions such as industry capacity, capitalization, and labor. This document addresses the utilization process from the generation of raw material to its sale to the remanufacturer.

Utilization Benefits

As has already been discussed, the primary objective of any vegetation or fuel management program should be achievement of the desired future condition. However, when the appropriate treatment option is likely to produce utilizable material, or when production of such material might be the decisive factor in selecting between alternative methods, then such potential should be considered in the decision-making process. Utilization can be undertaken to generate profit or to offset the cost of the treatment program.

- Profitable transactions occur when (a) useful materials are generated and (b) the resultant transactions cover all extraction and transportation fees and produce a margin of profit for the landowner/manager. Profitable transactions are generally market driven.
- Cost offset transactions reduce the cost of treatment that is undertaken to attain condition goals rather than to generate profit.

When generation of useful material is not the primary motivation, cost offset transactions can be important to implementing the necessary fuels management program. Such transactions can comprise a combination of product sales, cost sharing, price supports, and grants that provide monies to offset the costs of extraction and transportation not covered by market transactions.

In addition to useful products generated directly by fuel reduction activities, indirect benefits, such as increased revenue from recreation (e.g., camping, hunting, fishing), can result from fuel reduction activities. However, because such indirect benefits are difficult to describe and quantify and are generally very case- or site-specific, they are beyond the scope of this document.

Types of Products Generated

Products that may be generated by nonburning treatment activities can be broadly divided into two categories: industrial and nonindustrial. Industrial products are those that are available in large quanitities, consistently, or over large geographical areas. Nonindustrial products are generally associated with lifestyle-related or aesthetic enterprises; these tend to be used in producing specialty or value-added products.

Industrial Products

Below is a general list of industrial products than can be generated by some vegetation and fuel load management programs.

- Whole logs
  - lumber of varying grades
  - molding and finish pieces
  - engineered wood products (e.g., glued laminates, finger jointed material)
  - peeled veneers (e.g., finish veneers, plywood)
- Round wood

  - fencing material
  - vertical support elements (poles)
  - beams, joists, and truss elements
- Cord wood
  - firewood
  - low-grade fencing material
  - pulp for paper
  - extractive products (e.g., mineral spirits, alcohol)
- Clean chips
  - high BTU combustible uses (steam generation for power)
  - engineered wood products (e.g., flake board, oriented strand board)
  - pulp for paper
  - extractive products (e.g., mineral spirits, alcohol, sugars)
- Dirty chips
  - lower BTU combustible uses (e.g., drying operations, heating)
  - mulch
  - animal bedding

Energy-related products include firewood, fuel for drying kilns, and fuel for cogeneration plants. Energy products typically yield the lowest return of the spectrum of forest products that can be produced by vegetation and fuel management programs. In general, market decisions are based on site-specific and regional market conditions.

Nonindustrial Products

Nonindustrial products typically entail a high value-added component because of the skill required to create them, the inherent attractiveness of the material used, or limited availability. Examples include musical instruments, turned wood products, specialty cooking woods or charcoals, canes and walking sticks, and basket materials. While they generally do not produce industrial-scale benefits, these products may cumulatively provide substantial incentive because of the high value added; moreover, they offer some intriguing opportunities for creative entrepreneurial undertakings, particularly in areas that have suffered economic depression as a result of the flagging timber industry.

Utilization Constraints

Although useful material may be generated by vegetation management activities, there are often constraints to successful utilization. For instance, lack of demand or global competition can depress prices beyond the threshold of practicality. The material recovered may not meet industry standards in either the quality or quantity required to warrant commercial exploitation. The infrastructure necessary to extract, transport, or process recovered materials may be lacking due to mill closures, suppression of the lumber industry, or a shortage of skilled labor. Regulatory requirements can create costly and time-consuming constraints to pursuit of management activities. These issues are discussed in greater detail in Chapter 4 (*Getting to Work: How to Build a Nonburning Strategy*).

Funding Sources and Fuel Management Programs

Because nonburning alternatives may be more expensive than burning, greater effort may be necessary to secure funding to implement them. Potential sources of funding for nonburning alternatives generally fall into two categories: utilization earnings and program grants. Utilization has been discussed above. Program grant monies are acquired by applying to agencies or nonprofit organizations for financial assistance with fuel reduction efforts.

The NFP, the most notable grantmaking program associated with vegetation and fuel load management, has significantly changed the nature of fuel management funding. The NFP has in the last few years greatly increased the amount of funding available for firefighting, restoration, hazardous fuels reduction, and community assistance. This availability of funds has in turn increased the number of fuel management projects currently being implemented in the western United States and nationwide.

The USDA Forest Service and the Department of the Interior are currently in the second year of implementing the NFP. Congress provides substantial support, as evidenced by more than $2.26 billion allocated for the NFP in the *Interior and Related Agencies Appropriations Act* for fiscal year 2002. This amount includes $1,590,712,000 for the Forest Service and $678,421,000 for the Department of the Interior.

The NFP facilitates collaboration of federal, state, tribal, and local governmental and nongovernmental representatives for the purpose of improving the management of wildland fire and hazardous fuels, as well as meeting the need for ecosystem restoration and rehabilitation on federal and adjacent state, tribal, and private forest and rangelands. The NFP's 10-year comprehensive strategy outlines a new collaborative framework to facilitate implementation of proactive and protective measures that are appropriate to reduce the risk of wildland fire to communities and the environment.

While NFP funds dominate fuel management funding options, other sources are available. Appendix B provides a partial list of funding sources available for fuel management efforts.

Many programs dedicated to fuel management and other fire-related issues have evolved in recent years, both independently and as a result of the NFP. In addition to national programs such as the NFP and Firewise, many western states have instituted programs to assist private landowners and public land managers in managing and reducing fuel levels. Some communities have also initiated programs to manage local resources (e.g., Kootenai County, Idaho).

National, state, and local fuel management programs offer assistance to fuels managers in a multitude of ways. Fuels management programs may provide technical assistance to land managers. Program representatives can impart knowledge and guidance in project design, financing, and implementation.

Appendix C provides a partial list fuels management programs currently operating in the western states. This list was compiled from interviews with state representatives and from internet research. The list is not exhaustive; rather, it is representative of the array of national, state and local programs available to land managers.

Labor Sources

The availability of labor sources to perform fuel management work is an element of project implementation that should be considered following the identification of fuel conditions and treatment options. Landowners and land managers should assess the availability of manual and specialized laborers. Certain treatments, such as hand piling, require unskilled manual labor by a relatively large work force. Other treatments require specialized skills in operating machinery or equipment.

Some areas may suffer a shortage of available labor; others may have a surplus due to an expanding pool of unemployed loggers or other laborers. In some cases, land managers may need to hire out-of-state contractors to perform fuel reduction and removal activities.

Appendix D provides a list of some labor sources available in western states. While some states may currently rely on only a few of these sources for fuel management labor, all of them should be considered by landowners and land managers when seeking new labor. Land managers of new and future projects are encouraged to consider all potential labor options and to investigate which are available in their local areas.

Nonprofit Organizations

Nonprofit organizations can often provide support to landowners and land managers in planning and implementing projects. For example, local university extension programs may offer technical assistance and professional expertise in developing fuel management projects. Some nonprofit organizations may provide volunteers to participate in labor-intensive activities such as hand piling. There are also opportunities for partnering with nonprofits to secure project financing and to share the responsibility for project implementation and success.

Appendix E provides a partial list of nonprofit organizations throughout the western United States that could have an interest in fuel management projects. In addition to the obvious practical advantages, obtaining nonprofit participation can help to involve the local community in project planning, thus aiding in building popular support for the project.

Sociopolitical Considerations

Social and/or cultural considerations can play a critical role in developing a viable nonburning strategy. Some alternatives may have implications for certain groups, such as small landowners or residents of tribal land. Others are likely to provoke heated responses from certain community groups. Community groups that are predisposed in opposition to a particular type of treatment may have the organizational and financial resources to prevent or delay implementation.

Even when the decision maker has evaluated a treatment option in the context of technical feasibility, environmental appropriateness, and affordability, another suite of potential constraints remain to be addressed. These less concrete but no less real sociopolitical considerations can include:

- Health and safety concerns
- Tribal concerns
- Social justice
- Resistance by resource agencies
- Resistance by environmental groups
- Resistance by industry groups
- Resistance by community groups
- Regulatory constraints

Barriers to Nonburning Alternatives

There are numerous barriers that may discourage or prohibit the use of nonburning alternatives to manage fuels in the west. Table XX in Appendix XX lists barriers that were identified by respondents to the interviews conducted during preparation of this report. For this discussion, these barriers have been categorized in accordance with the four issue areas used throughout this document.

1. **Technical Constraints.** These barriers include inhibited access to project areas due to topographical or climatic conditions or the absence of roads; proximity to residential or other developed areas; and lack of available infrastructure, equipment, or labor.
2. **Environmental Constraints.** These barriers include presence of sensitive natural resources and the potential impacts of fuel treatments on these resources (e.g., sensitive soils, sensitive vegetation communities, presence of threatened or endangered species, water quality concerns); the potential for introduction or spread of invasive nonnative plant species or pathogenic organisms; and the presence of cultural resources.
3. **Economic Constraints.** These barriers include lack of funding to perform fuels management treatments; lack of markets for utilization of material; cost of equipment and labor; cost of transporting utilizable material; and the need to generate profit from activity (required by some jurisdictions).
4. **Sociopolitical Constraints.** These barriers include public opposition to specific treatment types; institutional resistance to new approaches; lack of available staff at relevant resource agencies; regulatory requirements; and non-statutory administrative obstacles to nonburning alternatives (discussed further below.

In its 1996 report to the EPA, the GCVTC provided emission management recommendations for area sources, including recommendations regarding fire. One of these recommendations suggested that the federal land management agencies and their state, tribal, local, and private counterparts should identify and remove non-statutory administrative barriers to emission reduction strategies by the year 2000, to the maximum extent feasible.

The majority of activities on wildlands are regulated by agencies that plan, approve, and implement projects within an administrative framework. The administrative framework includes statutory and non-statutory barriers. Statutory barriers are laws, codes, and regulations. Non-statutory barriers are internal policies defined in an agency's handbooks and manuals or formalized in approved land use or resource management plans or environmental documents. Non-statutory administrative barriers may be influenced by social, economic, cultural, or political factors.

Non-statutory administrative barriers can include requirements for compliance with best management practices (BMPs), mitigation measures incorporated into

National Environmental Policy Act (NEPA) documents or memoranda of agreement (MOAs), and policy-level decisions identified in resource and land management plans. For example, a BMP for use of mechanical equipment on the Plumas National Forest in northern California specifies a slope limitation beyond which use of mechanical equipment is prohibited. However, as new equipment is developed, it might become advantageous to allow mechanical treatments outside the parameters of the BMP, particularly under specific fuel conditions. In another example, BMPs incorporated into the MOA between the USDA Forest Service and the Tahoe Regional Planning Agency prohibit the use of mechanical equipment within the 100-year floodplain. However, if fuel load considerations warrant such work, it might be advantageous to suspend such prohibitions to reduce the greater risk of catastrophic wildfire.

In conclusion, it should be emphasized that despite the many barriers that currently exist, there is great opportunity in the growing field of nonburning alternatives. Many of these barriers can be overcome by the simple expedient of communication and education; others may require adjustments to the administrative and regulatory framework within which fuel management programs must operate. In any case, the increasing degradation of air quality and the continuing crisis of overaccumulated fuel loads clearly warrant concerted efforts in promoting the development and implementation of nonburning alternatives to prescribed burning.

Chapter 4

Getting to Work: How to Build a Nonburning Strategy

Developing Alternatives

There is, as has been asserted elsewhere in this document, no “one-size-fits-all” approach to developing a vegetation and fuel load management strategy. In assessing the array of nonburning alternatives and designing a program, the land manager must evaluate the categories of considerations described in the preceding chapter in light of regional and site-specific conditions. This chapter discusses in greater detail the chains of reasoning that one might follow in proceeding through the analysis of possible alternatives.

Technical Feasibility

When beginning to develop a strategy for vegetation or fuel load management, the land manager must first consider what is technically feasible. Clearly, there is no virtue in navigating the sociopolitical hurdles for activities that either cannot be conducted or will not achieve the desired results. The first step in determining the appropriate methodology is to understand the fundamental relationship between vegetation structure and the various types of treatment options available.

Methodology and Vegetation Structure

Every methodology, burning and nonburning, is constrained by parameters which, in turn, are associated with the physical conditions of the proposed treatment area. To assist in the decision-making process, the authors have developed a conceptual model that illustrates the relationships of various treatment types with vegetation structure and with one another.

This model simplifies the description of vegetation into two components: volume/density (measured in tons per acre) and average stem diameter. For analytical purposes, volume/density is represented on the *x*-axis of a simple graph, and stem diameter on the *y*-axis. It should be understood that the figures illustrating this model are merely schematic, and are not intended to accurately depict real-world situations. Similarly, the designation of *average stem diameter* is a conceptual descriptor; for real-world application, the model must be adjusted to take into account relative densities of various diameters in the context of the specific vegetation types to be treated.

Although there are many exceptions, this model suffices to describe the spectrum of vegetation structures. For instance, grassland habitat measures very low on both stem diameter and on volume/density; it is, accordingly, represented in Figure 4-1 as *Prairie*. A grazed field might be represented at a still lower volume, whereas a pampas of shoulder-high grasses would be depicted higher on the graph. Shrublands exhibit higher stem diameter, although sparse habitats supporting small shrubs might contain less volume/density than a tallgrass prairie. Forested habitats might exhibit dense stands of small-diameter trees (e.g., lodgepole pine) or sparse stands of large-diameter trees (e.g., eastside Sierran pine).

The graphs reflect a schematic representation of the parameters within which treatment types are typically selected. It should be understood that the graphically depicted limitations are not absolute, but can be artificially forced beyond normal bounds. For instance, the lower limit of harvesting is determined by the economic feasibility of carrying out operations within a certain range of density and diameter of materials. It should not be inferred that tree removal cannot be implemented under conditions of lesser diameter or volume; rather, the implication is that such an operation would not be profitable and would, consequently, require a source of funding beyond the revenue generated by extracted materials.

Traditional Treatments

Burning

The two vegetation management strategies traditionally employed on wildlands are harvesting and burning. Harvesting is associated with commodity production; burning is not. The conceptual model can be used to plot the boundaries of desirable, effective, and efficient conditions for each of these strategies.

The plot for burning (Figure 4-2) shows that burning is an effective and controllable method for almost all volumes of small-diameter vegetation arrangements. As stem diameter increases (e.g., ~4–10 inches), the volume for which burning is a reasonable method decreases. This is because fire behavior intensifies; the fire is likelier to escape control and, as temperatures increase, may cause undesirable levels of mortality in the vegetative structure. However, fire regains practicality with further increase of stem diameter because substantially larger stems are likely to survive fire, particularly in more open stands. The upper limit for fire is primarily defined by controllability and potential resource damage, although some areas outside the plot reflect conditions under which burning would be either inefficient or unnecessary.

As mentioned above, it would be possible to implement a burning program above the area delimited on the graph; such a program, however, would necessitate artificial modification of one or more parameters. For example, a burning program under such conditions would likely require multiple entries, with primary treatments being conducted under such restrictive circumstances that only minimal treatment would be accomplished. Subsequent burns would be necessary to achieve desired final conditions, and each burn would extend the time required to accomplish the goals, increase the risk of escape, and further contribute to air quality impacts.

Because the upper limit of the burning plot is essentially a function of risk, this boundary is, in a sense, a "soft" one. Especially in matters as difficult to quantify as natural systems and fire, risk is by its very nature a particularly subjective descriptor. Risk that is acceptable to a land manager might be out of the question to a small landowner. Moreover, a vegetation structure that would be too dangerous to burn under certain weather conditions could be reasonable to burn under others. Such variability and subjectivity can suggest that burning is a reasonable treatment for virtually all vegetation conditions—at least under certain circumstances.

Such a perception can have dangerous implications. Land managers might, by waiting for a certain set of conditions, decide to use prescribed fire on vegetation structures for which such treatment would normally not be indicated. The decision might be driven by short-term financial considerations and could, consequently, have unfortunate results. The requisite conditions could so minimize the effects of fire that only limited benefits would be realized. Alternatively, while waiting for the optimum conditions to align, habitat conditions could alter enough that unwanted resource damage could occur; in extreme cases, such changes could lead to escape. Also, as discussed in Chapter 2 (*Vegetation Management: To Burn or Not To Burn*), the constraints on requisite conditions could be so restrictive that the burn window might never open.

Harvesting

The plot for harvesting (Figure 4-3) is bounded by financial considerations. The bottom threshold represents the volume/density of material below which the mobilization of equipment and labor becomes economically unfeasible. The left boundary represents the weak market for small-diameter materials and, to a lesser extent, the limitations of equipment and technology for harvesting such materials.

The plot illustrates that as diameters increase, the overall volume/density of the material can decrease; this reflects the fact that very large trees have more value per unit of volume than smaller trees. Accordingly, if the land manager chooses to implement a harvesting program on forestland of low volume/density, the financial equation must be modified: the material must have higher than normal value, cost of extraction must be lower, or supplemental funding must be secured.

It should be noted that the left boundary—that reflecting a threshold of smaller diameter stems—has shifted towards the left over the last few decades. This is because the demand for wood and wood products has increased even as the number of available large trees has decreased; at the same time, mills that had been designed for large diameter logs have been retooled to accommodate smaller diameter materials. New harvesting equipment has also facilitated the shift.

The Burn/Harvest Disconnect

Figure 4-4 overlays the plots depicting harvesting and burning. Cursory examination reveals a significant gap in the range of vegetation structures suitable for treatment by the two traditional methods; in many cases, the vegetative structures represented by this gap are those most in need of treatment. The unavoidable implication of this gap is that either the limits of the traditional treatment paradigms must be forced to encompass the deficit, or a nontraditional paradigm must be developed to address those conditions beyond the bounds of traditional methodologies.

Mastication and Biomass Removal

Mastication

Mastication in its simpler forms is far from a new concept. Mowing of grass and even larger shrubs has been used to manage vegetation in situations ranging from lawns and gardens to railroad rights-of-way. Only recently, however, has mastication been applied to forest habitats.

The boundaries of mastication (Figure 4-5), and the factors those boundaries represent, are quite different than those of burning or harvesting. As in the case of harvesting, there is no risk factor limiting the level of volume/density for which mastication is appropriate. Mastication is suitable for even the finest fuels; the upper (right) limit of stem diameter corresponds almost precisely with the lower limit for harvesting. There are two reasons for this correspondence: first, the equipment used for mastication is not designed for large-diameter trees; second, larger trees have greater value when either left in the environment or harvested for market. Because mastication is a treatment option that is not intended to address market considerations, there is no lower limit of volume/density.

Biomass Removal

Biomass removal can be similar to mastication except that the material is removed from the site to be disposed or utilized. It can entail creation of chipping or mulching as well as whole tree yarding and, as discussed earlier, it entails a different suite of equipment. Depending on the particular type of biomass removal selected for the specific site, the boundaries can be the same as those for mastication (Figure 4-5) or can reflect whole tree yarding (Figure 4-6), which accommodates much higher stem diameters than mastication. The critical difference between mastication and biomass removal is that the material generated by mastication remains on site, whereas the material generated by biomass removal is transported from the site for disposal or utilization.

If whole tree yarding is the selected method of biomass removal, and if the treatment is undertaken as a commercial venture, then the boundaries to left and bottom are roughly congruent with the boundaries depicted for harvesting. However, the upper limit of stem diameters is lower, because very large trees cannot be removed intact without causing severe scarification to soils.

Site-Specific Considerations

The general nature of the foregoing discussion, once again, should be used as a filter through which to evaluate available options. Specific project design must begin with site-specific conditions that have been previously discussed: topography, habitat type, fuel load conditions, road accessibility, and existing infrastructure. In the second part of this chapter, *Assessing the Alternatives*, a framework is provided for eliminating inappropriate techniques and making the most informed selection of those that remain.

Environmental Feasibility

When the field of possibilities has been narrowed, the land manager must consider the environmental impacts associated with treatment options that have been found to be technically feasible. Because the environmental considerations are so intimately connected with the location and character of the project site, it is impossible to address them in other than a very general fashion in this document.

The treatment area should be thoroughly reviewed (through both literature reviews and field surveys, as appropriate) to inventory any sensitive resources that might be present on or adjacent to it; the proposed activities should then be evaluated to identify impacts that could result. Clearly, if listed species or other sensitive resources are identified, specific regulatory constraints can come into play; these must be addressed in keeping with the requirements of the jurisdiction that has authority over the site as well as with federal regulatory requirements (e.g., the Endangered Species Act, the Clean Water Act, the Migratory Bird Treaty Act).

In some respects, the regulatory constraints might be more easily navigated than other environmental influences. As has been stated previously, any vegetation or fuel management program will have environmental effects. Some of these will inevitably be adverse effects—at least from certain perspectives. For instance, any mechanical treatment is likely to result in some degree of soil compaction. The land manager must objectively weigh both the short- and long-term impacts and benefits and be willing to make sometimes difficult decisions. Do the short-term impacts of soil compaction and the temporary degradation of local water quality that might result from excess surface runoff outweigh the impact on air quality that would result from prescribed burning? Does the temporary loss of nesting habitat for raptor species outweigh the risk of catastrophic wildfire? In some instances the answer will be virtually self-evident; in others the decision might be driven not by clinical scientific analysis but by local political considerations.

With this in mind, it should be pointed out that environmental have driven the preponderance of the changes in land management in recent decades. Environmental regulation has profoundly altered the timber industry; environmental concerns have also precipitated many of the technological modifications that have increased the range of treatment options discussed in this document. For instance, a shift from wheeled to tracked vehicles has been fostered by concerns over soil compaction (tracked vehicles are less damaging because the vehicle's weight is more widely distributed than that of wheeled vehicles).

In all cases, the land manager must carefully evaluate the options, their relative costs and benefits, and the strategy that may be necessary to promote the desired program. The environmental feasibility is inextricably linked with sociopolitical considerations; this is discussed further in *Sociopolitical Feasibility* below.

Economic Feasibility

The cost of implementing nonburning alternatives is the single most challenging financial consideration to overcome; the previous chapter discussed potential funding mechanisms and fuel management programs, and Appendices _ and _ provide lists of these sources and programs. However, in cases where there is reason to consider utilization as a means to fund or offset the cost of treatment, it is necessary to examine barriers related to industry infrastructure.

In many areas of the western United States, adequate industry infrastructure is no longer available. Mills were at one time abundant throughout the country; now, however, only certain areas remain capable of processing forest products. Mill closures over the last several decades dismantled infrastructure beyond the loss of the mills themselves. Once a mill closes down the equipment is sold, industry experts relocate, associated businesses fail, and the community's ability to reengage in the processing of forest products is severely compromised. Additionally, mechanical equipment used for treatment activities is likely to be sold or relocated to regions where the industry is still viable.

The location of a project area is perhaps the most critical variable in assessing the cost of undertaking the project. The proximity of a treatment site to processing facilities can determine the feasibility of utilizing materials generated by nonburning alternatives. Presence of a pulp mill or cement plant (cement plants represent a potential market for dirty chips) within 100 miles of a project site can encourage the use nonburning methods because generated materials can be readily sold. In areas such as the Pacific Northwest where numerous mills still exist, the utilization of materials tends to be relatively affordable and practical. On the other hand, if processing facilities are not reasonably accessible, the cost of transporting the material can exceed the revenue generated by its sale. Moreover, in regions where mills have been retired or where the forest products industry has never become established, land managers can be forced to hire contractors from as far as two states away to carry out nonburning treatment activities. The cost of nonburning alternatives soars when material must be transported great distances or when contractors must be recruited from outside the region.

One hopeful solution to the financial quandary is the cogeneration industry, which could provide a viable market for biomass removed from treatment areas. Cogeneration entails combustion of biomass to produce both electricity and heat; cogeneration plants are typically designed and built close to the source of fuel and the site where the energy and heat will be consumed. Unfortunately, this industry is still in its infancy; accordingly, it is currently a reasonable option only in certain areas. Other biomass utilization technologies, such as biomass gasification and the production of ethanol, also suggest a promising future, not only in increasing the economic feasibility of nonburning alternatives but also in further reducing air quality impacts.

Sociopolitical Feasibility

The sociopolitical hurdle should probably be the last one crossed, because the outreach, education, and negotiations involved in crossing it would all be wasted if the selected nonburning alternative were found to be impractical or infeasible for some more prosaic reason (e.g., technical constraints or presence of a high-profile endangered species). Nonetheless, the sociopolitical considerations are quite serious, and many projects meet their demise because the proponents fail to pay sufficient heed to the human factor.

Public Management Barriers

The tendency of agencies to endorse only those fuel management methods with which they have experience and knowledge inherently limits the options customarily utilized. A public resource agency that has always used fire to manage fuel loads and that has no desire or incentive to do otherwise is likely to continue to use fire and to neglect the use of nonburning alternatives. At the same time, many agency staffpersons with a knowledge of specific management techniques (e.g., timber sales) have retired or left the field. This emigration of traditional expertise leaves in place a new generation of land managers who endorse land management philosophies that deemphasize the commodification of resources.

Many natural resource agencies lack the funds and staff to treat all the areas and fuels requiring treatment. The shortage of personnel, equipment, and expertise may discourage resource managers from considering more expensive or labor-intensive nonburning alternatives. This shortage of resources forces some natural resource managers to select which areas will be treated and which will be neglected.

Some jurisdictions are constrained by such restrictive operational mandates that deviation from the status quo is virtually impossible. For example, the Montana Department of Natural Resources and Conservation is charged with generating profit from management of the state's natural resources; these profits are an integral funding source for Montana schools. This primary agency goal drives all decision-making and management actions. In turn, the fuel management alternative that is least expensive or that generates the greatest profit is and has to be the technique employed.

The interviews conducted during the preparation of this document suggested that vegetation and fuel management programs undertaken on private lands are subject to minimal regulatory requirements unless some commodity is to be generated. If a commodity is to be generated, some administrative process is likely to be required; however, this process varies greatly from state to state.

On public land, however, the planning and documentation efforts are frequently the most time-consuming portion of any treatment project. The costs of these efforts can weigh heavily in the selection of treatment type; even, sometimes, to the extent of outweighing considerations of ecological outcomes and levels of risk.

Because so much habitat in need of treatment lies on federal lands, NEPA is the regulatory mechanism most frequently addressed by land managers. The interviews indicated that while prescribed burning treatments can generally be implemented with preparation of an environmental assessment (EA) or can even be eligible for categorical exclusion (i.e., a designation exempting projects from the NEPA review process), nonburning treatments usually require at least an EA, if not an environmental impact statement (EIS). Moreover, the general level of evaluation in EAs prepared for nonburning treatments tends to be considerably higher than that in EAs prepared for prescribed burns. In addition to the increased efforts for NEPA compliance associated with nonburning alternatives, the nonburning alternatives are more likely to be appealed by opponents of the proposed action, causing additional delays and increased costs.

These NEPA-related considerations, while anecdotal, have several implications. They support the likelihood of many agencies to be predisposed in favor of prescribed burning over nonburning alternatives. Furthermore, many EAs limit the alternatives analysis required by NEPA to a comparison of the Proposed Action and the No-Action Alternative. This is an important point, because it is in the EA that the purpose and need statement for a Proposed Action is developed. The purpose and need statement can be articulated to limit the scope of alternatives that must be analyzed. If the scope of the EA is narrowed in this manner, potentially feasible nonburning alternatives can be eliminated altogether from the public discourse that is part of the NEPA process.

Public Opinion Barriers

Public opinion regarding fuel treatments varies widely and can be influenced by a myriad of factors. In New Mexico, for instance, the public had long supported fire as the fuel treatment method of choice. In the summer of 2000, the Cerro Grande wildfire, which was caused by the escape of a prescribed burn, swept across the Bandolier National Monument in the Jemez Mountains. Following this event, public opinion shifted in support of nonburning alternatives.

Public opinion is highly localized and can vary widely within a relatively small geographic area. Numerous conflicting opinions may be expressed within the same state, region, or municipality. Public opinion on fuel treatments and their respective effects, particularly those effects related to aesthetics, can exert tremendous influence on the selection process. For example, some communities may resent the presence of cattle grazing on fuels, while other communities find the visual results of mechanical treatment unacceptable. Trends among public attitudes, particularly on a small geographic scale, are difficult to predict; it is therefore advisable to assess the opinions and sensibilities of the local community prior to any fuels management project. When possible, inclusion of the local community in the decision-making process helps to ensure popular support.

Perception, of course, is critical to bridging the gaps between various stakeholder groups in the arena of public opinion. For example, the most environmentally beneficial treatment in a particular situation might be a tree-thinning operation that will, if effectively implemented, increase forest health, reduce the risk of catastrophic wildfire, result in minimal air quality impacts, and potentially generate some revenue to fund the operation wholly or in part. However, such an operation uses similar equipment and techniques to traditional harvest operations, which can be perceived to be environmentally irresponsible. Such perceptual barriers present challenges, but also offer opportunities for innovative collaborative efforts.

Environmental Groups

Local environmental groups can be highly visible and influential in dictating the fuel management methods used in a given area, particularly on public lands.

Such local groups can often be brought into a participatory role through proper outreach and communication efforts. However, fuel management projects that have been developed through such a collaborative process can nevertheless be jeopardized by opposition from outside environmental efforts, particularly those initiated by national organizations headquartered elsewhere. These groups may convey their opinions through the scoping process and public comment requirement specified by NEPA. They may express their opposition through the courts, bringing lawsuits or appeals to delay or kill projects. Legal involvement is frequently initiated long after project development, and can severely limit fuel management options and impede implementation. Often, the level of resistance from national environmental organizations is closely correlated with the visibility and political sensitivity of a given project. Such resistance, when it obstructs projects that have been developed through successful collaboration of stakeholders at the local level, is particularly disheartening because it increases the level of frustration and disenfranchises the participants. In some cases, such reversals can reopen philosophical or ideological rifts that have begun to heal through the advent of a successful local collaboration.

Assessing the Alternatives

For the purposes of this discussion, it is understood that the primary goal of any vegetation or fuel load management action is to treat as many high-priority acres as possible with a minimum of onsite emissions. In examining the constraints on specific treatment options, the following discussion focuses on forested habitats. Once again, because of the very generic nature of this document, the authors have chosen to adopt a convention likely to enjoy the widest applicability. Because the preponderance of areas requiring treatment in the western states lie in forested habitats; because the widest variety treatment methods are potentially suitable to such habitats; and because the more controversial treatment methods—i.e., harvesting and tree removal—are specific to those habitats, shrubland and grassland are excluded from this discussion. Similarly, because grazing and chemical treatment options have rather restricted applications, they, too, have been excluded.

Overcoming Obstacles

This analysis compares burning with four categories of nonburning alternatives: hand work, mastication, tree removal, and biomass removal. The graphic comparison in Figure 4-8 is, like the other figures in this chapter, a conceptual illustration of relationships and not a representation of quantitative data. Rather, the figure illustrates conclusions based on the professional experience of the authors and on the collation of the results of the interviews conducted in the preparation of this document.

The analysis compares the treatment types in the context of five key obstacles:

- **Gross capitalization:** the full amount of expenditures that have to be made before any fuel is treated. This includes equipment and facilities acquisition, staffing, marketing, and planning.
- **Post-treatment fuel residue:** the fuel that remains on site after the treatment action has been completed. This should be evaluated in the context of the residual fuel's conditions and arrangement.
- **Administrative resistance:** the level of resistance exhibited by resource agencies. Administrative resistance can also involve the level of environmental documentation that is required for a particular treatment project.
- **Production inefficiency:** the amount of money/labor required to treat a unit measure of habitat.
- **Interest group resistance:** the level of resistance exhibited by particular interest groups (e.g., environmental and community groups).

Figure 4-8 illustrates the relative weight of these five obstacles in the context of various treatment options. In selecting an approach, one should determine which technique is most appropriate for achieving the desired future conditions and which has the greatest potential to be implemented.

Hand treatments require the least gross capital investment, but are also the least efficient of the nonburning treatment options. They tend to leave high levels of post-treatment fuel residues. Though time-consuming and relatively unproductive, hand treatments face very little interest group opposition or administrative challenge.

Mastication requires specialized equipment that is often less common and more expensive than traditional logging equipment. However, transportation and road systems are not as critical for mastication operations. Additionally, there is no need for markets or the associated infrastructure (e.g., processing facilities, transportation system) necessary to exploit them. These factors combine to limit the gross capitalization requirement for mastication. Because it creates limited environmental impacts, mastication encounters little resistance from the environmental and administrative sectors. Mastication experiences only moderate production inefficiency and produces moderate amounts of post-treatment fuel residue.

Tree removal also requires specialized equipment, much of which is readily available and consequently more affordable than mastication equipment. The gross capitalization requirement is higher than that for mastication, however, because of the dependence upon a comprehensive transportation system (i.e., roads and available logging trucks). Moreover, tree removal produces the highest level of post-treatment fuel residue of any treatment option. Perhaps the greatest hindrance to tree removal is environmental and administrative resistance. Some interest groups are strongly opposed to tree removal and the perceived commodification of public lands. Regulatory compliance requirements and other administrative barriers are significant for tree removal operations.

Biomass removal requires very specialized equipment and operational skills, a well-developed transportation network, and a market for generated materials. This industry, contrasted with both standard tree removal and hand treatments, is in its infancy, suggesting that, to achieve a substantial level of efficiency, development would be necessary on a whole-industry scale. Such expansion would result in a very high gross capitalization requirement; this could, for the present, effectively eliminate biomass removal as a regionally applicable approach to solving the fuels problem.

Comparing Effectiveness

The effectiveness of nonburning treatment techniques can be compared by examining a common goal of land managers: the reduction of fine fuels. A principal indicator of elevated fire risk is the availability of large quantities of fine fuels in particular arrangements.

Hand operations are typically used in treating fine fuels; these operations change the arrangement by moving large quantities of surface and lower ladder fuels closer to the ground surface; hand treatments do not, however, actually reduce the volume.

Mastication (including crushing and mowing,) does not reduce volume, but alters the vegetation structure even more radically than does hand treatment. The use of vehicles to grind the masticated material into the soil surface enhances this effect.

Chipping and grinding, particularly when conducted in concert with biomass removal, transports significant quantities of fine fuels either to a central location or completely off site. Whole-tree yarding, although properly considered a tree removal technique, achieves the same end.

Logging operations are generally focused on extraction of commercial materials and not on treatment of fine fuels. Slash operations (as a post-silvicultural treatment) can include hand lopping; however, the intent is rather to comply with regulatory requirements than to perform fuel treatments, and these operations are not as effective as operations in which fine fuels reduction is the monitored success indicator.

Figure 4-8 shows that mastication/mowing operations may offer the greatest potential for success in the context of both desired future conditions and likelihood of implementation. However, mastication requires an industry that is still in development and does not yet generate useful materials. It is possible that mastication could be the best first step towards other more market-driven methods such as biomass removal. Consideration should be given to developing a subsidized program that effectively builds industry capacity and aids landowners/managers in offsetting planning elements of the gross capitalization element.

Making the Decision

[Diagrammatic representations of the decision-making process are in development. These figures and explanatory narrative will be inserted here for the next iteration of this document. We've experimented with a number of options and have finally focused on an approach that seems both clear and user-friendly; again, as we've emphasized, because there is no "one-size-fits-all" solution to fuel load management, it is also not possible to develop an exhaustive 'decision tree' that addresses the spectrum of variables and site-specific kinds of issues with which land managers must grapple. Accordingly, we are creating a schematic depiction of the sequence and relationships of issue areas; this will be followed by a matrix evaluating the advantages and drawbacks of a range of mechanical treatment types.]

Chapter 5

Conclusions and Recommendations

Discussion

Clearly, there is a need to address with determination the fuel load crisis that has developed in the western United States through a century of fire suppression policies. No less pressing are concerns over the deteriorating air quality that plague urban areas and wildlands alike. Although the promotion of nonburning alternatives cannot alone resolve these issues, the reduction of prescribed burning where nonburning alternatives will adequately address the fuel load situation can certainly contribute to advances in both areas.

The investigations conducted during the preparation of this document suggest several salient points.

1. A sound range of nonburning alternatives to prescribed burning currently exists, and emerging technologies await exploitation. While there are obstacles to implementation of many of these alternatives, few of the obstacles are insurmountable; indeed, the greatest challenge is that of stepping beyond the confines of conventional wisdom to explore innovative and creative solutions.

2. Perceived regulatory and administrative barriers to use of nonburning alternatives, while very real, can perhaps be more readily overcome through education and training on the part of land managers and air quality management officials than through an assault on the existing regulatory infrastructure. For example, as discussed in the preceding chapters, the NEPA process can be initiated in such a fashion that nonburning alternatives are excluded from the onset. However, with a relatively cursory amount of training, proponents of nonburning alternatives could be instructed to use the existing procedural requirements of the NEPA review process to ensure that such alternatives are addressed.

3. Very limited accountability mechanisms are in place to promote the use or ensure the consideration of nonburning alternatives. This has been partially addressed in item 2 above; but the issue of accountability is also tied to the fact that traditional treatment programs are evaluated on the basis of numbers of acres treated—and in many cases, *treated* can be considered as synonymous with *burned*. Such mechanisms obviously preclude consideration of nonburning alternatives. Situations of this sort, however, are more appropriately addressed at the level of agency policy or land

management plan development (e.g., individual forest plans, resource management plans) than at the level of legislative action (e.g., NEPA).

4. Because many of the obstacles to nonburning alternatives are economic, there is a substantial need to develop technologies to encourage use of these alternatives. While capitalization costs may in some cases be high, these costs should be weighed not only against the costs of prescribed burning, but also against the potential savings and revenues that could be realized by development of new industries that produce energy, reduce air quality impacts, create job opportunities, and reduce dependence on imports of fossil fuels.

5. Despite the advantages of nonburning alternatives in the context of air quality impacts, it is evident that prescribed fire will remain a critical component of many vegetation and fuel load management programs. Accordingly, the object should be not to replace burning with nonburning alternatives, but to design programs to include a greater proportion of nonburning techniques, such that air quality impacts are substantially reduced.

Air quality and risk of wildfire are subject to influences far beyond wildland management policies. The energy industry, transportation policy, regional economics, technology, environmental protection, and social justice are all interconnected with both issues and the decisions that are made to address them. Consequently, communities and decision makers should look beyond the immediate boundaries of vegetation and fuel load management programs for comprehensive solutions to the problems.

Finally, the increased acceptance of nonburning alternatives is dependent upon a change of mindset. Resource agencies, industry groups, environmental groups, and community groups must all be willing to reassess their preconceptions if significant progress is to be made in combating the dual problem of air quality and fire risk.

Recommendations

A number of recommendations emerged from the process the authors followed in preparing this report. Although some of these recommendations arguably lie outside the initial scope of this document, they have nevertheless been included because the authors feel them to be germane to the matter at hand. Because the recommendations in many cases cross the organizational structure followed in previous chapters, that structure has been forgone for this discussion.

- **Promote consideration of nonburning alternatives within agencies.** This should be undertaken at the agency policy or land management plan level. For instance, every federal agency as its own set of guidelines for NEPA compliance; proponents of nonburning alternatives could suggest relevant agencies to adopt measures requiring consideration of nonburning alternatives in the process of developing vegetation and fuel load management plans.

- **Promote proactive participation in the NEPA review process.** The WRAP could disseminate educational materials to proponents of nonburning alternatives to enable them to engage in the NEPA scoping and review process early on. Where appropriate, the purpose and need portion of the project description should be broadened such that nonburning alternatives are not precluded.
- **Initiate an outreach and education program.** This is a two-pronged recommendation. One area of outreach should be directed to the public, promoting acceptance of nonburning alternatives as environmentally responsible; this program should emphasize that protection of air quality, like protection of wildland habitat, is a critical component of responsible environmental stewardship.

  A parallel outreach program should be developed for resource agency staff to promote acceptance of nonburning alternatives and to encourage inclusion of such alternatives in analyses conducted during development of planning documents.
- **Provide administrative and economic support to development of infrastructure.** If nonburning alternatives are to be successful, additional infrastructure will be necessary. As discussed above, this infrastructure need not be a recapitulation of traditional timber industry infrastructure; indeed, the political climate precludes such a course of action. Rather, attention should be paid to promoting the development of local and regional biomass utilization programs. Such programs offer intriguing opportunities for entrepreneurial innovation; economic redevelopment of depressed rural communities (particularly those impacted by the contraction of the timber industry); reduction of dependence on imports of fossil fuels; reduction of increasing waste disposal problems; and reduction of air quality impacts.
- **Encourage nonindustrial utilization programs.** In concert with the preceding item, opportunities for development of value-added enterprises abound. In the Pacific Northwest, where traditional logging communities have suffered mill closures and high unemployment, innovative value-added businesses have offered examples of the potential of this approach. For instance, a small company on Vancouver Island produces spruce and cedar guitar tops. The company anticipates gross revenues of $Canadian 1 million in 2002. It provides 14 year-round jobs utilizing 3,600 cubic meters of timber annually—an amount that would support 2.5 mill workers in the industrial timber business. Moreover, leftover material that is unsuitable for guitar tops is used by another local business to craft gift boxes for exporting smoked salmon.

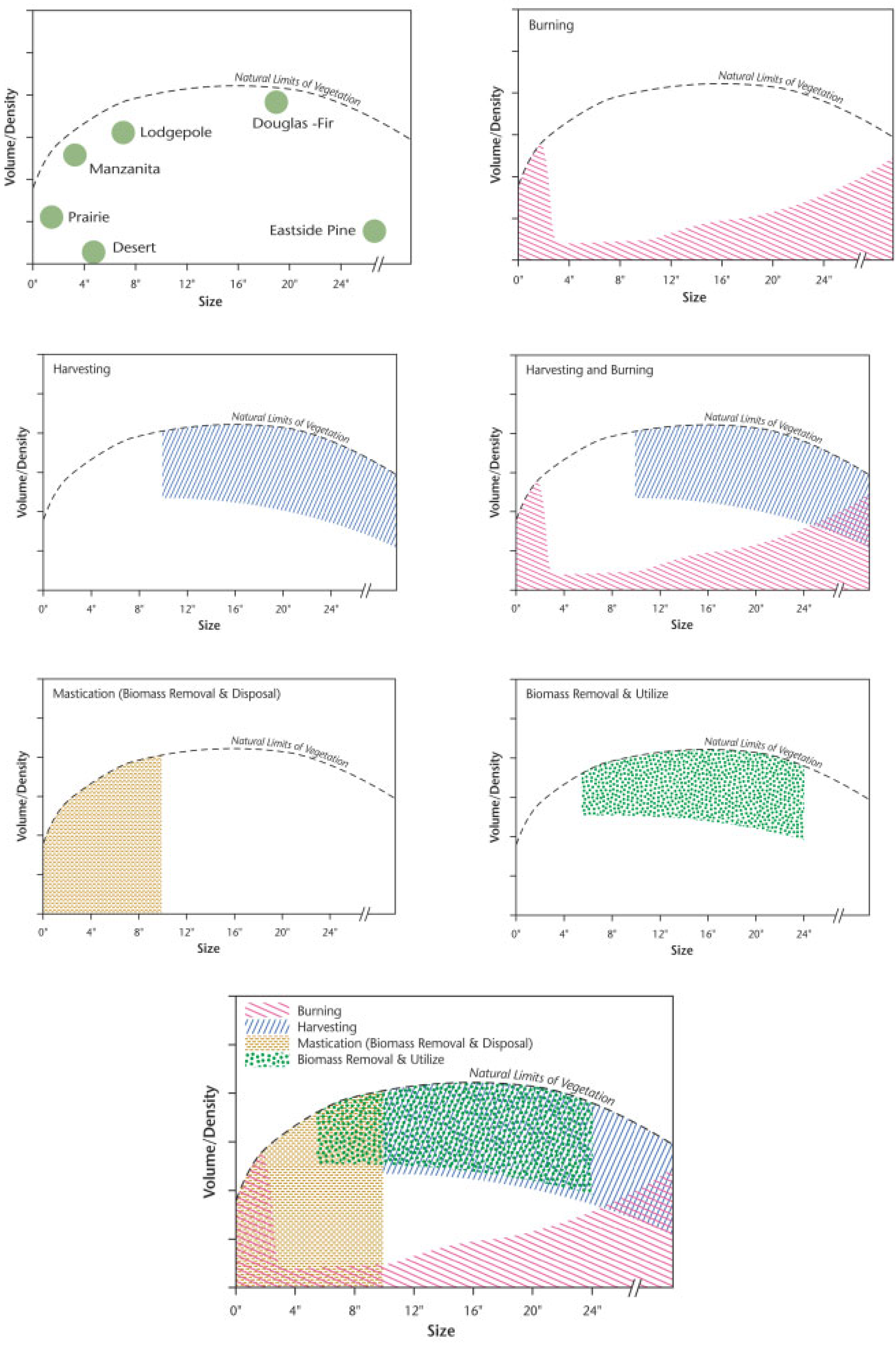
  In another example, homesteaders in a forested region of northern California cut limbs and small trees both to reduce the risk of wildfire and to provide themselves with firewood. However, realizing that much of the hardwood left behind by the previous harvest operations could have intrinsic commercial value of its own, they created a small-scale logging and milling system. Harvesting hardwood trees on the basis of promoting forest health, they market hardwood to local craftspeople, who create value-added products. Their harvest techniques, employing pickup trucks, portable sawmills, and preexisting logging roads, reduce the risk of catastrophic wildfire, minimize air quality impacts, promote forest health, and contribute to the local economy.

Programs such as these, while in themselves not able to address vast tracts of wildlands in need of treatment, can certainly contribute to the promotion of nonburning alternatives. Perhaps more importantly, they can help to bridge the gap between traditional forest practices and those who are unconditionally opposed to any form of commodification of forest products.

- Develop a comprehensive vegetation and fuel management manual. This report fundamentally addresses and promotes nonburning alternatives. However, as has been discussed above, prescribed burning is not likely to be removed from the repertoire of treatment options. With that in mind, it is recommended that the contents of this be expanded, or combined with existing materials, to provide a comprehensive guide to program development. Such a manual would begin with the earliest planning stages and would include prescribed burning techniques, but would emphasize incorporation of emission reduction techniques. It must be emphasized that many of the nonburning alternatives described in the previous chapters can in fact be considered emission reduction techniques, because they are frequently used as parts of larger programs that also entail prescribed burning.

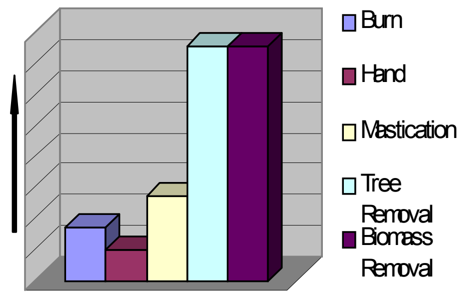
A Final Word

In conclusion, perhaps the most important lesson to learn from the forest management issues that confront us is that single solutions rarely suffice. The present crisis developed because those involved in making management decisions failed to understand the complexity of the natural systems they were attempting to manage, and because they did not consider the myriad consequences of their actions. So, too, we must bear in mind that a great deal remains to be discovered about the mechanics of ecosystems, the interrelationships of seemingly disparate occurrences, and the unanticipated consequences of solutions we undertake. It is imperative, therefore, as both fuel load and air pollution conditions continue to worsen, that we consider a range of solutions as broad and interconnected as the factors that gave rise to the problems in the first place.

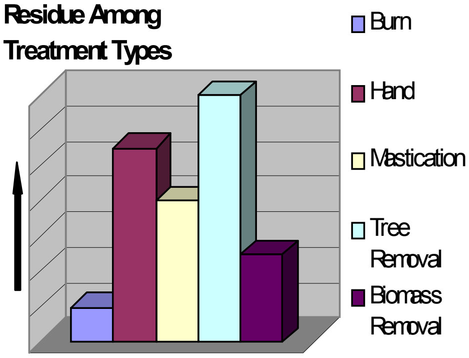


Natural Limits of Vegetation
Douglas -Fir
Lodgepole
Manzanita
Prairie
Desert
Eastside Pine
Volume/Density
Size
0"
4"
8"
12"
16"
20"
24"
Burning
Harvesting
Harvesting and Burning
Mastication (Biomass Removal & Disposal)
Biomass Removal & Utilize

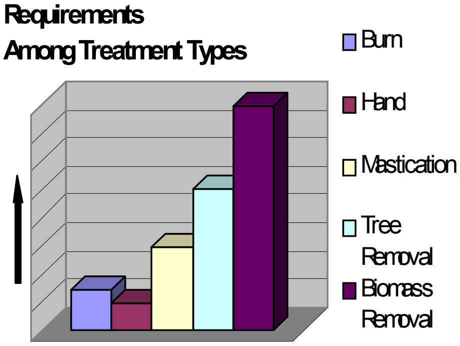
Comparison of Administrative Resistance Among Treatment Types



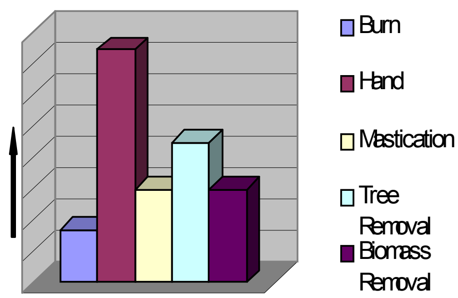
Comparison of Post-treatment Fuel Residue Among Treatment Types



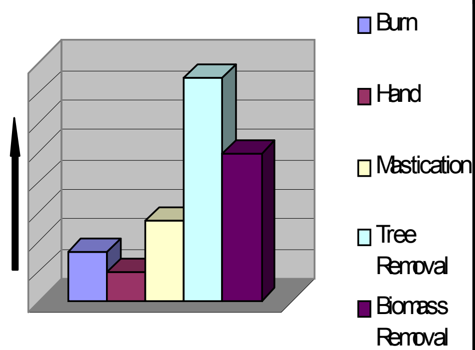
Comparison of Gross Capitalization Requirements Among Treatment Types



Comparison of Production Inefficiency Among Treatment Types



Comparison of Interest Group Resistance Among Treatment Types



Appendix A-10g. WRAP report "Burning Management Alternatives on Agricultural Lands in the Western United States"

Eastern Research Group, Inc.

Non-Burning Management Alternatives on Agricultural Lands in the Western United States

Volume I:

Agricultural Crop Production and Residue Burning in the Western United States

FINAL

Prepared for:

The Fire Emissions Joint Forum of the Western Regional Air Partnership

Enviro-Tech Communications

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NON-BURNING MANAGEMENT ALTERNATIVES ON AGRICULTURAL LANDS IN THE WESTERN UNITED STATES

VOLUME I:

AGRICULTURAL CROP PRODUCTION AND RESIDUE BURNING IN THE WESTERN UNITED STATES

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Prepared for:

The Fire Emissions Joint Forum of the
Western Regional Air Partnership

Prepared by:

Eastern Research Group, Inc. (ERG)
8950 Cal Center Drive, Suite 260
Sacramento, California 95826

and

Enviro-Tech Communications
P.O. Box 593
Folsom, California 95763

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FIGURES AND TABLES

ACRONYMS

A_BURN	acres burned
AH	acres harvested
AK	Alaska
AQTF	Air Quality Task Force
Avg	average
Avg_Crop	Crop average percentage burned
Avg_State	State average percentage burned by crop
AZ	Arizona
BAL	bales
BU	bushels
CA	California
CA_Lake	Lake County, California
CA_SJV	San Joaquin Valley, California
CA_South_Coast	South Coast Air Basin, California
CASS	California Agricultural Statistics Service
CDFA	California Department of Food and Agriculture
CO	Colorado
CoFips	County-Federal Information Processing Standards
COMM	commodity
CRP	Conservation Reserve Program
CWT	hundredweight (100 pounds)
EI	emissions inventory
e-mail	electronic mail
ERG	Eastern Research Group, Inc.

ETC	Enviro-Tech Communications
FEJF	Fire Emissions Joint Forum
FIPS	Federal Information Processing Standards
FSA	Farm Service Agency
GIS	geographical information system
HI	Hawaii
ID	Idaho
KBG	Kentucky bluegrass
MT	Montana
NASS	National Agricultural Statistics Service
ND	North Dakota
NM	New Mexico
NRCS	Natural Resources Conservation Service
NV	Nevada
OR	Oregon
PEDB	Published Estimates Data Base
QA/QC	quality assurance/quality control
R_BURN	residue burned (tons)
RES	residue (tons)
RL	residue loading (tons/acre)
SD	South Dakota
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
StFips	State-Federal Information Processing Standards
U.S. EPA	United States Environmental Protection Agency
USDA	United States Department of Agriculture

UT	Utah
WA	Washington
WESTAR	Western States Air Resources Council
WGA	Western Governors' Association
WRAP	Western Regional Air Partnership
WY	Wyoming
YR_HAR	year harvested

EXECUTIVE SUMMARY

The Western Regional Air Partnership and its Fire Emissions Joint Forum (WRAP/FEJF) sponsored this project to investigate the alternatives to agricultural burning. The geographical scope of the project includes the 15 Western states of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, North Dakota, New Mexico, Nevada, Oregon, South Dakota, Utah, Washington, Wyoming, and the tribal lands within these states.

The objectives of this project were designed to facilitate the development of crop production and agricultural burning activity data to support analysis of alternatives to burning, and they include:

- Development of a crop production database and an agricultural burning activity database;
- Identification of the "universe" of potential non-burning management alternatives;
- Design of a methodology to assess the impacts of alternatives (e.g., agronomic, environmental, economic, etc.);
- Identification of existing and potential accountability mechanisms for tracking if, and which, non-burning alternatives are used by federal, state, local, and tribal entities, and potential barriers to their implementation; and
- Development of a plan for implementing alternatives in the 15 Western states.

This analysis was supported by a three-tiered approach to research. The three tiers of sources included: (1) federal agencies such as the U.S. Department of Agriculture (USDA) and the National Agricultural Statistics Service (NASS); (2) agencies such as the University Agricultural Extension Services and state air agencies; and (3) private consortiums such as growers, producers, distributors, and information clearinghouses.

The results of this project are documented in two reports under the title "Non-Burning Management Alternatives on Agricultural Lands in the Western United States," Volume I and Volume II.

Volume I: Agricultural Crop Production and Residue Burning in the Western United States

The goal of the crop production database was to compile acres harvested by crop at the county level for all major crops harvested and/or crops known to be burned in each of the 15 Western states. The crop production database was developed from three main sources of information:

1. The NASS database;
2. State agricultural statistics data and reports; and
3. The 1997 Census of Agriculture.

Also, the Farm Service Agency (FSA) website was used to obtain information on lands included in the Conservation Reserve Program (CRP). Although the target year for these data was 1996, it was necessary to include 1997 data when 1996 data were missing for crops that were known to be burned. The crop database underwent an extensive quality assurance/quality control (QA/QC) process to ensure that at least 90 percent of the acres harvested of major (i.e., top 10) crops and 100 percent of all crops burned were accounted for in the database. In total, over 50 different crops were grown in the 15 Western states which amounted to nearly 77,000,000 acres harvested in a single year during the 1996/1997 timeframe. The resulting county-level data were mapped using a geographical information system (GIS) (see Appendix B).

The agricultural burning database was developed for purposes of identifying the extent of burning in the Western states, and to assist with the emissions inventory being developed by the WRAP/FEJF. The burning database was compiled from three types of data representing various geographical areas within the 15 Western states region:

- Burn permits issued or other mechanisms for determining actual burn activity;
- Emissions inventory estimates;
- Anecdotal information from surveys sponsored by the WRAP/FEJF, the Western States Air Resources Council (WESTAR); and
- Data resulting from peer review of the draft agricultural burn activity database prepared for this project.

Although a significant amount of data were obtained, burning was known to occur in certain counties and states for which data were unavailable. A gap filling technique was developed to provide estimates of acres and residues (tonnage) burned at the county level for those unaccounted areas (i.e., North Dakota, New Mexico, and South Dakota). Table ES-1 shows the results of the overall database in terms of average percentage of acres burned by crop. The resulting county-level data were mapped using GIS (see Appendix D).

Although the data that were collected and compiled were subject to specific QA/QC procedures, some of the data and results have inherent uncertainty. These uncertainties are due to such factors as use of "as is" data sets provided by the various sources and an inconsistent definition of "agricultural burning" within these data sets. Also, the gap filling averages used to provide missing data in some states cannot accurately depict actual burn activity that occurred in those states. Even for some areas where gap filling was not used, information originally provided for the draft database was revised with significantly different information obtained during the peer review process (e.g., Utah). While it can be concluded that the peer review process worked in this case, this result is illustrative of the need for a coordinated, systematic process to collect agricultural burning data, establish data quality objectives, and resolve conflicting data.

The researchers and peer reviewers contributing to the final agricultural burn activity database made the following recommendations pertaining to future improvements of this database:

1. Develop a mechanism (e.g., program, regulation, etc.) whereby the relevant state, county, tribal, agricultural, and stakeholder entities establish data quality objectives, define data sources, and compile data on a regular basis to estimate the extent of agricultural burning in the Western United States. Also, this mechanism should provide a consistent definition of the residue types to be included in the agricultural burning category.

2. Conduct research to identify and/or calculate specific yield-based RL factors for each geographical zone or area; and

3. Incorporate the impact of irrigated and nonirrigated land agricultural practices.

Table ES-1. Average Percentage of Acres Harvested that are Burned for Selected Crops in the Western United States

Crop	Acres Harvested[1]	Acres Burned	Overall Average Percentage of Acres Burned
Wheat	31,619,000	905,756	2.9%
Rice	500,000	254,706	50.9%
Corn	5,766,000	10,668	0.2%
Barley	5,696,900	137,872	2.4%
Sugarcane	42,900	30,000	69.9%
Orchards (Trees, Bushes, Vines)	2,497,767	530,100	21.2%
Grasses and Seeds	899,976	394,077	43.8%
CRP	286,174[2]	28,917	10.1%

Notes:
[1] Acres harvested and burned are for the 15 Western states, excluding Nevada because burning in that state was not identified for specific crops .
[2] Value represents number of acres in the Conservation Reserve Program (CRP).

Volume II: Non-Burning Management Alternatives and Implementation Plan Strategies

The majority of information collected and reviewed in this study suggests that states, local agencies, tribal communities, and fire control experts agree that the development and use of non-burning alternatives is desirable. However, identification, development, and use of these alternatives throughout the 15 Western states and tribal communities appears to be in the fundamental research stages. This fact, in combination with the lack in most states of formal requirements to implement non-burning alternatives, made identification and characterization of alternatives a difficult task. Over 20 different non-burning alternatives were identified in the following categories:

1. Leave residues in place either with or without infield residue treatment (e.g., cut, mulch, and drop in place; soil incorporation);

2. Improved management practices and scientific advancements in horticulture (e.g., genetic selection for disease/pest resistance or less fuel residual);

3. Alternative land use (i.e., conservation tillage; land conversion to non-agricultural use; and plant crops with residues that do not need to be burned); and

4. Residue collection and hauling for use offsite (e.g., haul to waste or landfill facility; haul to ethanol production facility).

In order to determine the reasonableness, or feasibility, of implementing non-burning management alternatives, it is important to assess the impacts they have on agriculture, the environment, and other aspects of society. In this study, the impacts to non-burning alternatives were defined and criteria were established for assessing their effects and determining the feasibility of implementation. The range of impacts due to implementation of non-burning alternatives included:

- Agronomic impacts—what happens to the agricultural production unit when an alternative is implemented, what the grower must do on the land and how does that change affect the productivity of the land;

- Environmental impacts—what effect does the alternative have on visibility, air quality, water quality, wildlife, and other vegetation;

- Health and safety impacts—what hazards do alternatives present in the workplace when implemented;
- Energy impacts—what are the impacts due to use of agricultural waste to produce energy;
- Economic impacts—what is the cost of implementation considering the difference in cost of agricultural operations between the traditional burning operation and the new alternative approach;
- Social and equity issues—beyond cost considerations, how are the growers, tribal communities, and other groups, affected by non-burning alternatives, and what is the equity of controlling some burning/crops and not others; and
- Political issues—when promotion of non-burning alternatives tends to antagonize farmers and agricultural interest groups.

Criteria were developed to evaluate each potential impact relative to a particular crop/alternative combination. A rating scheme using feasibility factors was developed that can be applied to the potential impacts relevant to each alternative being evaluated (e.g., 0 = No impact; 1 = Some impact/problem; 2 = Definite problem; and 3 = Major problem). High ratings indicate worse impacts relative to low ratings. This methodology is demonstrated in two case studies (for rice straw and grass seed) in order to show how to quantify some impacts (e.g., cost-effectiveness) and apply feasibility factors. As an example, the results showed for rice straw that the average feasibility factors for the non-burning alternatives ranged from 1.1 (least negative impact) for alternatives such as Cut/Collect and Haul to Ethanol Production Facility, to 2.1 (most negative impact) for Land Conversion to Non-Agriculture.

Accountability mechanisms are procedures used for tracking if, and to what extent, non-burning alternatives are used by local, state, tribal, or federal entities. In-place mechanisms are categorized and discussed. How the mechanisms support or promote the use of non-burning management alternatives is described in the implementation section (Section 7.0 of Volume II). The information gathered on accountability mechanisms came from state, county, local, and tribal environmental authorities representing all 15 Western states. The 17 different accountability mechanisms were identified in the following categories:

a. Accountability initiated at the state or regional level (i.e., exemption or inclusion of agricultural burning in regulations);

b. Accountability at the state or local level that supports active regulation of agricultural burning activities (e.g., existing regulations or rules addressing agricultural burning activities);

c. Accountability at a programmatic level that supports a formal approval and/or permitting process (e.g., smoke management programs);

d. Mechanisms that encourage accountability at the local level and provide information for applying non-burning alternatives to current agricultural burning practices (e.g., fuel types burned, emissions tracking); and

e. Mechanisms that facilitate and encourage the use of non-burning alternatives (e.g., pre-burn permits, financial assistance).

The presence, or in some cases absence, of accountability mechanisms appears to be an indicator of whether non-burning alternatives will be used in the Western states. In general, for states with aggressive mandates to reduce agricultural burning such as Washington, Oregon, and California, many accountability mechanisms are in place. These states also have the largest number of non-burning alternatives in use. An important finding, which served to complicate the identification and interpretation of information on accountability mechanisms, was the inconsistent definition of "agricultural burning" in the 15 Western states. For example, in some areas irrigation ditch, fenceline, and weed or land clearing for range land improvement is included in regulations covering agricultural burning; in other areas these are not addressed.

Non-statutory administrative barriers are those situations, circumstances, activities, or factors that serve to minimize, deter, or prevent the active use of non-burning alternatives. Eighteen barriers that fall into the following four categories were identified:

- *Economic challenges* including labor costs; increased liability; disposal, storage, packaging, or transport costs; availability and/or willingness of investors to provide capital for new technologies or non-traditional methods; market return; crop yield, quality, and production rates;

- *Geographical limits* due to climate or topography;

- *Political, cultural, or religious practices* including activities that center around agriculture/harvest activities or tribal ceremonies; historical promises of land as a lure to relocate;

- *Public acceptance* of a practice or program result (which may be closely tied to aesthetics); and

- *Aesthetics* including visual, olfactory, and auditory impacts, but possibly nuisance due to plant debris or dust in or near homes and businesses.

A strategy for increasing the development and use of non-burning alternatives is described as applicable to the 15 Western states. A detailed discussion lays out the critical elements of an effective implementation plan, including items such as developing a strategic plan, allocating resources, and providing consistent program implementation. Based on the results of this study and the suggested guidelines, recommendations were made for developing an successful non-burning alternatives program at the state, local, and tribal level:

1. Air quality or environmental program entities should conduct a focused review to identify the nature and extent to which agricultural burning contributes to air quality problems in the state, or local, or tribal area. A starting point for this review could be the evaluation of agricultural burning activity such as that presented in Section 3.0 of Volume II. A key element of this review that should be included is a careful consideration of the definition of "agricultural burning". This is important so that accurate comparisons can be made between other state, local or tribal programs.

2. If agricultural burning does not contribute significantly to local or statewide air quality problems which fall under the jurisdiction of the state, local or tribal entity, it is still recommended that the focused program assessment also take into account, to the greatest extent possible, the potential impacts agricultural burning may have on interstate regional air quality.

3. If agricultural burning is not found to be a significant source of air pollution for a given state, local region, tribal entity, or interstate region, it may not be necessary to continue with non-burning alternatives program development.

4. If agricultural burning is found to make a significant contribution to air quality problems on either a local, state, tribal community, or regional level, then the air quality or environmental agencies in authority in the affected areas and the areas contributing to the problems should work together to define solutions and develop non-burning alternatives programs. This will help to ensure success on a regional level.

5. If agricultural burning is found to be a significant source of air pollution for a given state, local region, tribal entity or interstate region, or if a given entity desires to more effectively implement non-burning alternatives, then an overall air quality review should be conducted to determine how to integrate agricultural burning. One goal of this review would be to determine which of the accountability mechanisms identified in Section

5.0 of Volume II are in place and how they are being used. Table 5-2 of Volume II can be used to determine specific accountability mechanisms and tailor the agricultural burning program.

6. For those states, local regions, and tribal entities desiring to more effectively address the use of non-burning alternatives in general, it is recommended that a list of effective and economically viable non-burning alternatives be developed (ideally including non-burning alternatives for use by crop, by season, and by region or area). Table 2-1 of Volume II (listing of non-burning alternatives by crop) can be used to identify specific alternatives. The criteria, methodology, and case studies described in Sections 3.0 and 4.0 of Volume II can be used to determine feasibility.

7. It is further recommended that a list, or in some cases multiple lists, of feasible non-burning alternatives should be maintained and updated periodically by the participating lead public or private entity. The list(s) should be made available using a variety of common effective communication strategies, methods, and technologies.

8. If non-burning alternatives have not been previously identified or have not been characterized for practical use an area, it is recommended that air quality and environmental entities work closely with university and agricultural extension scientists, affected agricultural community stakeholders, and interested members of the public to identify and characterize non-burning alternatives for specific use in their state or region.

9. WRAP member states should form a technical working group or task force to systematically identify and review the current use of non-burning alternatives and to make recommendations, if desired, on how and where the use of these non-burning alternatives may be improved or enhanced in other states, local regions, and tribal communities.

10. WRAP member states should work together to begin to address ancillary non-emission related program implementation issues, such as assisting the affected agricultural community and local business developers with post-residue removal product development, manufacturing, distribution, and marketing. Although this often falls outside the traditional charter of most state air quality and environmental programs, it does not fall outside the realm of services offered by other state agencies, boards and environmental departments. Some states have taken steps to assist in the research and development stages but their efforts have not extended to distribution and marketing.

11. It is highly recommended that the results of this and any of the above mentioned program efforts be carried out in close coordination with a well defined stakeholder outreach, education and communication program.

The agency roles and responsibilities associated with the identification, development, and implementation of non-burning alternatives are not clearly identified for any of the 15 Western states. It is recommended that as non-burning alternatives programs are reviewed and developed in the future, that the air quality or environmental agency responsible for developing the non-burning alternatives program (see Recommendation 4 above) be the agency responsible for monitoring and implementation. Regional approaches to defining responsibility for non-burning alternatives programs are also needed. This is in response to instances such as the relocation of grass seed companies within the last five years from Washington and Oregon to Wyoming where there are relatively less stringent air quality regulations.

A well designed, closely coordinated, and consistently implemented stakeholder involvement, outreach, and communication effort is essential to the success of any non-burning alternatives program. Stakeholder involvement is not only an important way to encourage the use of non-burning alternatives, it will be key in developing future alternatives to infield burning of agricultural residues.

A number of directions for further research and information development are recommended for the Western states and tribal communities in order to increase knowledge and encourage use of feasible non-burning management alternatives:

- Better characterization of agricultural burning activities in the 15 Western states and tribal communities, including development of a consistent definition for “agricultural burning”;
- More thorough collection and evaluation of agricultural burning activity data (e.g., daily acres burned by county, permits records, etc.) by regulatory agencies and stakeholders;
- More thorough assessment of the air quality impacts from agricultural burning;
- On-going investigation into effective non-burning alternatives;

- Effective inclusion of stakeholders in the identification and implementation of non-burning alternatives; and

- Development of a well designed, consistently implemented stakeholder outreach, education, and communication programs that address local, state, tribal, and regional issues pertaining non-burning alternative program implementation.

1.0 INTRODUCTION

Air emissions from burning agricultural residue, primarily consisting of fine particulate matter (CARB, 1996), can impact visibility in Class I areas located near burns, as well as those Class I areas located far away through regional transport. The Western Regional Air Partnership (WRAP) and its Fire Emissions Joint Forum (FEJF) sponsored this study to assess the non-burning alternatives to infield burning of agricultural residues, including their impacts on the environment, economy, health and safety, society, politics, and on the business and productivity of the agricultural industry. This study was performed under the Western Governors' Association (WGA) Contract 30203-31 by Eastern Research Group, Inc. (ERG) and Enviro-Tech Communications (ETC).

In the context of this study, "agricultural burning" is defined as the burning of organic crop residue consisting of field crops, wood, and leaves. Also, the burning of ditch banks adjacent to, or associated with, crop production are included in this evaluation of alternatives to agricultural burning. The geographical scope of the project includes the 15 Western states of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, North Dakota, New Mexico, Nevada, Oregon, South Dakota, Utah, Washington, and Wyoming, as well as tribal lands in these states.

The temporal scope of the data collected for this project was 1996, chosen to coincide with the WRAP base year emissions inventory effort. However, as described herein, it was necessary to use data from 1997 or other years in some cases when 1996 data were not available. This use of various years of data is an important limitation of the results of this project. There is no assurance that 1996 crop production acreage, for example, is indicative of 2001 acreage due to factors such as increasing urbanization and regulatory impacts. Also, crop rotations will impact year-to-year variations.

1.1 Study Objectives

The objectives of this study are diverse. They are designed to facilitate development of crop production and agricultural burning activity data to support analysis of the alternatives to burning—which is the main objective of this study. Also, these data are used for estimating emissions from agriculture burning under another project. The specific objectives of this study are as follows:

1. Identification of crops grown and the extent to which residue is disposed of through burning for the 15 Western states. The goal is to develop county-level estimates of acres harvested and acres (or residues) burned by crop for each of the 15 Western states.

2. Display of the crop and residue burned data using a geographical information system (GIS). The goal is to illustrate the level of crop production (acres harvested) and agricultural burning (acres or residues burned in tons) within the 15 Western states. The GIS maps provide a useful means to compare burning activity county-to-county, and to ensure that all available data are included and that gap-filling procedures provide accurate results.

3. Identification of potential alternatives to agricultural burning and characterization of their agronomic, environmental, health and safety, social, economic, and political impacts. A three-tiered approach to collecting information on the potential impacts to non-burning alternatives is employed. The three tiers include: (1) federal agencies such as the United State Department of Agriculture (USDA); (2) state agencies such as the University Agricultural Extension Services; and (3) private consortiums such as growers, producers, distributors, and information clearinghouses.

4. Development of criteria for selecting reasonable non-burning alternatives, cost-abatement curves (i.e., cost of alternative by crop), and examples of how to apply the criteria and cost-abatement curves (i.e., case studies) to evaluate alternatives. The goal is to develop a global methodology that can be used to assess the reasonableness of non-burning alternatives; thereby, minimizing the need for region-and crop-specific assessment when possible.

5. Identification of existing and potential accountability mechanisms for tracking if, and which, non-burning alternatives are used by federal, state, local, and tribal entities. The goal is to describe the specific mechanisms, mainly statutory and currently in-place (e.g., required burn permits, available financial incentives, agricultural burning exemptions, etc.), that support, promote, or hinder the implementation of non-burning alternatives.

6. Identification of existing and potential barriers to the use of non-burning alternatives including non-statutory barriers (e.g., public acceptance, cultural practices, etc.) and recommendations on how these can be overcome. This objective presents the "flip-side" of Objective 5

(accountability mechanisms) in order to understand the current limitations (i.e., non-regulatory) to new program development and implementation of non-burning alternatives.

7. Development of a plan for implementing a non-burning program based on the analysis, findings, and recommendations developed in this study. The goal of the implementation plan is to give the WRAP/FEJF a “course of action” for implementing the recommendations developed under this project. The plan recommends agency responsibilities for implementation, and methods for disseminating information to stakeholders such as private landowners and others who will ultimately be responsible for implementing non-burning strategies.

1.2 Data Collection Methodology

Data were collected for this project based on a three-tiered approach. The first-tier sources were expected to have the highest quality data; the second-tier sources were expected to have readily available data; and, the third-tier sources were anticipated to provide additional crop-, state-, or regional-specific information pertaining to the identification and use of non-burning management alternatives. The primary data sources used in this project were as follows:

- Tier 1 sources included the Farms Services Agency (FSA), Economic Research Service, National Agricultural Statistics Service (NASS), USDA within each state, several state Natural Resources Conservation Service (NRCS) offices, Federal Agricultural Research Centers;
- Tier 2 sources included land grant universities, joint agency working groups and task forces (e.g., California Advisory Committee on Alternatives to Rice Straw Burning), State Agricultural Research Centers, University Agricultural Extension Services, divisions or departments of pesticide management; and
- Tier 3 sources included various private consortiums, farmers, distributors, professional agricultural organizations, and information clearinghouses.

Specific data sources are discussed as they pertain to crop production and residue burning, and identification and implementation of non-burning management practices.

1.3 Document Organization

This document is organized into two volumes that address all of the objectives of the project. Earlier in-progress work was reported in three draft reports–the Task 1 Draft Report which addressed Objectives 1, 2, and 3; the Task 2 and Task 3 Draft Report which addressed Objectives 4, 5, and (partially) 6; and, a Draft Final report which provided a complete initial analysis addressing all objectives. A detailed description of the content of the final Volume I and Volume II reports, and how the study objectives are addressed within each report is as follows:

- Volume I: Agricultural Crop Production and Residue Burning in the Western United States:
  - Section 1.0 describes the project background and objectives. This section also explains the data collection methodology and organization and content of the Volume I and Volume II reports.
  - Section 2.0 describes the development and results of the crop production database (Objectives 1 and 2). This section quantifies the level of crop production in each of the 15 Western states, including the number of acres harvested by crop and county. The results are presented in various tables and maps. A detailed quality assurance/quality control (QA/QC) procedure ensures the accuracy of the results.
  - Section 3.0 describes the development and results of the agricultural burning database (Objectives 1 and 2). This section explains the data collection and compilation procedure used to compile the burn activity data (e.g., acres and residues [tons] burned by crop and county). Also, since only limited data on actual burn activity is available in the 15 Western states, a gap-filling procedure is employed to provide estimates in states/counties where burning is known to occur, but records on specific quantities are not tracked. The results are presented in various tables and maps.
  - Section 4.0 provides relevant conclusions and recommendations pertaining to the crop production and agricultural burning databases.
  - Section 5.0 lists the references used in the development of Volume I, including reports, journal articles, websites, and personal communication.
  - Appendix A contains a listing of the crop production data (i.e., acres harvested by crop, county, state).
  - Appendix B contains the crop production GIS maps for each state.

- Appendix C contains listings of the agricultural burning activity data (i.e., residues burned [tons] by crop, county, state).

- Appendix D contains the agricultural burning activity GIS maps for each state.

- Appendix E contains relevant tables from Volume II.

- Volume II: Non-Burning Management Alternatives and Implementation Plan Strategies:

  - Section 1.0 describes the project background and objectives. This section also explains the data collection methodology and organization and content of the Volume I and Volume II reports.

  - Section 2.0 describes the "universe" of non-burning alternatives which are in-use, or have been used in the past in the 15 Western states (Objective 3). The alternatives are listed in a table based on applicable crop and by category (i.e., leave in place, scientific improvements, alternative land use, cut or collection and haul).

  - Section 3.0 presents a methodology for assessing the impacts of non-burning alternatives (Objective 4). First, the different types of potential impacts are described (i.e., agronomic, environmental, health and safety, energy, economics, social and equity issues, and political). Criteria are presented to assist in evaluating the relative feasibility of implementing alternatives (e.g., agronomic–soil compression, increased water use; economic–not cost-effective, substantial farm stress, etc.). A table shows available sources of information and expected outcomes of the analysis for each of the impacts. A methodology that can be used to evaluate these impacts for various crops/alternatives is described.

  - Section 4.0 contains two case studies that illustrate the methodology developed to analyze the impacts of non-burning alternatives (Objective 4). Impacts of non-burning alternatives for two significant crops (rice and grass seed) are described. The criteria developed in Section 3.0 are used to evaluate the impacts. Cost curves display the economic impacts of implementing non-burning alternatives.

  - Section 5.0 presents the accountability mechanisms currently in place, or practiced in the past for implementing and tracking progress of alternatives to agricultural burning (Objective 5). A table lists the 17 mechanisms identified through an extensive research effort, along with the state/county where each mechanism is employed.

— Section 6.0 describes the non-statutory administrative barriers currently existing at the state level for each of the 15 Western states (Objective 6). Where they exist, county- and local-level barriers are discussed, along with barriers affecting tribal communities' ability to implement non-burning alternatives.

— Section 7.0 provides a summary of strategies for increasing the development and use of non-burning management alternatives on agricultural lands in the 15 Western states (Objective 7). A summary of the overall results of the entire project is presented along with conclusions and recommendations for future work. The contents for each section of a "state-specific" implementation plan are described, strategies to address stakeholder involvement are given, and suggestions for further research and information development are made.

— Section 8.0 lists the references used in the development of Volume II, including reports, journal articles, websites, and personal communication.

— Appendix A contains a detailed listing of the participants (i.e., name, affiliation, phone, fax, e-mail) contacted as part of the informal survey conducted for this study.

— Appendix B gives a project case study (Alaska Agriculture Project, Delta Junction) that presents realistic information on the success and challenges encountered when developing and implementing a non-burning program in the West.

— Appendix C contains relevant tables from Volume I.

2.0 CROP PRODUCTION IN THE 15 WESTERN STATES

Information on the amount, type, and location of crops grown in the 15 Western states forms the foundation for quantifying the amount of agricultural burning that occurs, and provides the basis for an analysis of the alternatives to burning and their impacts. Quantification of crop production is followed by identification and quantification of residues, or fuels subject to agricultural burning. This section describes the sources of information used to develop the database of crop production statistics, how they were compiled and checked, and the results of the compilation.

2.1 Sources of Crop Production Data

The three sources of data used to compile a crop production database for the 15 Western states are described next. In general, all of these sources rely on surveys from a sample of farms and ranches within their geographical jurisdiction that result in county-level statistics. Crop production on tribal lands is included in these county-level statistics.

2.1.1 National Agricultural Statistics Service Database

The NASS database was the first data source to be reviewed and compiled. The NASS is under the administrative jurisdiction of the USDA. The NASS annual county data for 1996 were downloaded from the NASS "Published Estimates Data Base" (PEDB) (NASS, 1996a). The county-level data in the PEDB are based on surveys from a sample of farms and ranches. Surveys are conducted in a variety of ways including mailed questionnaires, telephone interviews, face-to-face interviews, and field observations. The types of information that were obtained from the PEDB for use in the project included:

- Commodity (crop type);
- Year (1996);
- State name;
- County name;
- State Federal Information Processing Standards (FIPS) code;

- District code (i.e., three-digit code for state-defined regions comprising multiple counties);
- County FIPS code;
- Harvested acres;
- Planted acres;
- Yield (quantity of crop produced per acre);
- Yield units (e.g., BU = bushels, CWT = hundred weight, BAL = bales, etc.);
- Production (Harvested acres x Yield); and
- Production units (generally the same as yield units).

Priority was given to collecting complete data for harvested acres. No attempt was made to search for and fill data gaps for planted acres, yield, and production since these data are not as relevant to this study as are harvested acres.

The NASS data were chosen to provide the foundation for the crop database for several reasons. First, the NASS data were available for 1996 (target year for the database chosen to support WRAP emissions inventory efforts) and at the county level (level of spatial resolution desired for this study). Second, the NASS data covered the major crops grown in each state (i.e., wheat, barley, oats, rye, corn, rice, cotton, hay, and some vegetables and orchard crops). Third, the NASS data are available electronically thus making them easier to compile than other data sets that must be entered into electronic format from hard-copy reports. The NASS data provided a comprehensive “starting point” for the development of the crop production database. When crops were missing from the NASS data (i.e., crops known to be burned in certain states such as orchard crops in California and grasses and seeds in Oregon, Washington and Idaho), then other data were used to supplement the NASS data for these specific crops. These other data sources are described next.

2.1.2 State Agricultural Statistics and Reports

State agricultural statistics data and reports for 1996 were obtained from state links provided on the NASS website (NASS, 1996b). The state statistics and reports served as a secondary data source for identifying data on crops known to be burned which were not reported by NASS. Additional data for California were obtained from "1996 Agricultural Commissioners' Data Report" (CDFA, 1997) and the reports link found on the California Agricultural Statistics Service (CASS) website (CASS, 1996). The state total production quantities for each crop from the state data were compared to the NASS state totals to help identify incorrect data or errors that may have occurred during data download or manipulation. (This quality assurance step is discussed in detail in Section 2.3.)

2.1.3 1997 Census of Agriculture

The 1997 Census of Agriculture was reviewed (NASS, 1999). The NASS compiles the agricultural census every five years, with 1997 being the most recent year available. The census contains information on the market value of agricultural products sold, farms by market value, land use, selected crops harvested, and production expenses. The census data provided county-level crop data for crops not found in the PEDB or the state statistics publications; however, the census data were least preferred because they represented 1997 instead of 1996, which is the target year for this study.

2.2 Crop Production Data Compilation and Gap Filling

Crop data were collected by downloading electronic files and obtaining hard-copy reports from the NASS and state agricultural services. The steps for collecting crop data, along with filling data gaps were as follows:

1. Crop data for 1996 were downloaded from the NASS website for all crops, at the county level, for each of the 15 states.

2. Microsoft© Excel spreadsheets were developed from the NASS data for each state.

3. In some cases, crop totals were reported as "combined counties" totals. In these cases, the "combined counties" data were disaggregated to the county level according to the following procedure:

a. When a district contained some county-level data and a "combined counties" total, then the harvested/planted/production quantities were distributed over the counties with no production shown. However, if distribution would have resulted in 100 or fewer acres harvested for a given county, then the harvested/planted/production quantities were added to these totals for the county in the combined county's district with the largest number of harvested acres.

b. When a district contained only "combined counties" total (i.e., no county-level data were shown), then the harvested/planted/ production quantities were distributed evenly over all counties in the district. However, if distribution would have resulted in 100 or fewer acres harvested for a given county, then the quantities were distributed evenly over the two, three, or four counties adjacent to counties in neighboring districts having the largest number of harvested acres.

c. Recalculated yields (e.g., bushel/acre, tons/acres) whenever production quantities were distributed.

4. Data from the individual states' databases and/or hard-copy reports were compared to the NASS data to identify missing crops or incorrect values.

5. Data from the 1997 Agricultural Census were used in the absence of 1996 data to fill in data on missing crops for each state that may not have been collected by the NASS or states.

6. Although not technically considered a "harvested crop," information on the acreage planted under the Conservation Reserve Program (CRP) was included. The CRP is a program that provides funding for planting permanent vegetation on idle, highly erodible farmland. The CRP is administered by the Commodity Credit Corporation through the FSA. It is supported by the NRCS, Cooperative State Research and Education Extension Service, state forestry agencies, and the local Soil and Water Conservation Districts. The CRP acres by state and county in 1996 were obtained from the FSA (FSA, 1996) and were added to the crop production database.

7. Crop residues known to have been burned since 1996 were identified from surveys made by the Western States Air Resources Council (WESTAR) and the WRAP/FEJF (WESTAR, 1999; WRAP, 2001a).

8. Spreadsheets were imported into a single Microsoft Access 1997 (hereafter Access) database for use with GIS software for mapping. (Details on the geographic database are described in Section 2.5.)

The following issue should be noted with regard to the individual wheat categories (i.e., all, winter, spring, and durum) and hay categories (i.e., all, alfalfa, and other) contained in the compiled database. The total of wheat/winter, wheat/spring, and wheat/durum acreage may not sum to the wheat/all acreage for a given county. This anomaly is due to the combined effect of two factors. First, some of the NASS data could not be reconciled on the county level. Second, data for “combined counties” were disaggregated to specific counties. The same situation applies to hay. Although the wheat and hay types may not sum to the wheat/all or hay/all at the county-level, they <u>do</u> sum at the district- and state-level. This issue was discussed with the WRAP/FEJF Project Manager and it was agreed that it was adequate to have reconciliation at the district-level (Jenkins, 2001).

Table 2-1 shows the universe of crop production data collected for each of the 15 Western states. Table 2-2 shows the sources of the data used for each crop for each state according to the compilation procedure described above.

2.3 QA/QC Procedures

The QA/QC procedure was developed based on the United States Environmental Protection Agency’s (U.S. EPA’s) QA/QC document (EIIP, 1997). The purpose of this procedure is to ensure that the following data quality objectives for the crop database for the 15 Western states are met:

- To account for the major crops grown in each state, at the county level for 1996. *Metric*: collect county-level data for the top 10 crops (based on total acres harvested) in each state. For states with fewer than 10 crop types (e.g., Alaska and Hawaii), collect data for all of the crops comprising 90% of all acres harvested.

- To account for all crops subject to agricultural burning in each state, at the county level for 1996. *Metric:* Collect county-level data for all crops that are subject to agricultural burning.

- To account for acres harvested and production quantities for crops meeting data quantity objectives 1 and 2. *Metric:* Acres harvested quantities compare across alternative data sources within ±15% accuracy.

Table 2-1. Crops Harvested During 1996/1997 in the 15 Western States

Crop Types	AK	AZ	CA	CO	HI	ID	MT	ND	NM	NV	OR	SD	UT	WA	WY
Field Crops															
Barley	✔	✔	✔	✔		✔	✔	✔		✔	✔	✔	✔	✔	✔
Beans, Dry Edible			✔	✔		✔	✔	✔					✔	✔	✔
Canola														✔	
Corn for Grain		✔	✔	✔		✔	✔	✔	✔		✔	✔	✔	✔	✔
Corn for Silage		✔	✔	✔		✔	✔	✔	✔			✔	✔	✔	✔
Cotton, Upland and American Pima		✔	✔						✔						
Flaxseed								✔				✔			
Hay, All	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Hay, Alfalfa	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Hay, All Other	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Hops														✔	
Lentils						✔									
Oats	✔		✔	✔		✔	✔	✔			✔	✔	✔	✔	✔
Peas, Dry Edible			✔			✔								✔	
Proso Millet				✔								✔			
Rice			✔												
Rye								✔				✔			
Safflower			✔												
Sorghum		✔	✔	✔					✔			✔			
Soybeans								✔				✔			
Wheat, All		✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Wheat, Durum		✔	✔				✔	✔				✔			
Wheat, Other Spring				✔		✔	✔	✔		✔		✔	✔	✔	✔
Wheat, Winter All		✔	✔	✔		✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
Orchard Crops															
Almond			✔												
Apple		✔	✔						✔		✔		✔	✔	
Apricot			✔												
Avocado			✔												
Cherry			✔								✔		✔	✔	
Citrus		✔	✔												
Fig			✔												
Filbert											✔				
Grape		✔	✔								✔			✔	
Kiwi			✔												
Macadamia Nut					✔										
Nectarine			✔												
Olive			✔												
Peach		✔	✔								✔		✔	✔	
Pear		✔	✔								✔			✔	
Pecan			✔						✔						
Persimmon			✔												
Pistachio			✔												

Table 2-1. Continued

Crop Types	AK	AZ	CA	CO	HI	ID	MT	ND	NM	NV	OR	SD	UT	WA	WY
Plum and Prune			✓								✓			✓	
Walnut			✓												
Fruits and Vegetables															
Asparagus			✓											✓	
Blueberries														✓	
Pineapple					✓										
Other[1]	✓	✓	✓		✓				✓	✓	✓		✓		
Grasses and Seeds															
Alfalfa, Seed		✓	✓	✓		✓	✓			✓	✓	✓	✓	✓	✓
KBG, Seed						✓	✓				✓			✓	
Other, Seed[2]		✓	✓	✓		✓	✓				✓	✓	✓	✓	✓
Other															
CRP			✓	✓		✓	✓	✓	✓		✓	✓		✓	✓
Coffee					✓										
Mint						✓					✓				
Peanuts			✓						✓						
Potatoes	✓	✓		✓		✓	✓	✓	✓	✓	✓		✓	✓	✓
Sugarcane					✓										
Sugarbeets			✓	✓		✓	✓	✓			✓			✓	✓
Sunflowers				✓				✓				✓			

Sources: See Table 2-2

[1] Fruits and vegetables “other” = cabbage, carrots, lettuce, tomatoes, green peas, sweet corn, snap beans, dry onions, melons

[2] Grasses and Seeds “other” = bermuda, fescue, red clover, ryegrass

CRP = Conservation Reserve Program
KBG = Kentucky bluegrass

Table 2-2. Sources of Data for Crops Harvested During 1996/1997 in the 15 Western States

Crop Types	AK	AZ	CA	CO	HI	ID	MT	ND	NM	NV	OR	SD	UT	WA	WY
Field Crops															
Barley	1	1	1	1		1	1	1		1	1	1	1	1	1
Beans, Dry Edible			1	1		1	1	1					1	1	1
Canola														4	
Corn for Grain		1	1	1		1	1	1	1		1	1	1	1	1
Corn for Silage		1	1	1		1	1	1	1			1	1	1	1
Cotton, Upland and American Pima		1	1						1						
Flaxseed								1				1			
Hay, All	4	1	4	1	1	1	1	1	1	1	1	1	1	1	1
Hay, Alfalfa	4	1	4	1	1	1	1	1	1	1	1	1	1	1	1
Hay, All Other	4	1	4	1	1	1	1	1	1	1	1	1	1	1	1
Hops														1	
Lentils						4									
Oats	1		1	1		1	1	1			1	1	1	1	1
Peas, Dry Edible			3			4								4	
Proso Millet				4								4			
Rice			1												
Rye								1				1			
Safflower			3												
Sorghum		1	3	1					1			1			
Soybeans								1				1			
Wheat, All		1	1	1		1	1	1	1	1	1	1	1	1	1
Wheat, Durum		1	1				1	1				1			
Wheat, Other Spring		1	1	1		1	1	1		1		1	1	1	1
Wheat, Winter All															
Orchard Crops															
Almond			2												
Apple		4	3						4		4		4	2	
Apricot			3												
Avocado			3												
Cherry			3								4		4	4	
Citrus		4	3												
Fig			3												
Filbert											3				
Grape		2	3								4			4	
Kiwi			3												
Macadamia Nut					2										
Nectarine			3												
Olive			3												
Peach		4	3								4		4	4	
Pear		4	3								4			4	
Pecan			3						4						
Persimmon			3												
Pistachio			2												

Table 2-2. Continued

Crop Types	AK	AZ	CA	CO	HI	ID	MT	ND	NM	NV	OR	SD	UT	WA	WY
Plum and Prune			3											4	
Walnut			2								4				
Fruits and Vegetables															
Asparagus			3											4	
Blueberries														4	
Pineapple					2										
Other	1	4	3		2				4	4	1		4	4	
Grasses and Seeds															
Alfalfa, Seed		4	3	4		4	4			4	4	4	4	4	4
KBG, Seed						4	4				4			4	
Other, Seed		4	3	4		4	4				4	4	4	4	4
Other															
CRP			5	5		5	5	5	5		5	5		5	5
Coffee					2										
Mint						4					4				
Peanuts			3						1						
Potatoes	1	1		1		1	1	1	1	1	1		4	1	4
Sugarcane					1										
Sugarbeets			1	1		1	1	1			1			1	1
Sunflowers				1				1				1			

Data Sources:
1 = 1996 NASS Published Estimates Database (NASS, 1996a)
2 = State statistics database (NASS, 1996b)
3 = Other state data and reports (CASS, 1996; CDFA, 1997)
4 = 1997 Agricultural Census (NASS, 1999)
5 = Conservation Reserve Program (FSA, 1996)

The applicable functions of the types of QA/QC methods employed are shown in Table 2-3. The QA/QC methods shown on Table 2-3 were employed both before and after the crop production spreadsheets were converted into Access. A description of how these methods were used to evaluate the crop data are presented below.

2.3.1 Reality Checks: Compare Data to Standard Reference Value

The crop data compiled from the 1996 NASS were compared to the 1996 data in the state agricultural statistics annual reports. None of the data for crops reported in NASS were more than ±15% different from state data; thus, no changes were made.

For each state, Table 28 of the 1997 Agricultural Census (NASS, 1999) (i.e., "Specified Crops by Acres Harvested") was used to rank the top 10 crops based on acres harvested during 1997. These data were compared to the NASS data to ensure that the top 10 crops for each state were consistent between 1996 and 1997. If any top 10 crops were missing, then data were obtained based on the following data sources (in order of preference):

- State agricultural statistics reports for 1996;
- Other references for 1996; and
- 1997 Census of Agriculture.

The WESTAR agricultural burning survey and FEJF agricultural burning survey (WESTAR, 1999; WRAP, 2001a) were reviewed to determine the types of crops burned since 1996.

2.3.2 Peer Review: Checklist or Written Comments by Reviewer

Notes were kept on the data sources used to compile each state's crop data, gap filling techniques, and corrected errors. Notes were made on hard copies of the draft crop data spreadsheets for future review. A complete listing of data sources used is shown on Table 2-2.

Table 2-3. Summary of QA/QC Methods Used to Evaluate Crop Production Data

Method	Ensure Completeness of Data	Ensure Reasonableness of Data	Ensure Validity of Data and Assumptions	Ensure Mathematical Correctness	Ensure Accuracy of Data
Reality checks	✓	✓			
Peer Review	✓	✓	✓		
Sample Calculations			✓	✓	✓
Computerized Checks			✓	✓	✓
Independent Audits	✓	✓	✓	✓	
Validation	✓	✓	✓		✓

To ensure the completeness and reasonableness of the data collected (i.e., top 10 crops in each state and all crops that could potentially be burned), the database was distributed to members of the FEJF for review of their respective states. A "Peer Reviewers Checklist" was provided to facilitate consistent and useful comments from the reviewers. Checklists were completed and returned by state personnel from the states of Alaska, Arizona, California, Idaho, Oregon, Utah, and Wyoming. Some crop information for the states of Arizona (i.e., harvested acres for apples, citrus, cotton, grapes, hay, peaches, and pears) and Utah (i.e., harvested acres for apples, beans, cherries, peaches, and potatoes) were changed.

2.3.3 Sample Calculations: Replication of One Set of Calculations

Generally, calculations related to the crop data were not performed; however, some simple calculations were performed to ensure mathematical correctness and accuracy of data. For example, county-level crop data were summed to ensure that county totals sum to district and state totals reported in the data sources.

2.3.4 Computerized Checks: Electronic Methods of Checking

Completeness and consistency checks were performed on the crop data. These were conducted on specific data elements as follows:

- County and state names and FIPS codes were checked against those included in the GIS database to ensure consistency of spelling and codes;
- Tables indexing crop names were developed and compared to ensure consistency in crop names among states; and
- After spreadsheets were imported into one database, the totals for acres harvested and production quantity were summed to ensure these totals matched the "State Total" data for each crop by county.

2.3.5 Independent Audits: Systematic Evaluation to Determine Quality

The WRAP/FEJF Project Manager conducted an independent audit of the crop database in order to:

- Evaluate the effectiveness of the technical and quality assurance procedures used to develop the data;

- Help ensure the completeness and accuracy of the data;
- Determine whether data quality objectives were met; and
- Determine the need for additional QA/QC measures.

Based on the review by the WRAP/FEJF Project Manager, data were added for acres of land included in the Conservation Reserve Program in 1996 (FSA, 1996).

2.3.6 Extended Peer Review: Local Knowledge

Validation of the crop data can be conducted in two ways:

1. The crop data could be compared to actual field observations. However, this is not a feasible exercise given the time and budget constraints of this study.
2. The knowledge possessed by many of the state representatives on the FEJF could be used in lieu of actual field observations to:
    a. Ensure the major crops are accounted for;
    b. Ensure the crops that could potentially be burned are accounted for; and
    c. Provide additional reality checks on the values of acres harvested, acres planted, production, and the location of the crops by county.

The review shown in the second step–an extended peer review–was conducted by FEJF and states' representatives. The changes resulting from comments received by the reviewers in Arizona and Utah are described above in Section 2.3.2.

2.4 Results of Compiled Crop Data

Table 2-4 shows the number of acres harvested for the top 10 crops (i.e., largest number of harvested acres) within each of the states. The crops shown on Table 2-4 are grouped by the categories of "Cereals and Grains," "Orchard Crops," "Grasses and Seeds," and "Other."

Table 2-4. Summary of Crop Production of the Top 10 Crops Within the 15 Western States for 1996/1997 (Acres Harvested)

Crops	AK	AZ	CA	CO	HI	ID	MT	ND	NM	NV	OR	SD	UT	WA	WY	TOTAL
Grains and Hay																
Barley	6,900	54,000		92,000		730,000	1,150,000	2,600,000		5,000	150,000	145,000	100,000	440,000	120,000	**5,592,900**
Corn; for Grain		40,000		890,000			15,000	600,000	84,000		37,000	3,650,000	20,000	120,000	50,000	**5,506,000**
Corn; for Silage			275,000	90,000		68,000	39,000		44,000			320,000	40,000		33,000	**909,000**
Hay; Alfalfa	3,801	160,000	944,056	860,000		1,000,000	1,700,000	1,700,000	250,000	250,000	460,000	2,500,000	545,000	490,000	620,000	**11,482,857**
Hay; All Other	20,222	19,000	754,717	650,000		280,000	900,000	1,200,000	100,000	230,000	610,000	1,800,000	160,000	310,000	600,000	**7,353,939**
Oats	700						50,000	380,000			35,000	360,000	9,000		32,000	**866,700**
Proso Millet				125,765												**125,765**
Rice			500,000													**500,000**
Sorghum		45,000		260,000					225,000			145,000				**675,000**
Wheat; All		178,000	688,000	2,268,000		1,560,000	6,360,000	12,515,000	110,000	19,000	920,000	3,854,000	185,000	2,745,000	236,000	**31,638,000**
Orchard																
Almonds			400,692													**400,692**
Apples														154,930		**154,930**
Citrus		38,823	284,790													**322,690**
Grapes			721,505													**721,505**
Pecans									23,188							**23,188**
Grasses and Seeds																
Seeds; Alfalfa										11,731						**11,731**
Seeds; Other											513,246					**513,246**
Other																
Fruits and Vegetables	343	28,800	777,358		13,120				38,375	4,415			6,695	189,269		**1,058,375**
Beans; Dry Edible				125,000		93,000		570,000							31,000	**824,201**
Coffee					5,400											**5,400**
Cotton; Upland		314,000	995,000						55,000							**1,364,000**
Cotton; American Pima		40,300														**41,900**
Lentils																**65,540**
Macadamia Nuts					20,200											**20,200**
Mint											45,221					**45,221**
Peanuts									16,500							**16,500**
Peas; Dry Edible						71,507								126,975		**198,482**
Pineapple					20,000											**20,000**

Table 2-4. Continued

Crops	AK	AZ	CA	CO	HI	ID	MT	ND	NM	NV	OR	SD	UT	WA	WY	TOTAL
Potatoes	630					413,000				6,999	61,000		4,200	161,000		**642,629**
Soybeans								845,000				2,670,000				**3,515,000**
Sugarbeets						184,000	57,500								56,800	**298,300**
Sugarcane					42,900											**42,900**
Sunflower				107,000				1,165,000				690,000				**1,962,000**
Total	**32,596**	**917,923**	**6,341,118**	**5,467,765**	**101,620**	**4,399,507**	**10,271,500**	**21,575,000**	**946,063**	**527,145**	**2,831,467**	**16,134,000**	**1,069,895**	**4,737,174**	**1,778,800**	**76,918,791**

Data Sources:
1996 NASS Published Estimates Data Base (NASS, 1996a)
State statistics databases (NASS, 1996b)
Other state data and reports (CASS, 1996; CDFA, 1997)
1997 Agricultural Census (NASS, 1999)

These categories, which are different than those shown in Table 2-1, are used to facilitate development of fuel categories to be used in later analyses. Table A-1 in Appendix A shows state crop production data in terms of acres harvested for all crops for which data were collected.

As Table 2-4 shows, the greatest production of crops in terms of acres harvested is in the “cereals and grains” category, with hay and wheat varieties comprising the most acres. Although orchard crops and grasses and seeds make up a relatively smaller portion of the top 10 crops harvested, these are important crops to consider with regard to non-burning alternatives since their residues are widely burned in the West. The states of North Dakota, South Dakota, and Montana have the most acres harvested, primarily wheat. Although California ranks fourth in terms of top 10 crops harvested, it is an important state with regard to the individual top 10 crops harvested because their residues are widely burned (e.g., residues from orchard crops, especially almonds and walnuts).

The procedure used to compile the crop production database resulted in a comprehensive set of data depicting agricultural production during 1996/1997. For purposes of facilitating analysis of burn activity and alternatives to burning, this database is felt to be the best available. Also, having undergone qualitative and quantitative review, these data are also supported by the state agencies responsible for compiling and using these data. A limitation of these data is that they represent a combination of 1996 and 1997 activity (although for the most part, they are for 1996), depending on the state and crop grown; thus, these data should not be used to compare activity between states for the same crops. There is no assurance that 1996 crop production is similar to 1997 crop production within a given county due to factors such as increasing urbanization and crop rotation.

2.5 Development of the Geographic Database

The first step in the development of the geographic database was to import the crop production data. As noted in Section 2.2, Excel spreadsheets containing county-level crop production data (based on data from NASS and state agricultural services) were imported into Access. Before they were imported, a check was performed to ensure that all the Excel spreadsheets had the same fields (those listed in Section 2.1), as well as a field indicating whether data had been disaggregated from a district total or combined-counties total to individual counties. After the files were imported, a check was performed to ensure that the number of records present in the Access database was equal to the number of records in the Excel spreadsheets.

A field called FIPS was then added to each record in the database, representing a concatenation of the two-digit state FIPS code and the three-digit county FIPS code. The reason for this is because the ArcView GIS software associates each state and county with a 5-digit FIPS code. The addition of the 5-digit FIPS code to the Access database allows each record in the database to be linked to ArcView geographic data files representing the locations of each state and county. Then an Access query was used to compare the state name, county name, and 5-digit FIPS codes used in ArcView to the state name, county name, and 5-digit FIPS codes present in the Access database. Discrepancies were corrected using the U.S. EPA's master list of FIPS codes (USEPA, 2001a).

Additional QA/QC procedures that were performed included the following:

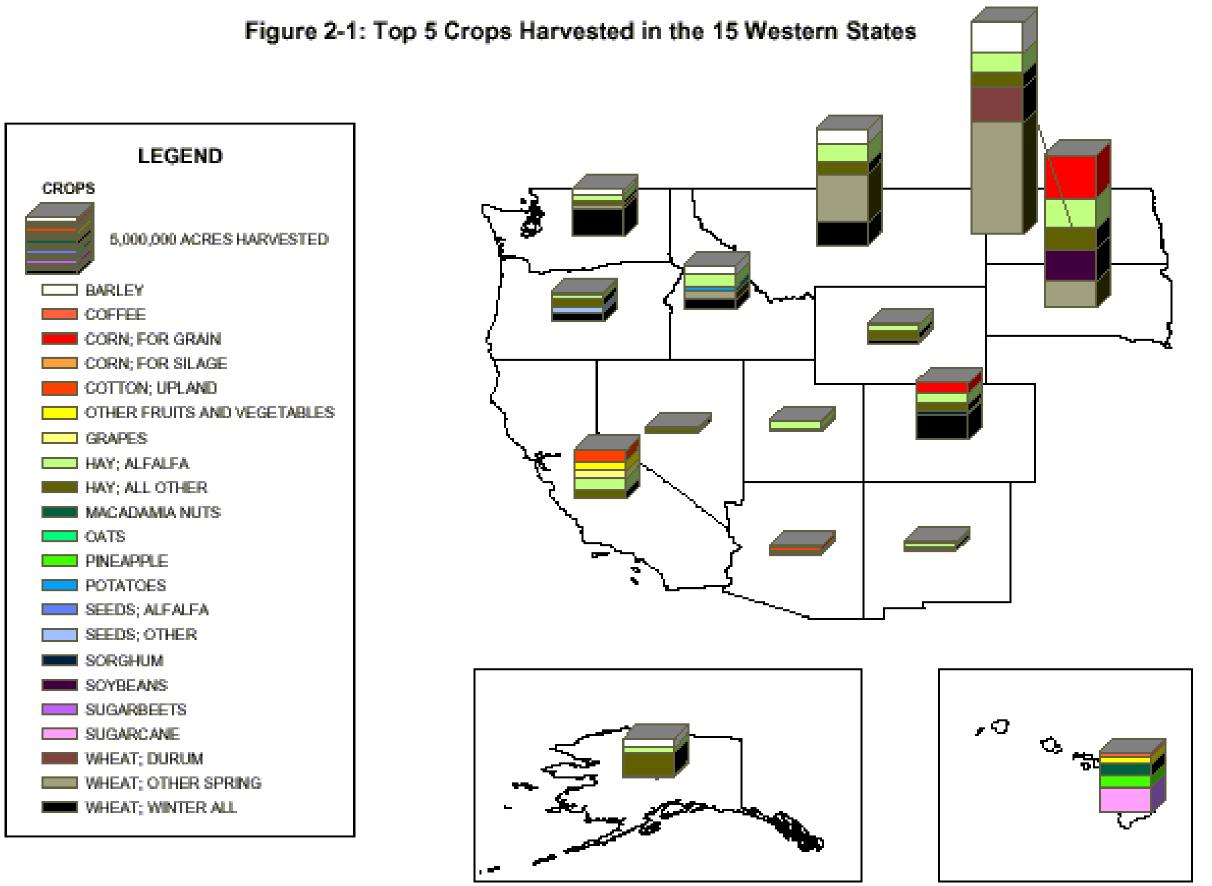
- Access queries were used to sum the total acres planted, acres harvested, and production for an individual crop in all the counties within a state and to compare this sum to the record in the database showing the state total acres planted, acres harvested, and production. In cases where discrepancies arose, they were corrected by referring to the source data.
- Access queries were used to verify that only one record for each crop type in each individual county was present in the database. In cases where discrepancies arose, they were rectified based on consulting the source data.

Printouts from the final crop production database are included in Appendix A.

In order to develop maps that would show the top five crops in each state and county, Access was programmed to generate a "GIS crop production summary table" that listed each state and county down the rows and all the available crops for which data was collected across the columns, filling the cells with the number of acres harvested for the appropriate crop in the appropriate county (or state as a whole) with the data present in the Access database. A version of this table (the "GIS Top 5 table") was created that showed only the acres harvested for the Top 5 crops grown in a county (or state as a whole), leaving the remaining cells blank. This second table was imported into ArcView and linked to the program's geographic data files representing the locations of each state and county based on matching 5-digit FIPS codes.

A map showing the top 5 crops in all 15 Western states is included as Figure 2-1. This map uses the "GIS Top 5 table" to generate legends that show the relative number of acres harvested for each state (or county). Also, Appendix A contains maps of each state indicating the number of total acres harvested on the county level. The GIS tables were submitted to the WRAP/FEJF at the close of the project. These tables can be used to ArcView to make changes to the maps as necessary in the future.

Figure 2-1: Top 5 Crops Harvested in the 15 Western States



Note: Alaska and Hawaii are not to the same scale as the other states. Specifically, the height that represents 100,000 acres in the 13 (continental) states represents 1,000 acres in Alaska and 2,000 acres in Hawaii.

3.0 AGRICULTURAL BURNING ACTIVITY IN THE 15 WESTERN STATES

An important goal of this project is the development of an agricultural burning database for the 15 Western states. This database provides information on crop residues (total generated and total burned) by county for two purposes:

1. To identify the extent to which agricultural burning occurs, types of crops burned, and the location (i.e., county, state) and time (i.e., month, and day if feasible) when burning occurs in order to facilitate the evaluation of alternatives to burning and their impacts; and

2. To provide county-level (and sub-county level if feasible) data on residue burned by crop for estimating emissions from agricultural burning in the 15 Western states.

This section describes the sources of information used to develop the agricultural burning database, and how they were compiled, gap filled, and checked.

3.1 Sources of Agricultural Burning Data

The types of data needed to characterize agricultural burning include amount of residue burned and/or number of acres burned, by crop. For purposes of assessing burning and understanding the impacts of alternatives, monthly activity at the county and crop level are needed; however, to assist with emissions inventory development, daily activity and location-specific data are best. For example, information regarding the day of the burn is most desirable, but the season and/or month of the burn is sufficient. Also, information regarding the address or section (township and range) is best, but county location is sufficient.

Obtaining agricultural burning data presented a significant challenge. First, only a few states had organized smoke management programs that track actual burn activity. Some states provided agricultural burning activity data based on information collected for their emissions inventories. Also, anecdotal information was available for a few other states in the form of responses to surveys conducted by the WESTAR and the WRAP/FEJF (WESTAR, 1999; WRAP, 2001a), and an informal survey conducted by the investigators for this non-burning management alternatives project. Comments received during the review of the draft database also resulted in new and/or revised estimates of agricultural burning activity in the Western states.

As mentioned above, documented agricultural burning activity data exist for only a portion of the 15-state domain, although agricultural burning is known to occur in nearly every state. Thus, it was necessary to devise a data gap filling procedure to provide the necessary data to complete the database. The results of the data compilation and the gap filling techniques are discussed next.

3.2 Agricultural Burning Data Compilation and Gap Filling

Agricultural burning data were compiled for the 15 Western states using several steps:

- First, actual burn data statistics were obtained as available (i.e., data from states and/or counties that compiled statistics on agricultural burning activity occurring in their jurisdiction).
- Second, a draft database was designed whereby the actual data were compiled into a consistent format. Gaps were "filled" to provide missing information.
- Third, the draft database was reviewed by the WRAP/FEJF members. From each state, including representatives from NRCS and other state-level and county-level agricultural, air quality, and fire departments.
- Based on comments received, changes were made and the database was finalized. This final database of agricultural burning activity data was provided to the WRAP/FEJF emissions inventory contractor for additional review and incorporation into the emissions inventory being performed under a separate project.

All of these steps are described in detail below.

3.2.1 Sources of Agricultural Burning Data

Table 3-1 shows the sources and general characteristics of data used to develop the agricultural burning activity database for the Western states. The burning activity data sets generally fall into three categories: data based on permits issued or other mechanisms for determining actual burn activity; data used to develop emissions inventory estimates; and

Table 3-1. Summary of Agricultural Burning Data Collected for the Western States

Data Set	Type of Data		Temporal Resolution[1]			Spatial Resolution			Sources(s)	Relevant Counties (Crops)
	Acres Burned	Residue Burned (Tons)	Year	Month	Day	State Level	County Level	Sub-County Level		
AZ	✔		2000-2001	✔	✔		✔		Graves, 2002	Graham, Cochise (various)
									Foster, 2002	Yuma (citrus, ditches/weeds, jojoba beans)
									Johnson, 2001	Yuma (citrus)
									Gabrielson, 2002	Pinal (ditches/weeds)
									Conrad, 2002	Pima (ditches/weeds)
									Tickes, 2002	Yuma (wheat, bermuda)
CA_Imperial	✔		1996	✔	✔		✔		ICAPCD, 2001	Imperial (various)
CA_Lake	✔		1997	✔			✔		WRAP, 2001a	Lake (various)
CA_Sac_Valley	✔		1996	✔	✔		✔		Fife, 2002	Sacramento Valley: Butte, Glenn, Colusa, Placer, Sacramento, Shasta, Sutter, Tehama, Yolo, Solano, Yuba (various)
CA_South_Coast	✔	✔	1996	✔			✔		SCAQMD, 2001	South Coast Air Basin: San Bernardino, Riverside (various)
CA_SJV	✔	✔	1999	✔	✔		✔	✔	SJVUAPCD, 2001	San Joaquin Valley Air Basin: Fresno, Kings, Madera, Merced, San Joaquin, Stanislaus, Tulare, Kern (various)
CO	✔		Avg	✔			✔		Sharkoff, 2002	Mesa (wheat)
HI	✔		1996	✔		✔	✔		WESTAR, 1999	All (sugarcane)
									MacCluer, 2002	All (pineapple)
ID	✔		1996	✔		✔	✔		WESTAR, 1999; IDEQ, 2001; Riley, 2002	All (various)
MT			1996	✔		✔			Coeffield, 2002	All (irrigated wheat)

Table 3-1. Continued

	Type of Data		Temporal Resolution[1]			Spatial Resolution				
Data Set	**Acres Burned**	**Residue Burned (Tons)**	**Year**	**Month**	**Day**	**State Level**	**County Level**	**Sub-County Level**	**Sources(s)**	**Relevant Counties (Crops)**
ND			Avg	✔		✔	✔		WRAP, 2001a; McDonald, 2002; Shaver, 2002	Pembina, Cavalier, Towner, Ramsey, Walsh, Nelson, Grand Forks, Benson, Eddy, Foster, Stutsman, Griggs, Steele, Traill, Barnes, Cass (wheat)
NM			Avg	✔		✔	✔		WRAP, 2001a; Shaver, 2002	All (wheat stubble); Curry (wheat stubble)
NV	✔		1998	✔		✔	✔		Sergent, 2002	All (unspecified)
OR		✔	1996	✔		✔	✔		WRAP, 2001a; ODEQ, 2001	All (various)
SD			Avg	✔		✔	✔		WESTAR, 1999; Stover, 2002; Shaver, 2002	All (barley, winter wheat)
UT	✔		1996	✔		✔	✔		WESTAR, 1999; UDEQ, 2001; Bernards, 2002; Goodrich, 2002	All (various)
WA	✔	✔	1999	✔		✔	✔	✔	WDOE, 2001a; WDOE, 2001b	All (various)
WY	✔		1996	✔		✔	✔		WESTAR, 1999; Potter, 2002	All (various)
									Grover, 1998	Big Horn, Hot Springs, Park (alfalfa seeds)
									Cunningham, 1998	Fremont (barley)
									Spiering, 1998; Shaver, 2002	Park (alfalfa and grass seed)

✔ Data are available. Blanks indicate that data are not available.

[1] "Avg" year means the specific year of burning could not be determined from the information provided. Months of burning for most states were determined as part of an informal survey conducted by Enviro-Tech Communications. See Appendix E (Tables 5-1 and 5-1a) for a summary of results from that survey. See Volume II for more details.

information obtained from informal telephone interviews and during the draft database review process.

Some data sets were developed based on documentation of actual burning that occurred as tracked by permit records for California (San Joaquin Valley, Imperial County, Sacramento Valley, and South Coast Air Basin), Arizona, and Washington. Other data sets were based on county-level data used to develop emissions inventories for Idaho and Oregon. Data sets that were developed using information obtained from surveys (WESTAR, 1999; WRAP, 2001a) and interviews conducted under this project include: CA_Lake (Lake County, only), HI, and WY. Data sets that were developed from information obtained during the peer review of the draft agricultural burning database prepared under this project include CO, MT, NV, and UT. Data sets developed using gap filling techniques supplemented with anecdotal information obtained during peer review include ND, NM, and SD.

The timeframes for the burn data vary from 1996 only, to data for 1996 through 2001. Data for 1996 were preferred because that is the year of the crop production data and the WRAP's base year emissions inventory. However, in order to provide data for as large of a geographic area as possible, it was necessary to use other years if 1996 data did not exist or were known to be largely incomplete compared to later years. For example, based on conversations with SJVUAPCD it was determined that although 1996 data are available in the CA_SJV data set, 1999 data are much preferred and more complete than the 1996 data due to improvements in data collection and management procedures. In California, the magnitude of agricultural burning appears to have been fairly constant during the years 1996-2000 based on the data sets reporting multiple years. Therefore, mixing years of burn data should not introduce significant error into the resulting emissions calculations. Also, officials in Washington stated that the data for 1999 are probably more indicative of 1996 burn activity contained in their database due to incomplete data in the database for 1996.

Even though the survey of burning activity by tribes in the WRAP region provided insight into the types of burning that occurs on tribal lands (i.e., range, agricultural, and wildland), the survey does not provide sufficient detail to allow quantification of burning in terms of acres or residue. The survey results show that of the 76 tribes that conduct prescribed burning, only 45 conduct agricultural burning (WRAP, 2001b). Of the 45 respondents/

reservations conducting agricultural burning, the survey categorizes the reasons for burning as weed abatement and ditch and canal clearing. Only one survey respondent mentioned a crop type (i.e., "stubble"). Based on this survey alone, it might be concluded that agricultural burning within reservation boundaries is relatively insignificant compared to agricultural burning outside of reservation boundaries. In Northern Idaho, for example, state officials report that more acres of Kentucky bluegrass are burned within reservation boundaries than are burned outside of reservation boundaries (Riley, 2001).

3.2.2 Database Development

A database was designed to provide a consistent format for compiling the existing burning data (i.e., as shown on Table 3-1). Table 3-2 shows the data fields in the agricultural burning database. Database tables were developed and populated with data from the data sets listed in Table 3-1, and data contained in the crop database. Crop data were used to determine county-level burn activity on the basis of crop activity for data sets that contained only state level data (explained below). Lookup tables were developed to appropriately link crop names (from the crop database) to commodity names (in the burn data sets).

Several other steps were applied to the data sets shown in Table 3-1 as they were imported into the new database to ensure ensure consistency and maintain the correct level of spatial and temporal resolution. These steps were:

- For burn activity data reported on a statewide level (e.g., sugarcane in Hawaii, wheat in Montana), the acres burned were assigned to counties based on the acres harvested of those crops burned. For example, for Montana it was estimated that 1% of the irrigated wheat stubble is burned (Coeffield, 2002). Therefore, these acres burned were distributed over the counties where irrigated wheat was harvested based on the percentage of the harvested acres within each county.

- For burn activity data reported for aggregated crops (e.g., cereal grains, orchard prunings, etc.), the acres burned were assigned to counties based on the acres harvested of those crops from the crop database that comprised the aggregated category. For example, the CA_South_Coast (Riverside County) data set included acres burned of "orchards." These residues were linked to the crop data for the orchard crops grown in Riverside County (i.e., almonds, apples, cherries, persimmons, pistachios).

Table 3-2. Description of the Agricultural Burning Database for the Western States

Database Fields		Units/ Format	Data Source or *Calculation*
COMM	Commodity or crop	Text	Crop database
YR_HAR	Year harvested	YY	Crop database
STATE	State name	Text	Crop database
StFips	State FIPS code	##	Crop database
COUNTY	County name	Text	Crop database
CoFips	County FIPS code	###	Crop database
AH	Acres harvested	Acres	Crop database
RL	Residue loading	Tons/Acre	AP-42, ARB, other
RES	Amount of residue	Tons	*AH x RL*
A_BURN	Acres burned	Acres	Actual data
Year	Year burned	YY	Actual data
Month	Month burned	MM	Actual data
Day	Day burned	DD	CA_SJV and WA, only
R_BURN[1]	Residue burned	Tons	*RL x A_BURN*
Avg_State[2]	State average % burned by crop	%	*A_BURN/AH*
Avg_Crop[3]	Crop average % burned	%	Average of all Avg_State by crop

Notes:

[1] R_BURN (residue burned) is reported directly by Oregon; thus, this value is taken as reported and is not calculated according to this procedure for Oregon.

[2] Avg_State is calculated based on actual and anecdotal information for the data sets shown in Table 3-1. Each average is weighted according to the total acres of each crop harvested in each county within each data set. In some cases, this average represents a “data set” average if the data set contains information for areas not comprising an entire state (e.g., CA_SJV).

[3] Avg_Crop is calculated as a weighted average of the Avg_State amounts from each data set. Each average is weighted according to the total acres of each crop harvested within the geographical area covered by each data set.

Italics indicate the data value is *calculated*.
= Indicates 2-digit numerical value
= Indicates 3-digit numerical value

Total orchard residue was disaggregated based on the percentage that each crop represented of the total acres harvested of these orchard crops in Riverside County.

- For burn activity data reported on an annual basis, anecdotal information was used to assign burning activity to specific months. For example, burning of grass seeds and grain field stubble occurs in the months of July, August, and September, in Oregon (WRAP, 2001a). Therefore, the residues burned were distributed (evenly) over these three months.

After all the data sets had been imported and linked with the appropriate data from the crop database, individual tables for each geographic area were imported into Excel spreadsheets for additional processing (e.g., calculating additional averages to be used in gap filling areas where burn data do not exist) and quality checking.

3.2.3 Residue Loading Factors

Another important type of data that was used to estimate quantities of residues burned was residue loading factors. Residue loading (RL) factors were matched to specific crops, and residues were calculated (i.e., acres harvested x RL = residue). A summary of these factors, which are based on various studies and research into the yields of residue of specific crops, is shown in Table 3-3. The factors shown on Table 3-3 come from several sources including AP-42 (USEPA, 1995), CARB (CARB, 2000), Jenkins and Sumner (1986), and others.

As Table 3-3 shows, most of the RL factors chosen for this study are crop-specific, and do not necessarily take into account the differences in yield (which can determine amount of residue generated) based on geographic variability. Also, differences between irrigated (relatively high yield) as compared to non-irrigated land (relatively low yield) are important; these are not evident in the crop-based RL factors shown on Table 3-3. For example, dryland farmers in eastern New Mexico yield 17 to 25 bushels/acre of wheat; in parts of Washington the yield is 90 to 125 bushels/acre. This can make a very big difference in the residues generated (Shaver, 2002).

In the case of wheat yields in Colorado, Table 3-3 shows the difference between a Colorado-specific RL (i.e., 4.0 tons/acre for irrigated, spring wheat) as compared to the AP-42 RL (i.e., 1.9 tons/acre) and the New Mexico RL (i.e., 1.5 tons/acre). The Colorado RL was based

Table 3-3. Residue Loading Factors for Crops Burned in the Western States

Fuel Type	States Where Crops are Burned[1]	Residue Loading (tons/acre)[2]	Comments/Sources of Residue Loading
Grains and Hay			
Barley	CA, ID, OR, SD, UT, WA, WY	1.7	
Corn, Grain	AZ, CA, OR, WA	4.2	
Hay, Alfalfa	CA, WA	0.8	
Hay, All Other	CA, WA	0.8	
Hops	WA	1.9	Wheat RL
Oats	CA, OR, WA	1.6	
Rice	CA	3.0	
Rye	CA	1.9	Wheat RL
Sorghum	CA	2.9	
Wheat	AZ, CA, ID, MT, ND, OR, SD, UT, WA	1.9	
Wheat (spring, irrigated)	CO	4.0	Sharkoff, 2002 (CO only)
Wheat	NM	1.5	Shaver, 2002 (NM only)
Orchard			
Almond	CA	1.0	
Apple	AZ, WA	2.3	
Apple	CA	0.8-1.0	Beyer, 2002[3] (CA only)
Apricot	CA	1.8	
Avocado	CA	1.5	
Cherry	CA, WA	1.0	
Citrus	AZ, CA	1.0	
Date	CA	1.7	Orchard Pruning, Unspecified RL
Fig	CA	1.7	Orchard Pruning, Unspecified RL
Grape	CA, WA	2.5	
Kiwi	CA	1.7	Orchard Pruning, Unspecified RL
Nectarine	CA	1.7	Orchard Pruning, Unspecified RL
Olive	CA	1.7	Orchard Pruning, Unspecified RL
Peach	CA, WA	2.5	
Pear	CA, WA	2.6	
Pecan	AZ, CA	1.7	Orchard Pruning, Unspecified RL
Persimmon	CA	1.7	Orchard Pruning, Unspecified RL
Pistachio	AZ, CA	1.7	Orchard Pruning, Unspecified RL
Plum and Prune	CA, WA	1.2	
Pomegranate	CA	1.7	Orchard Pruning, Unspecified RL
Quince	CA	1.7	Orchard Pruning, Unspecified RL
Walnut	CA	1.2	
Orchard Pruning, Unspec.	AZ, CA, WA	1.7	
Orchard Removal, Unspec.	CA, UT, WA	15.0	Jenkins, 2001
Grasses and Seeds			
Seeds, Alfalfa	ID, WA, WY	0.8	IDEQ, 2001
Seeds, KBG	ID, WA	2.0	IDEQ, 2001
Seeds, Other, Unspec.	AZ, CA, WA, WY	2.0	Assume same as KBG
Bermuda	AZ, CA	2.0	Assume same as KBG

Table 3-3. Continued

Fuel Type	States Where Crops are Burned[1]	Residue Loading (tons/acre)[2]	Comments/Sources of Residue Loading
Grasses, Unspec.	CA, OR	2.0	Assume same as KBG
Fruits and Vegetables			
Asparagus	CA, WA	1.5	
Beans, Dry Edible	CA, WA	2.5	
Berries	CA, WA	1.7	
Canola	WA	1.3	Safflower RL
Mint	ID	0.5	IDEQ, 2001
Other fruits and vegetables	CA, WA	1.5	Jenkins and Sumner, 1986 (average of all vegetables)
Peanuts	CA	1.2	Potatoes RL
Peas, Dry Edible	CA, WA	2.5	
Pineapple	HI		Undetermined
Safflower	CA	1.3	
Sugarcane	HI	14.0	Midpoint of AP-42 RLs
Vegetables, Unspec.	CA	1.5	Jenkins and Sumner, 1986 (average of all vegetables)
Other Agricultural Related Fuels			
CRP	WA	2.6	Midpoint of AP-42 RL for grasslands
Ditches, fence line	AZ	1.6	Gabrielson, 2002 (AZ only)
Ditches, fence line	CA, ID, WY	3.2	Weeds, Unspecified RL
Ditches, fence line	UT	0.75	Goodrich, 2002 (UT only)

CRP = Conservation Reserve Program
KBG = Kentucky bluegrass
RL = Residue loading
Unspec. = Unspecified

Sources:
[1] Table 3-1 summarized for sources of information relating to burning of specific crop residues in states.
[2] AP-42 (USEPA, 1995) except where otherwise noted.
[3] This RL was not obtained in time to be included in the calculation of residues burned for CA as reported in the final database.

on an estimated yield of 110 to120 bushels/acre and an estimated straw (residue) of 70 lbs/bushel. This results in residue loading of 4.0 tons/acre (Sharkoff, 2002). Some USDA NRCS offices have compiled location-specific crop yields and average residue production factors that can be used to estimate crop residues for specific geographic areas. Although it was not feasible to conduct this level of research for this study, this type of work could be done to make improvements to the agricultural burning activity database in the future.

3.2.4 Percent Burned By Crop

The average percentage of acres burned (of total acres harvested) for wheat and barley was calculated using data for counties and states where burning actually occurred (i.e., 5.2% and 8.0%, respectively). These averages were used to estimate the residues burned in the states/counties where burning of these crops was known to occur, but for which no data were available. The states/counties to which these “gap filling” averages were initially applied within the draft agricultural burning database, included Arizona (Pinal county, only), Colorado, Montana, North Dakota, New Mexico, Nevada (all counties excluding Pershing), and South Dakota. However, based on the information obtained during peer review of the draft database, it was possible to replace most of the gap filled data with information provided by the USDA NRCS and other organizations. Only North Dakota, New Mexico, and South Dakota remain with gap filled data.

Also, overall state-level averages were calculated based on total acres burned divided by total acres harvested by crop for each state. Using the state-level percentage acres burned, an overall crop average was calculated for most crops in the agricultural burning database and compared to values provided in a 1997 study by the USDA Air Quality Task Force (AQTF) (USDA, 1997). These averages are shown in Table 3-4. (Acres harvested for Nevada is not included in any average calculation because the burn data were not reported for specific crops).

For wheat and barley, the gap filling averages (i.e., 5.2% and 8.0%, respectively) are larger than the overall state-level averages (i.e., 4.2% and 2.3%, respectively) because the state-level averages are based on state-level acres harvested as compared to the gap filling averages which are based on applicable county-level acres harvested. In this manner, the effect

Table 3-4. Average Percentage of Acres Harvested that are Burned for Selected Crops in the Western United States[1]

Crop	Acres Harvested	Acres Burned	Overall Average Percentage of Acres Burned
Wheat	31,619,000	905,756	2.9%
Rice	500,000	254,706	50.9%
Corn	5,766,000	10,668	0.2%
Barley	5,696,900	137,872	2.4%
Sugarcane	42,900	30,000	69.9%
Orchards (Trees, Bushes, Vines)	2,497,767	530,100	21.2%
Grasses and Seeds	899,976	394,077	43.8%
CRP	286,174[2]	28,917	10.1%

Notes:
[1] Acres harvested and burned do not include Nevada because burning in that state was not identified for specific crops .
[2] Value represents number of acres in the Conservation Reserve Program (CRP).

of any non-reported burning is not incorporated into the gap filling averages. Spreadsheets containing the data used to calculate both averages are located in Appendix C.

3.2.5 Comparison to USDA Air Quality Task Force Study

A comparison was made between the results shown on Table 3-4 and estimated values from a study sponsored by the USDA AQTF (USDA, 1997). The USDA AQTF study provides information on the extent of burning on croplands in the U.S. (plus information on wild fires and prescribed burning). The USDA AQTF document gives percentage of cropland burned by crop for 1992, and estimates quantities for 1997. A comparison of the USDA AQTF findings to the results shown on Table 3-4 is presented below:

- Sugarcane:
    - The USDA AQTF report indicates that 100% of sugarcane acres in Hawaii were burned during 1997.
    - Table 3-4 shows approximately 70% of sugarcane acres in Hawaii were burned (based on 1996 data).

  Differences are likely due to different years of data and methods used to compile results.

- Orchard Crops (fruits, nuts, grapes, berries, citrus):
    - The USDA AQTF report indicates that 5% of these orchards were burned in the U.S. during 1997.
    - Table 3-4 shows that approximately 21% of orchards were burned in the Western states (based on a combination of data from 1996-1999).

  Differences are likely due to different years of data and geographical coverage (i.e., entire U.S. as compared to Western states).

- Rice:
    - The USDA AQTF report indicates that 25% of rice acres were burned in California during 1997, and 19% were burned for the total U.S.
    - Table 3-4 shows that approximately 51% of rice acres were burned in 1996 (entirely in the Sacramento Valley).

Differences are likely due to different years of data. Note that rice straw burning phase-down goals limited burning to 200,000 acres per year for three years starting September 1998 (Senate Bill 218, Statutes of 1997, Chapter 745, Section 2; California Health and Safety Code, Section 41865).

- Small Grains:

  — The USDA AQTF report indicates that 15% of grain acres were burned in the Pacific Northwest during 1997, and 10% were burned in the rest of the U.S.

  — Table 3-4 shows that approximately 3% of wheat and barley were burned in the Western states. The state-level averages located in Appendix C show that the state average of wheat burned was 14% in Oregon (1996), 12.7% in Idaho (1996), and 6.4% in Washington (1999).

  The amount of wheat and barley burned are comparable between the studies. The Oregon and Idaho averages for 1996 (Appendix C) are comparable to the 1997 projection by the USDA AQTF for the Pacific Northwest. The Washington 1999 percentage is more than 50% lower than the USDA AQTF percentage which might indicate less wheat stubble burning in 1999 as compared to 1997. The overall averages for wheat (2.9%) and barley (2.4%) are significantly lower than the USDA AQTF estimate. The relatively low averages for wheat and barley are significantly impacted by burning activity in Colorado, Montana, North Dakota, and South Dakota. The number of estimated (or gap filled) acres burned in these states are fairly small compared to acres harvested.

- Grass Seed:

  — The USDA AQTF report indicates the following percentage of fields burned (no year is given):

    – Washington, 0%.

    – Oregon, 50%.

    – Idaho, 100%.

    – Rest of U.S., 50%.

  — Table 3-4 shows that approximately 44% of grass seed acres are burned in the study domain. Respective percentages for Idaho, Oregon, and Washington are 72%, 53%, and 5% (Appendix C).

  The relative amounts for these states are comparable between the studies.

3.3 QA/QC Procedure

A QA/QC procedure was developed for the agricultural burning data to ensure that the following data quality objectives were achieved:

- To account for all crop residues that were actually burned within states in the WRAP region based on actual burn data compiled by state/county agencies at the county level for 1996 or other years (1997-2000). *Metric:* Collect available county-level data for all crops that are subject to agricultural burning that represent at least 90% of the data available.

- Develop a procedure to estimate crop residues burned within states in the WRAP region for which data do not exist (i.e., gap filling). *Metric*: Estimates of crop residues burned compare to estimate by state peer reviewers within ±25% accuracy.

It should be reiterated that the baseline data available were for different years (e.g., CA_SJV for 1999, ID for 1996, etc.); thus, the various amounts of acres and/or residues burned, and the averages calculated from these acres and/or residues should not be compared. The use of crop data from one year and burning data for a different year (e.g., CA crop data for 1996 and CA_SJV burn data for 1999, etc.) introduces error into the resulting calculation of average percentage burned. Furthermore, there is no assurance that 1996 crop production reflects acreage subject to burning due to such factors as increased urbanization and regulation, and crop rotation.

The QA/QC methods used to evaluate the agricultural burning data, as they were provided by the various agencies and used in this analysis to provide an estimate of the extent of agricultural burning in the 15 Western states, is described next.

3.3.1 Reality Checks: Compare Data to Standard Reference Value

The resulting values of acres burned, residues generated, acres and/or residues burned from each of the source data sets were compared against the values in the spreadsheets generated from the database. Total acres or residues for the entire dataset were compared, and discrepancies were corrected in the spreadsheets and database when found. Random checks were done to compare specific county values in the source data sets to the values in the spreadsheets for residue, acres and/or residue burned, and discrepancies were corrected in the spreadsheets and database when found.

3.3.2 Extended Peer Review by FEJF and Other Stakeholders

The draft agricultural burning activity database was submitted to the WRAP/FEJF and other stakeholders on February 11, 2002, for a detailed review of methods, ancillary data (e.g., RL factors), and results. The database was actually converted into separate spreadsheets for each state to facilitate this review and make it easier for reviewers to provide comments. As a result of this extended review, extensive comments were received from the following stakeholders and incorporated into the final database, and this final report, as appropriate:

- USDA NRCS in the states of California, Colorado, North Dakota, New Mexico, Nevada, South Dakota, Utah, and Wyoming (Shaver, 2002; Beyer, 2002; Goodrich, 2002; Sharkoff, 2002);
- State, county, and local air agencies and fire departments in Arizona, Idaho, Montana, North Dakota, Nevada, South Dakota, Utah, and Wyoming (Tickes, 2002; Johnson, 2002; Graves, 2002; Foster, 2002; Conrad, 2002; Gabrielson, 2002; Coeffield, 2002; McDonald, 2002; Sergent, 2002; Stover, 2002; Bernards, 2002; Grover, 1998; Cunningham, 1998; Spierling, 1998); and
- Agricultural business in Hawaii (MacCluer, 2002).

3.3.3 Sample Calculations and Computerized Checks

Some sample calculations (by hand and using computer software) were performed to ensure mathematical correctness and accuracy of the database and resulting spreadsheets. For example, acres harvested were multiplied by residue loading factors to ensure that the “RES” (residue) amount of selected records were correct.

In some cases on the county level, the reported acres burned in the source data set exceeded the acres harvested (i.e., AH < A_BURN). One example of this was for Yuma County, Arizona, where 1,841 acres of “seeds; other” (i.e., all grasses and seeds not including alfalfa and KBG) were harvested in 1997 (NASS, 1999) and 4,700 acres of bermuda grass were reported as having been burned in 1997 (Tickes, 2002). These types of apparent discrepancies (i.e., it is possible that more acres were burned that were harvested due to such factors as crop loss due to disease, drought, etc.) were not resolved; the burn data were assumed to be the accurate measure of burning activity and a comparison to the acres harvested could not be made.

A QA/QC spreadsheet was developed by compiling subtotals of acres harvested (AH) and residue burned (R_BURN) for each crop, and comparing these against the AH values in the crop database and the R_BURN values in the agricultural burning database tables. Accountable differences in AH occurred when not all counties that grew/harvested a crop reported that crop as being burned. Again, the burn data were assumed to be the accurate measure of burning activity. This occurred mainly when the burn records represented daily activity (i.e., CA_SJV and WA data sets), and was corrected by distributing the AH quantities evenly over the daily burn records.

3.3.4 Independent Audit by Emissions Inventory Contractor

The WRAP/FEJF emissions inventory (EI) contractor conducted an independent audit of the agricultural burning database and spreadsheets to help ensure the completeness and accuracy of the data related to their EI development. Discrepancies (e.g., missing or incorrect month/day) were corrected. The EI contractor used the corrected agricultural burning data to develop an emissions inventory submitted by them under a separate contract (AS, 2002).

3.4 Results of Agricultural Burn Activity Data

Table 3-5 provides a summary of agricultural residues burned by state in the Western U.S. (14 states, not including Alaska which reports no agricultural burning). An overall comparison of states is not valid because these data represent different years; however, data for states with the same years can be compared. The total residues burned, by year and state are as follows (California is not included since it contains a combination of years – 1996, 1997, and 1999):

- 1996:
  - HI: 420,000 tons (all sugarcane residue);
  - ID: 811,018 tons (mainly wheat and barley residues, and ditches);
  - MT: 5,055 tons (all wheat residue);
  - NM: 6,560 tons (all wheat residue);

Table 3-5. Summary of Agricultural Residues Burned within the Western States for Various Years (1996-1999) (Tons)[1]

Fuel/Residue	AZ 2000/01	CA 1996/97/99	CO Avg	HI 1996	ID 1996	MT 1996	ND Avg	NM 1996/Avg	NV[2] 1998	OR 1996	SD Avg	UT 1996	WA 1999	WY 1996/97
Grains and Hay														
Barley		889			167,943					21,429	14,158	4,671	22,223	3,060
Corn, for Grain	1,680	36,380											3,310	
Corn, Unspecified										5,112				
Hay, Alfalfa		7,213											2,882	
Hay, All Other		361											327	
Oats		3,944								7,902			1,021	
Rice		764,293												
Rye		124												
Wheat, All	15,352	224,709			376,010	5,055	410,145	6,560		244,755		17,379	48,121	
Wheat, Spring			2,000										63,125	
Wheat, Winter All											84,140		223,869	
Grasses and Seeds														
Bermuda	9,400	49,224												
Grasses, Propaning										3,204				
Grasses, Stack Burning										38,205				
Seeds, Other		1,604											394	
Seeds, Alfalfa					6,701								1,959	9,600
Seeds, Grasses (Field Burning), Unspecified	3,014									569,616			542	2,000
Seeds, KBG					100,000								750	
Sudan		5,770												
Orchard														
Almond		310,836												
Apple	74	8,071											879	
Apricot		6,603												
Avocado		1,371												
Cherry		7,511											88	
Citrus	548	15,458												
Fig		12,097												
Grape		78,860											513	
Nectarine		6,951												
Olive		8,042												
Pruning, Unspecified	2	5,570											458	
Pruning, Other		2,454												

Table 3-5. Continued

Fuel/Residue	AZ 2000/01	CA 1996/97/99	CO Avg	HI 1996	ID 1996	MT 1996	ND Avg	NM 1996/Avg	NV[2] 1998	OR 1996	SD Avg	UT 1996	WA 1999	WY 1996/97
Removal, Unspecified		84,359										11,265	32,024	
Peach		22,940											52	
Pear		17,748											395	
Pecan	7	3,186												
Pistachio	17	24,136												
Plum, Prune, Pluot		25,152											7	
Walnut		113,223												
Other														
Asparagus		8,819											21	
Beans	300	4,430											245	
Other		3,561			352								555	
Peas		1											495	
Safflower		6,686												
Sugarcane		4		420,000										
Agricultural Related Fuels														
CRP													76,096	
Ditches, Ditch Banks	1,225	25,552			160,013							3,030		
Total[3]	**31,619**	**1,898,134**	**2,000**	**420,000**	**811,018**	**5,055**	**410,145**	**6,560**	**20,952**	**890,223**	**98,298**	**36,345**	**480,349**	**14,660**

[1] AK does not conduct agricultural burning as defined under this project; thus only 14 states are shown. Values on this table represent tons of agricultural residue burned as reported by each state or developed with gap-filling/averaging techniques. As such, values for states should not be compared to each other.

[2] NV reports 20,952 acres burned; since specific crops are not indicated, residue (tons) cannot be estimated (Sergent, 2002).

[3] Sum of individual crops may not be equal total due to rounding.

Seeds, Other = All seeds not including alfalfa and Kentucky bluegrass (KBG).
Pruning, Other = Bushberry, kiwi, date, persimmon, pomegranate, quince
Other, Other = Other fruits and vegetables, unspecified, sorghum, peanuts, mint, jojoba beans, canola, hops
Wheat, All = All wheat not including spring and winter, all

— OR: 890,223 tons (mainly grass seed field burning, and wheat residue); and

— UT: 36,345 tons (mainly wheat, residues, and orchard removal).

- 1999: WA: 480,349 tons (mainly wheat and CRP);
- Average years (from gap filling):

— ND: 410,145 tons (all wheat residue); and

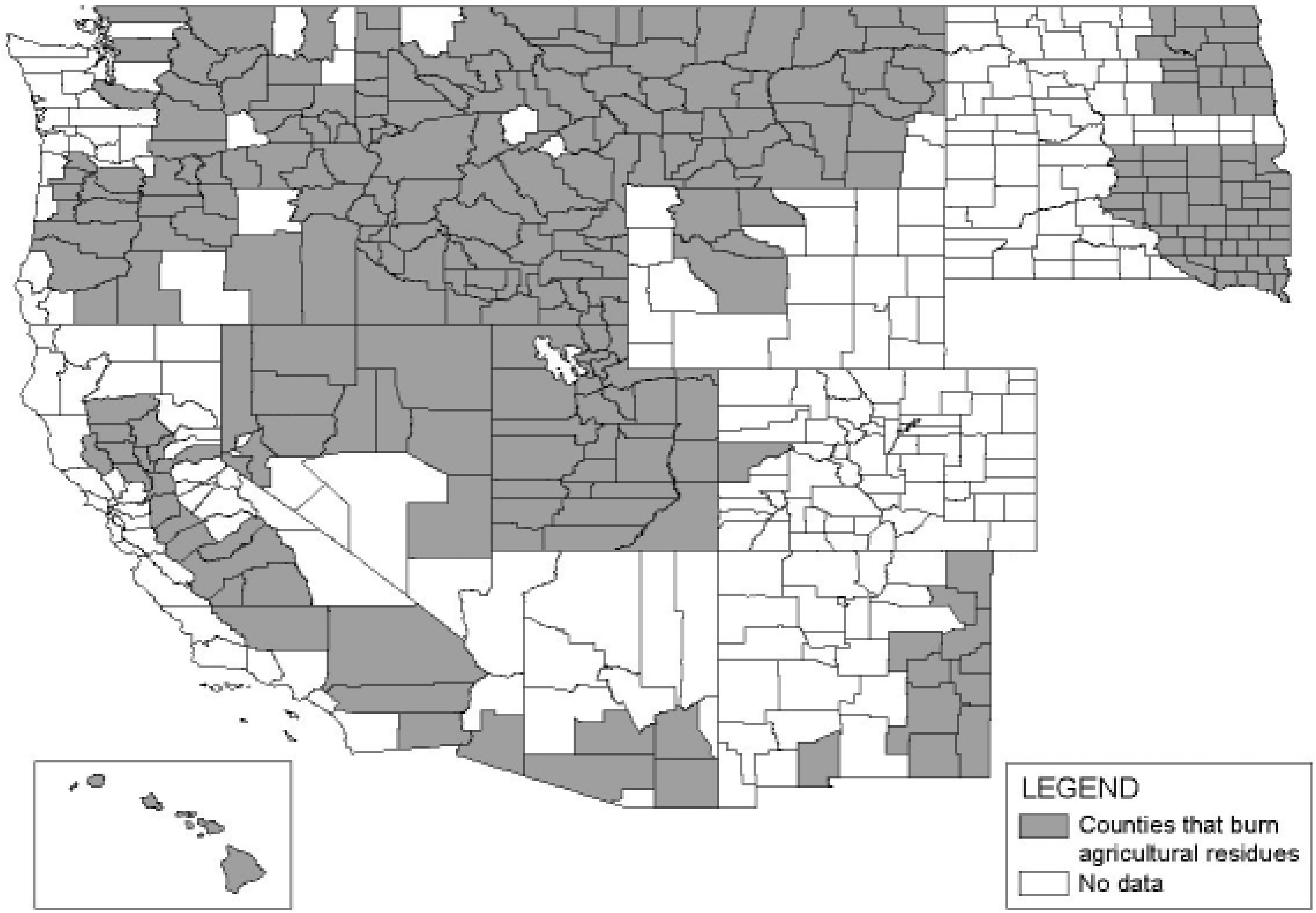
— SD: 98,298 tons (mainly wheat residue).

Of the states with burning activity data for 1996, ID and OR burned the most residues, with grasses being the main source of residues burned overall (569,616 tons). The Washington residues burned during 1999, in addition to wheat and CRP lands, included barley, orchard removal, and other smaller amounts of grains and hay crops.

Gap filling using averages by crop developed from data in areas where burn statistics are available (see Table 3-5) resulted in quantification of residues burned for an "average" year (i.e., it is not possible to assign these quantities to specific years). However, caution should be used when comparing these values to other states having gap filled residue estimates. These gap filled quantities have high levels of uncertainty due to the method used (i.e., combination of anecdotal information to determine counties and crops burned, and average percentages of crops or residues burned developed from data covering multiple years of activity). These gap filled values *provide only rough estimates of residues burned*. They can be used to alert officials as to the need to track agricultural burning activity in order to reduce uncertainties in these estimates in the future.

Two sets of maps depict agricultural burning activity in the 15 Western states. First, Figure 3-1 shows burning activity at the county level. Shading indicates counties where agricultural burning is known to occur. Appendix B contains maps of the individual states where the shading indicates the extent of burning (i.e., tons of residue burned) at the county level. The GIS tables used to generate these maps, were submitted to the WRAP/FEJF at the close of the project. These tables can be used with ArcView to make changes to the maps as necessary in the future.

Figure 3-1: Agricultural Burn Activity in the Western United States



4.0 CONCLUSIONS AND RECOMMENDATIONS

An extensive data collection and review process was undertaken in order to compile databases of agricultural crop production and residue burning activity in the 15 Western states. The objectives of these databases were to provide information for:

1. Evaluating non-burning management alternatives; and
2. Estimating an air emissions inventory conducted under a separate project (AS, 2002).

An indirect objective met by this project was the assessment of data availability (or unavailability) for developing these databases.

4.1 Conclusions

The crop production data were fairly accessible, and somewhat consistent in terms of data fields, data quality, and temporal scope. This is due to a structured, systematic process for developing these data by the National Agricultural Statistics Service, state agriculture departments, and other entities. However, identification and compilation of the agricultural burn activity data presented an immense challenge due to the lack of a consistent mechanism for collecting these data on a national, state, local, or tribal level. In fact, in some states where agricultural burning is exempt from regulation, barriers to collection of these data can be created. (A detailed discussion of the accountability mechanisms pertaining to agricultural burning activities and non-burning alternatives is located in Volume II. A copy of Tables 5-2 and 5-2a listing the 17 accountability mechanisms identified in the West is located in Appendix E of this report).

In order to provide the data for estimating air emissions, it was necessary to gap fill some missing data for states/counties where burning was known to occur but for which data did not exist. As explained in Section 3.2.4 of this report, averages based on burning activity on a statewide or crop basis were calculated. Then, the averages were used in combination with anecdotal information obtained from other studies (WRAP, 2001a; WESTAR, 1999) to estimate the extent of burning for certain crops in North Dakota, New Mexico, and South Dakota. These averages cannot accurately depict actual burn activity that occurred in those states. Even for some areas where gap filling was not used, information originally provided for the draft database was revised with significantly different information obtained during the peer review process (e.g., Utah). While it can be concluded that the peer review process worked in this case, this result is illustrative of the need for a coordinated, systematic process to collect agricultural burning data, establish data quality objectives, and resolve conflicting data.

Although the data that were collected and compiled were subject to specific QA/QC procedures, some of the data and results have inherent uncertainty due to several factors including the following:

- The use of permit data sets provided by several state air quality agencies that were accepted "as-is" and were not quality assured as part of this project. For example, data in the CA_SJV data set indicated burn permits had been issued for cotton field burning. Peer review comments indicated that these permits were actually issued for burning of ditch banks or fence lines located adjacent to cotton fields. Although the information in this example was corrected for the final database, other errors of this type may still exist in the final database. Also, the data sets do not contain a consistent set of data defined as "agricultural" residue. For example, it is not clear if ditch bank burning is defined as an agricultural residue in every data set.

- The use of crop-specific RL factors that do not take into account geographical variation in residue amounts based on yield or irrigated/nonirrigated agricultural burning practices. Peer review comments indicated that RL factors can vary significantly due to yield, and other factors such as irrigation practices. Although some locally-specific RL factors were incorporated into the final database (e.g., ditchbanks in Arizona and Utah, wheat in Colorado and New Mexico), the use of crop-specific RLs for most crops was carried forward to the final database.

- The use of a combination of calendar year data (i.e., 1996-2001) to depict a single year of burning activity. This was necessary in order to compile a geographically comprehensive set of burn activity data.

4.2 Recommendations

The researchers and peer reviewers contributing to the final database made the following recommendations pertaining to future improvements in the agricultural burning activity database:

1. Develop a mechanism (e.g., program, regulation, etc.) whereby the relevant state, county, tribal, agricultural, and stakeholder entities establish data quality objectives, define data sources, and compile data on a regular basis to estimate the extent of agricultural burning in the Western United States. Also, this mechanism should provide a consistent definition of the residue types to be included in the agricultural burning category (see Volume II for more discussion on this issue).

2. Conduct research to identify and/or calculate specific yield-based RL factors for each geographical zone or area (county, state).

3. Incorporate the impact of irrigated and nonirrigated land agricultural practices.

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APPENDIX A

CROP PRODUCTION DATA

State	Crop(s)	Acres Harvested
AK	barley	6,900
AK	fruits and vegetables; other	343
AK	hay; alfalfa	3,801
AK	hay; all	24,023
AK	hay; all other	20,222
AK	oats	700
AK	potatoes	630
AZ	apples	3,772
AZ	barley	54,000
AZ	citrus	38,823
AZ	corn; for grain	40,000
AZ	corn; for silage	16,937
AZ	cotton; amer. pima	40,300
AZ	cotton; upland	314,000
AZ	fruits and vegetables; other	28,800
AZ	grapes	6,050
AZ	hay; alfalfa	160,000
AZ	hay; all	179,000
AZ	hay; all other	19,000
AZ	peaches	324
AZ	pears	43
AZ	potatoes	9,000
AZ	seeds; alfalfa	2,667
AZ	seeds; other	3,556
AZ	sorghum	45,000
AZ	wheat; all	178,000
AZ	wheat; durum	164,000
AZ	wheat; winter all	14,000
CA	almonds	400,692
CA	apples	39,981
CA	apricots	21,314
CA	asparagus	34,121
CA	avocado	56,335
CA	barley	190,000
CA	beans; all dry edible	123,000
CA	cherries	17,438
CA	citrus	284,790
CA	corn; for grain	220,000
CA	corn; for silage	275,000
CA	cotton; amer. pima	164,000
CA	cotton; upland	995,000

State	Crop(s)	Acres Harvested
CA	CRP	2,400
CA	figs	14,564
CA	fruits and vegetables; other	777,358
CA	grapes	721,505
CA	hay; alfalfa	944,056
CA	hay; all	1,698,773
CA	hay; all other	754,717
CA	kiwi	5,242
CA	nectarines	36,634
CA	oats	30,000
CA	olives	34,409
CA	peaches	71,823
CA	peanuts	750
CA	pears	21,884
CA	peas; dry edible	697
CA	pecans	1,905
CA	persimmons	2,479
CA	pistachio	65,373
CA	plums and prunes	133,068
CA	rice; all	500,000
CA	safflower	156,801
CA	seeds; alfalfa	53,799
CA	seeds; other	77,499
CA	sorghum	18,855
CA	sugarbeets	82,200
CA	walnuts	168,298
CA	wheat; all	688,000
CA	wheat; durum	138,000
CA	wheat; winter all	550,000
CO	barley	92,000
CO	beans; all dry edible	125,000
CO	corn; for grain	890,000
CO	corn; for silage	90,000
CO	CRP	2,080
CO	hay; alfalfa	860,000
CO	hay; all	1,510,000
CO	hay; all other	650,000
CO	oats	35,000
CO	potatoes	87,600
CO	proso millet	125,765
CO	seeds; alfalfa	1,232
CO	seeds; other	6,879
CO	sorghum	260,000

State	Crop(s)	Acres Harvested
CO	sugarbeets	51,100
CO	sunflower	107,000
CO	wheat; all	2,268,000
CO	wheat; other spring	68,000
CO	wheat; winter all	2,200,000
HI	coffee	5,400
HI	fruits and vegetables; other	13,120
HI	macadamia nuts	20,200
HI	pineapple	20,000
HI	sugarcane	42,900
ID	barley	730,000
ID	beans; all dry edible	93,000
ID	corn; for grain	40,000
ID	corn; for silage	68,000
ID	CRP	3,229
ID	hay; alfalfa	1,000,000
ID	hay; all	1,280,000
ID	hay; all other	280,000
ID	lentils	65,540
ID	mint	23,790
ID	oats	25,000
ID	peas; dry edible	71,507
ID	potatoes	413,000
ID	seeds; alfalfa	31,210
ID	seeds; kbg	32,796
ID	seeds; other	17,629
ID	sugarbeets	184,000
ID	wheat; all	1,560,000
ID	wheat; other spring	700,000
ID	wheat; winter all	860,000
MT	barley	1,150,000
MT	beans; all dry edible	10,300
MT	corn; for grain	15,000
MT	corn; for silage	39,000
MT	CRP	33,037
MT	hay; alfalfa	1,700,000
MT	hay; all	2,600,000
MT	hay; all other	900,000
MT	oats	50,000
MT	potatoes	10,200
MT	seeds; alfalfa	13,122

State	Crop(s)	Acres Harvested
MT	seeds; kbg	259
MT	seeds; other	8,965
MT	sugarbeets	57,500
MT	wheat; all	6,360,000
MT	wheat; durum	280,000
MT	wheat; other spring	4,100,000
MT	wheat; winter all	1,980,000
ND	barley	2,600,000
ND	beans; all dry edible	570,000
ND	corn; for grain	600,000
ND	corn; for silage	140,000
ND	CRP	19,180
ND	flaxseed	77,000
ND	hay; alfalfa	1,700,000
ND	hay; all	2,900,000
ND	hay; all other	1,200,000
ND	oats	380,000
ND	potatoes	131,000
ND	rye	16,000
ND	soybeans	845,000
ND	sugarbeets	225,300
ND	sunflower	1,165,000
ND	wheat; all	12,515,000
ND	wheat; durum	2,940,000
ND	wheat; other spring	9,500,000
ND	wheat; winter all	75,000
NM	apples	1,192
NM	corn; for grain	84,000
NM	corn; for silage	44,000
NM	cotton; amer. pima	14,000
NM	cotton; upland	55,000
NM	CRP	3,425
NM	fruits and vegetables; other	38,375
NM	hay; alfalfa	250,000
NM	hay; all	350,000
NM	hay; all other	100,000
NM	peanuts	16,500
NM	pecans	23,188
NM	potatoes	10,300
NM	sorghum	225,000
NM	wheat; all	110,000
NM	wheat; winter all	110,000

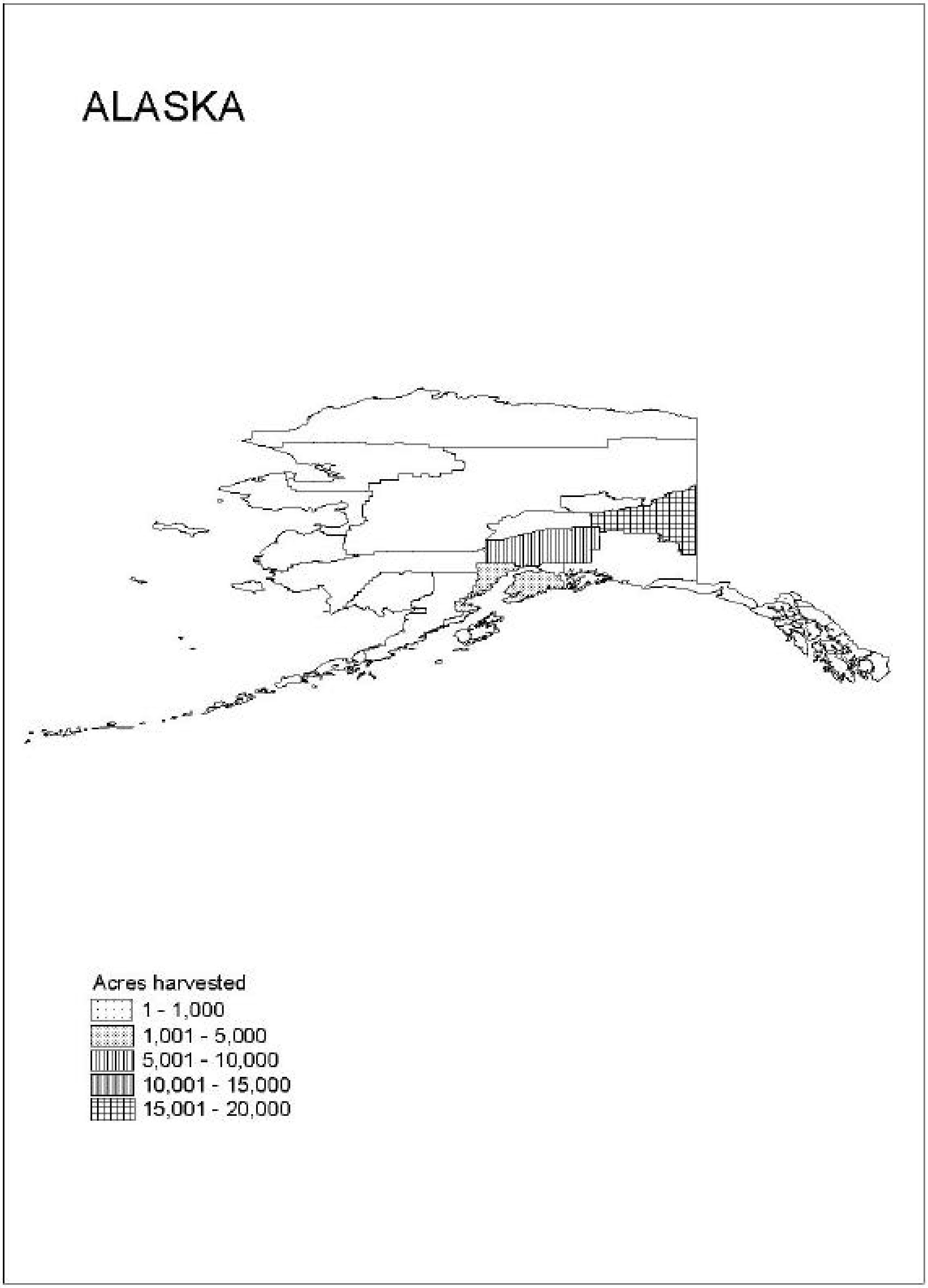
State	Crop(s)	Acres Harvested
NV	barley	5,000
NV	fruits and vegetables; other	4,415
NV	hay; alfalfa	250,000
NV	hay; all	480,000
NV	hay; all other	230,000
NV	potatoes	6,999
NV	seeds; alfalfa	11,731
NV	wheat; all	19,000
NV	wheat; other spring	10,000
NV	wheat; winter all	9,000
OR	apples	6,658
OR	barley	150,000
OR	cherries	8,804
OR	corn; for grain	37,000
OR	CRP	13
OR	filberts	26,678
OR	grapes	5,800
OR	hay; alfalfa	460,000
OR	hay; all	1,070,000
OR	hay; all other	610,000
OR	mint	45,221
OR	oats	35,000
OR	peaches	705
OR	pears	15,090
OR	plums and prunes	1,462
OR	potatoes	61,000
OR	seeds; alfalfa	9,465
OR	seeds; kbg	18,798
OR	seeds; other	513,246
OR	sugarbeets	16,300
OR	wheat; all	920,000
OR	wheat; other spring	105,000
OR	wheat; winter all	815,000
SD	barley	145,000
SD	corn; for grain	3,650,000
SD	corn; for silage	320,000
SD	CRP	8,071
SD	flaxseed	9,000
SD	hay; alfalfa	2,500,000
SD	hay; all	4,300,000
SD	hay; all other	1,800,000

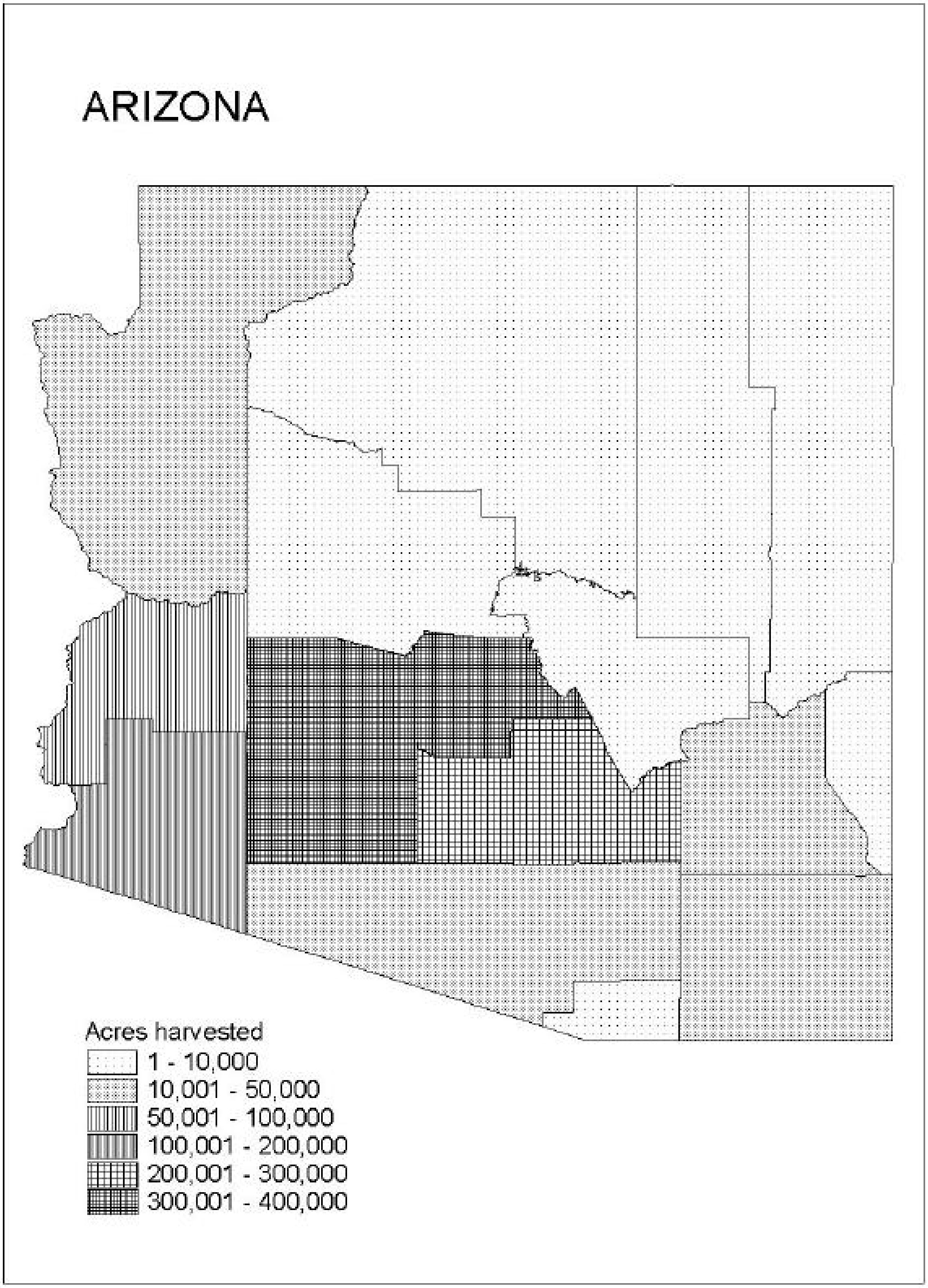
State	Crop(s)	Acres Harvested
SD	oats	360,000
SD	proso millet	122,451
SD	rye	36,000
SD	seeds; alfalfa	12,136
SD	seeds; other	12,900
SD	sorghum	145,000
SD	soybeans	2,670,000
SD	sunflower	690,000
SD	wheat; all	3,854,000
SD	wheat; durum	24,000
SD	wheat; other spring	2,250,000
SD	wheat; winter all	1,580,000
UT	apples	3,699
UT	barley	100,000
UT	beans; all dry edible	600
UT	cherries	4,010
UT	corn; for grain	20,000
UT	corn; for silage	40,000
UT	fruits and vegetables; other	6,695
UT	hay; alfalfa	545,000
UT	hay; all	705,000
UT	hay; all other	160,000
UT	oats	9,000
UT	peaches	1,775
UT	potatoes	4,200
UT	seeds; alfalfa	3,393
UT	seeds; other	3,739
UT	wheat; all	185,000
UT	wheat; other spring	25,000
UT	wheat; winter all	160,000
WA	apples	154,930
WA	asparagus	23,000
WA	barley	440,000
WA	beans; all dry edible	35,000
WA	blueberries	1,311
WA	canola	12,686
WA	cherries	17,700
WA	corn; for grain	120,000
WA	corn; for silage	50,000
WA	CRP	214,073
WA	fruits and vegetables; other	189,269
WA	grapes	35,265

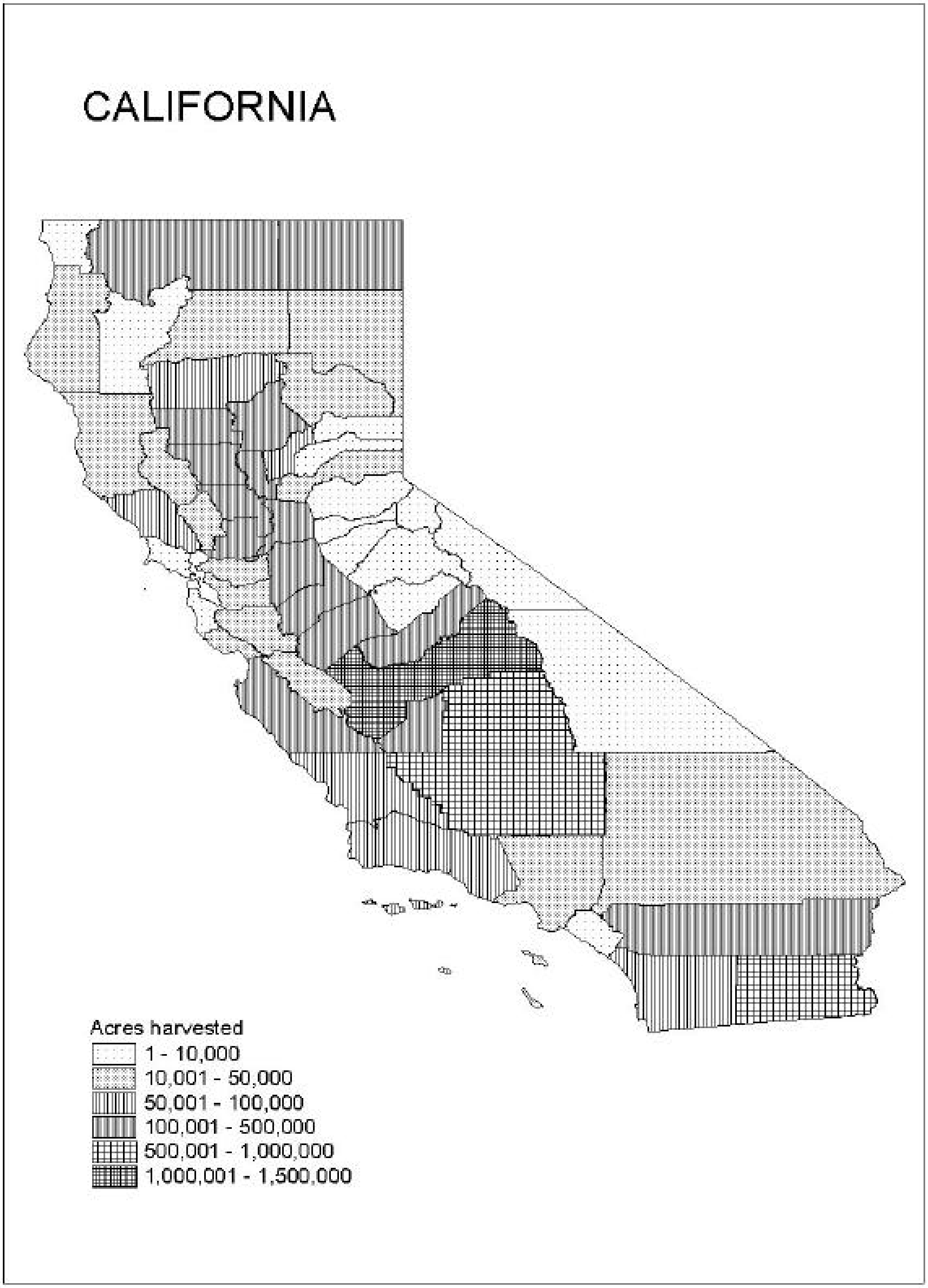
State	Crop(s)	Acres Harvested
WA	hay; alfalfa	490,000
WA	hay; all	800,000
WA	hay; all other	310,000
WA	hops	30,621
WA	oats	14,000
WA	peaches	2,200
WA	pears	23,555
WA	peas; dry edible	126,975
WA	plums and prunes	571
WA	potatoes	161,000
WA	seeds; alfalfa	13,197
WA	seeds; kbg	45,103
WA	seeds; other	13,693
WA	sugarbeets	13,000
WA	wheat; all	2,745,000
WA	wheat; other spring	395,000
WA	wheat; winter all	2,350,000
WY	barley	120,000
WY	beans; all dry edible	31,000
WY	corn; for grain	50,000
WY	corn; for silage	33,000
WY	CRP	666
WY	hay; alfalfa	620,000
WY	hay; all	1,220,000
WY	hay; all other	600,000
WY	oats	32,000
WY	potatoes	704
WY	seeds; alfalfa	3,927
WY	seeds; other	766
WY	sugarbeets	56,800
WY	wheat; all	236,000
WY	wheat; other spring	26,000
WY	wheat; winter all	210,000

APPENDIX B

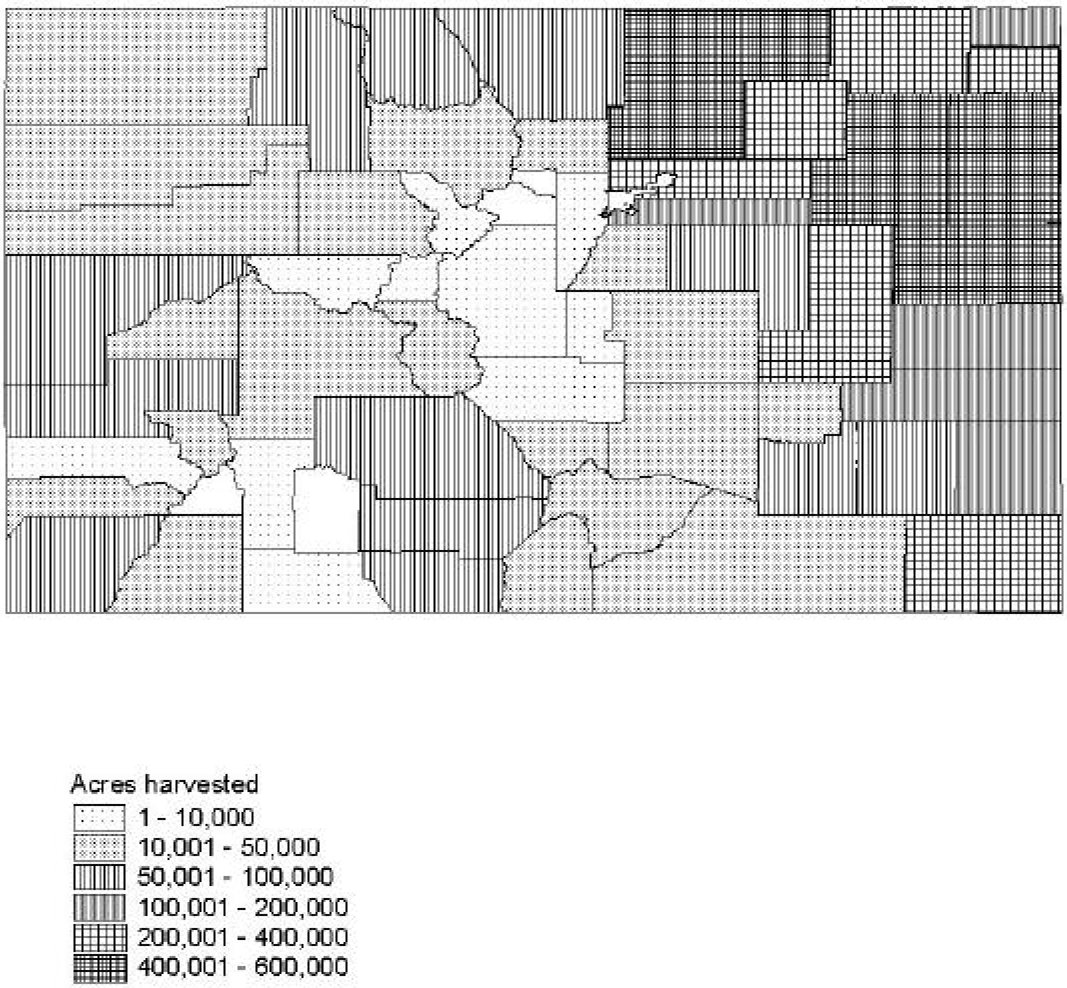
CROP PRODUCTION MAPS

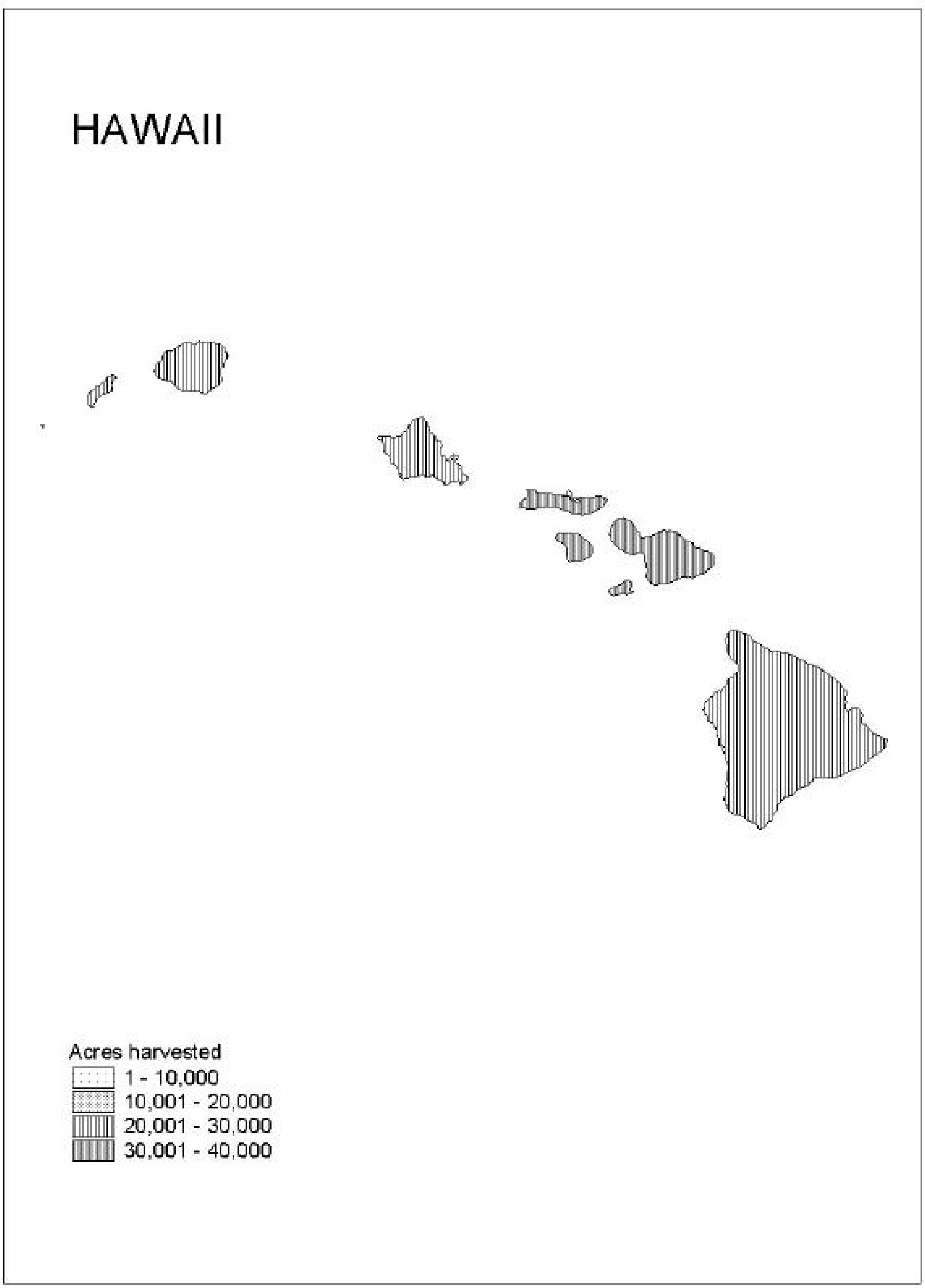

ALASKA
Acres harvested
1 - 1,000
1,001 - 5,000
5,001 - 10,000
10,001 - 15,000
15,001 - 20,000

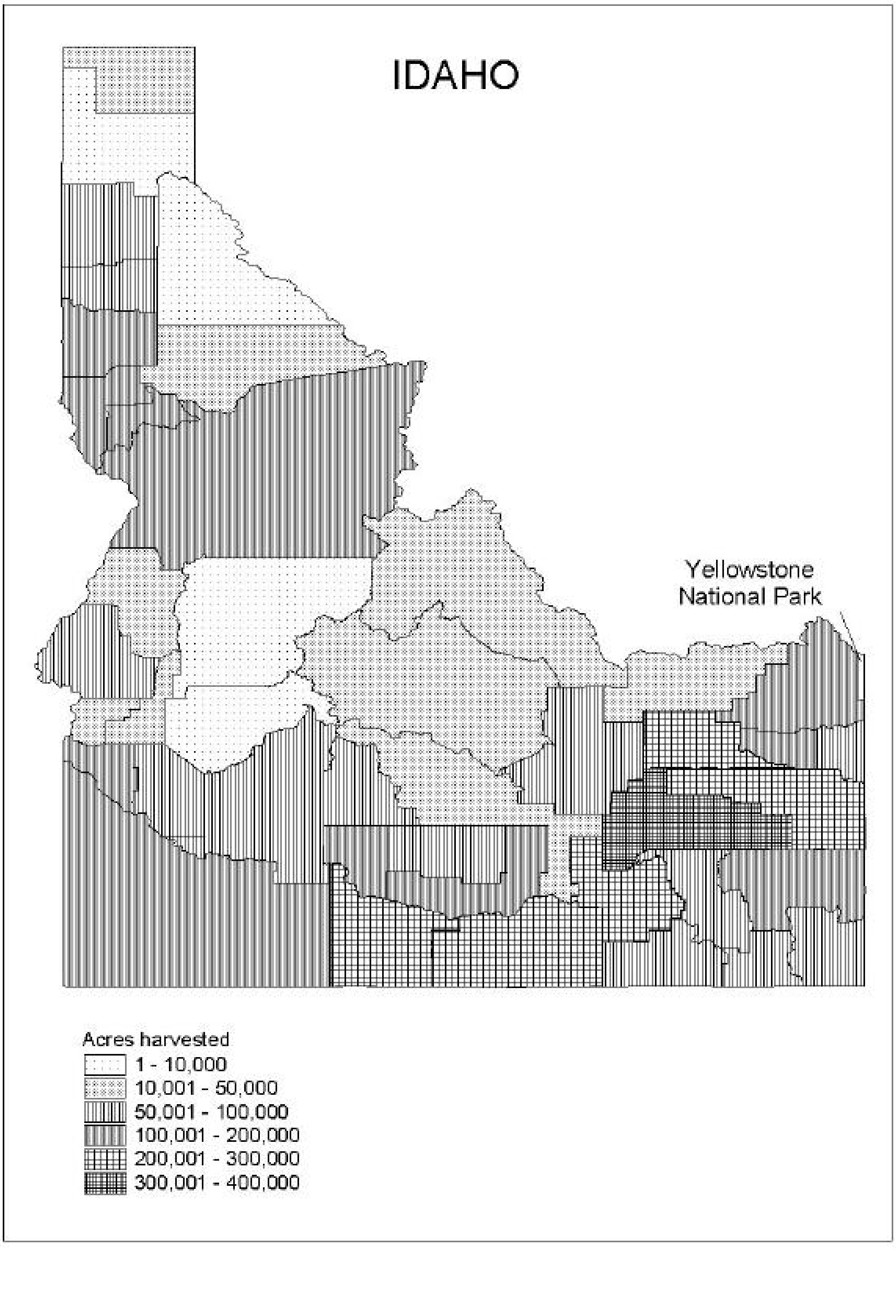

ARIZONA
Acres harvested
1 - 10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 200,000
200,001 - 300,000
300,001 - 400,000


CALIFORNIA
Acres harvested
1 - 10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 500,000
500,001 - 1,000,000
1,000,001 - 1,500,000

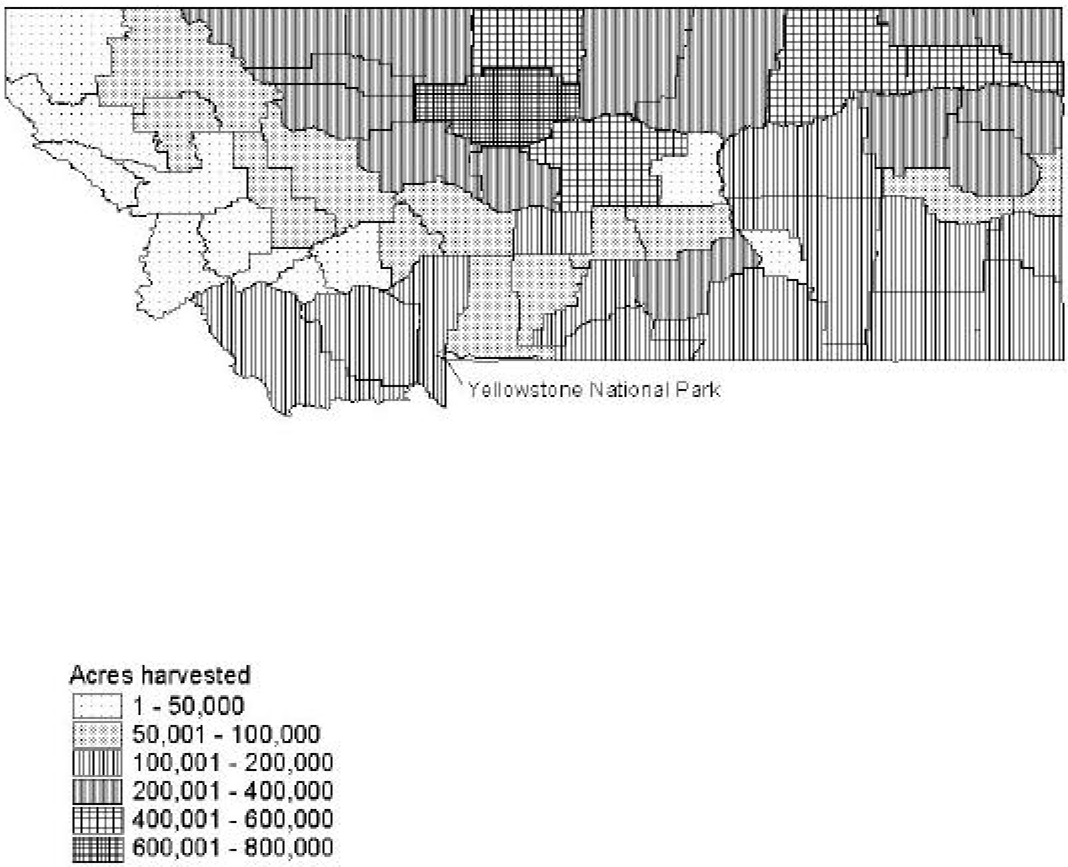
COLORADO

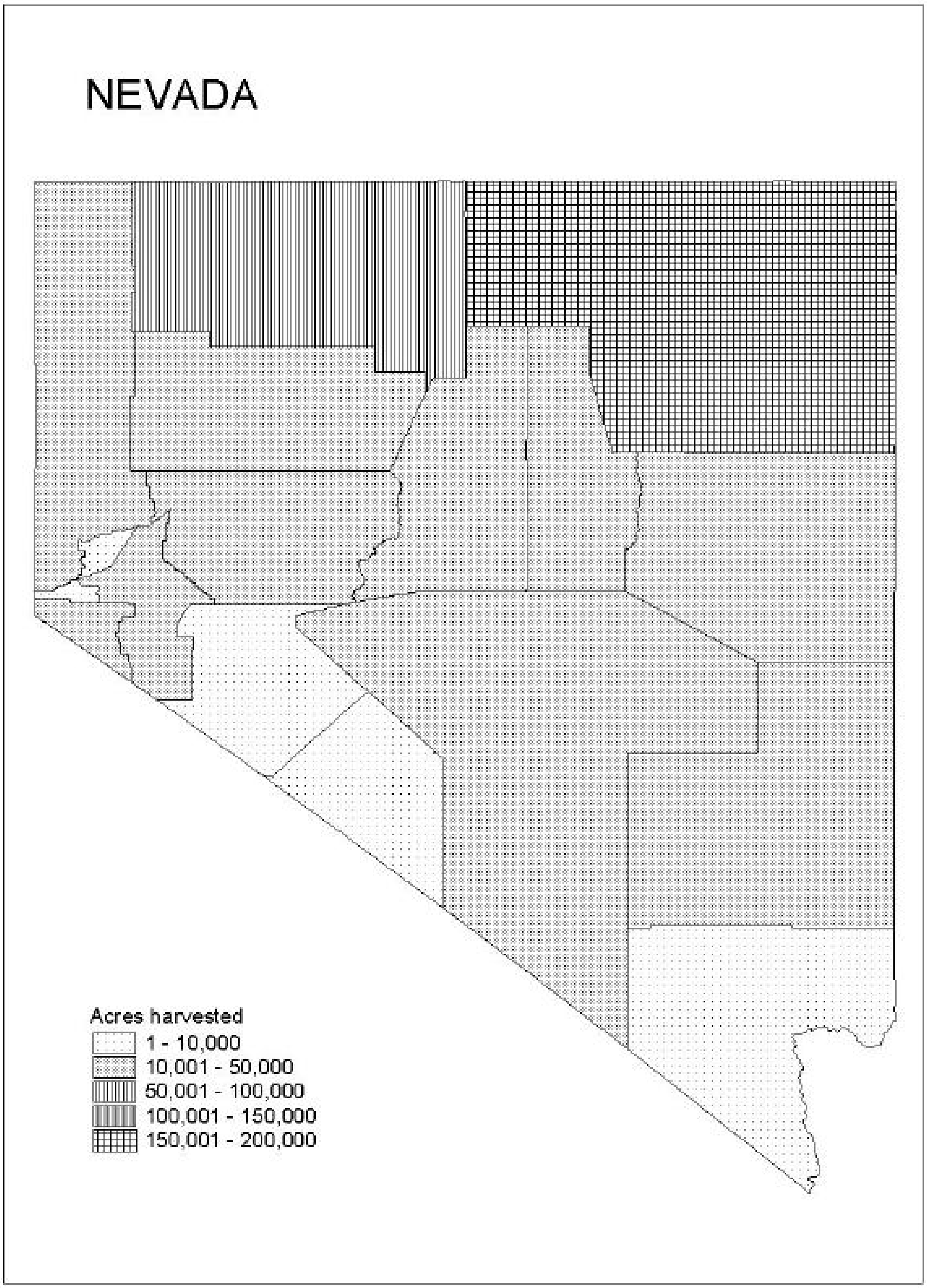

Acres harvested
1 - 10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 200,000
200,001 - 400,000
400,001 - 600,000


HAWAII
Acres harvested
1 - 10,000
10,001 - 20,000
20,001 - 30,000
30,001 - 40,000

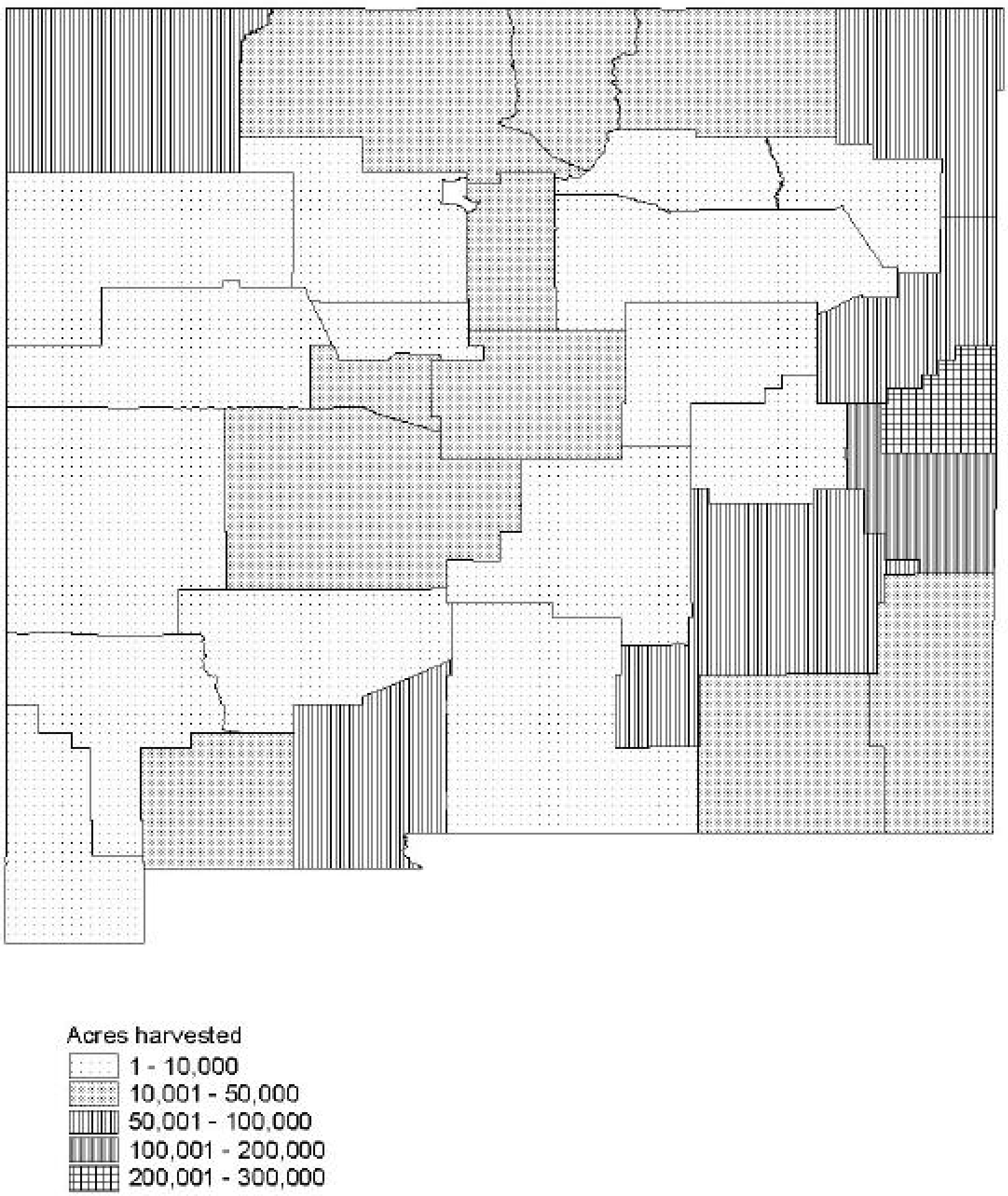

IDAHO
Yellowstone
National Park
Acres harvested
1 - 10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 200,000
200,001 - 300,000
300,001 - 400,000

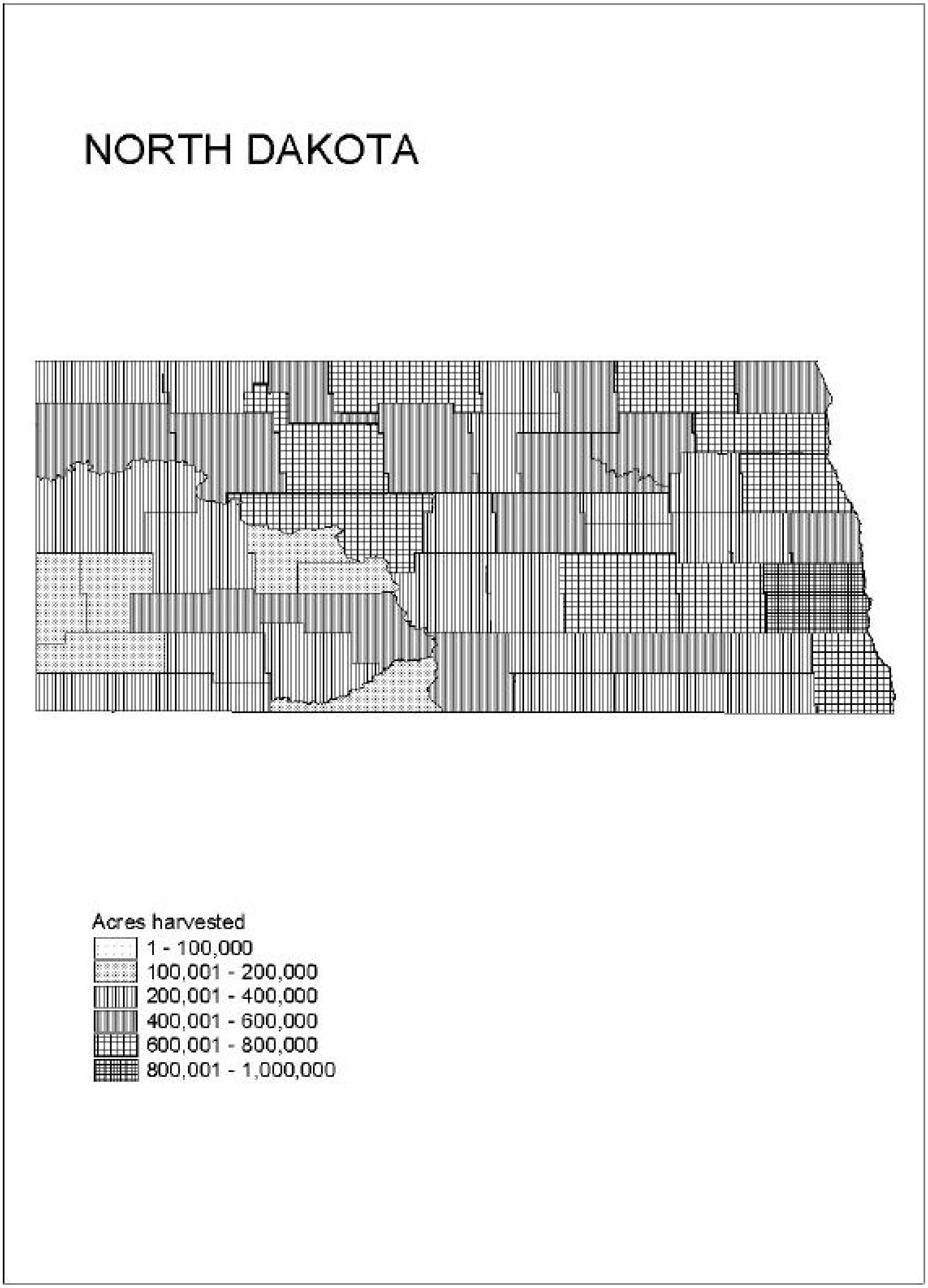
MONTANA

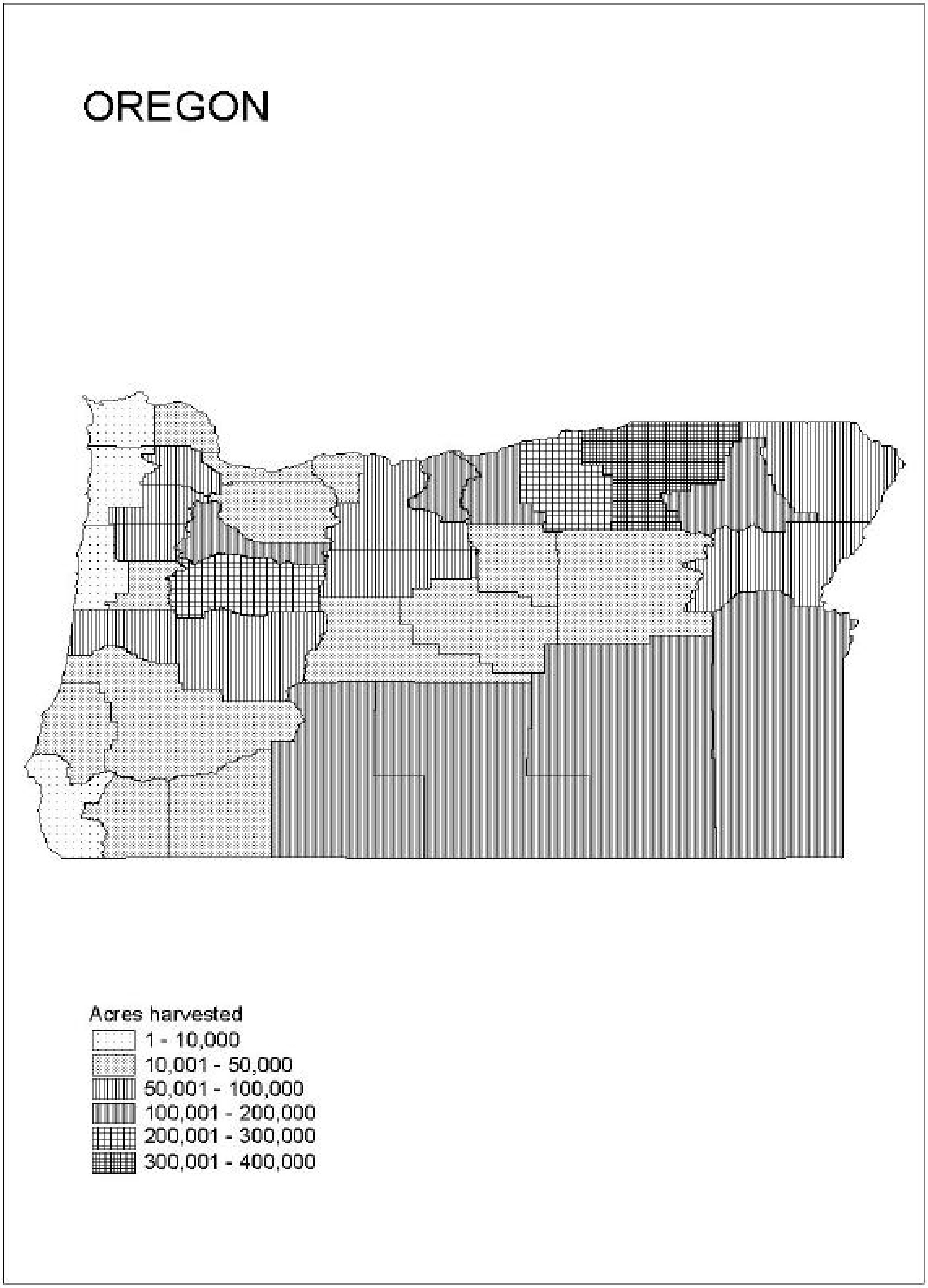

Yellowstone National Park
Acres harvested
1 - 50,000
50,001 - 100,000
100,001 - 200,000
200,001 - 400,000
400,001 - 600,000
600,001 - 800,000

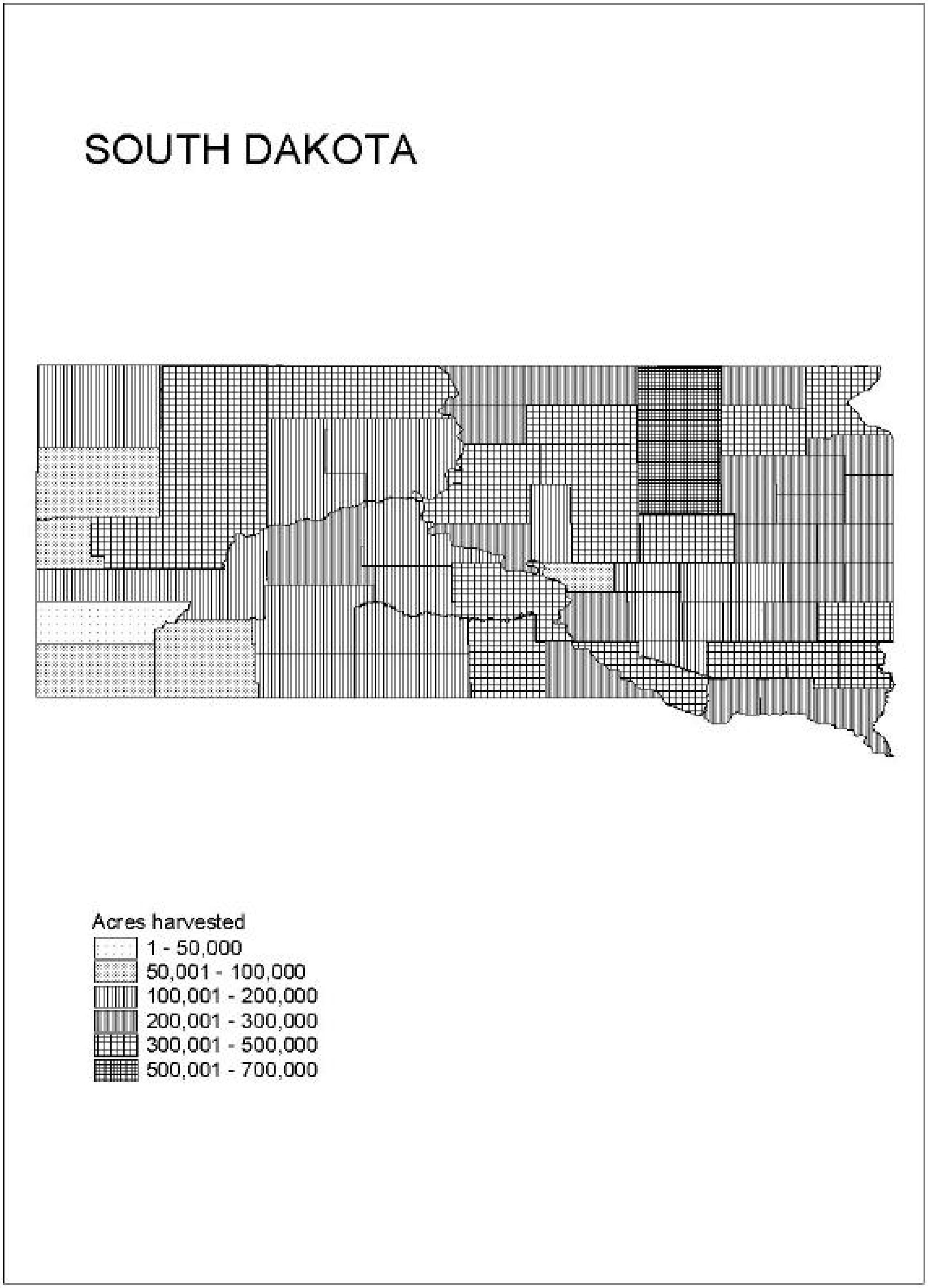

NEVADA
Acres harvested
1 - 10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 150,000
150,001 - 200,000

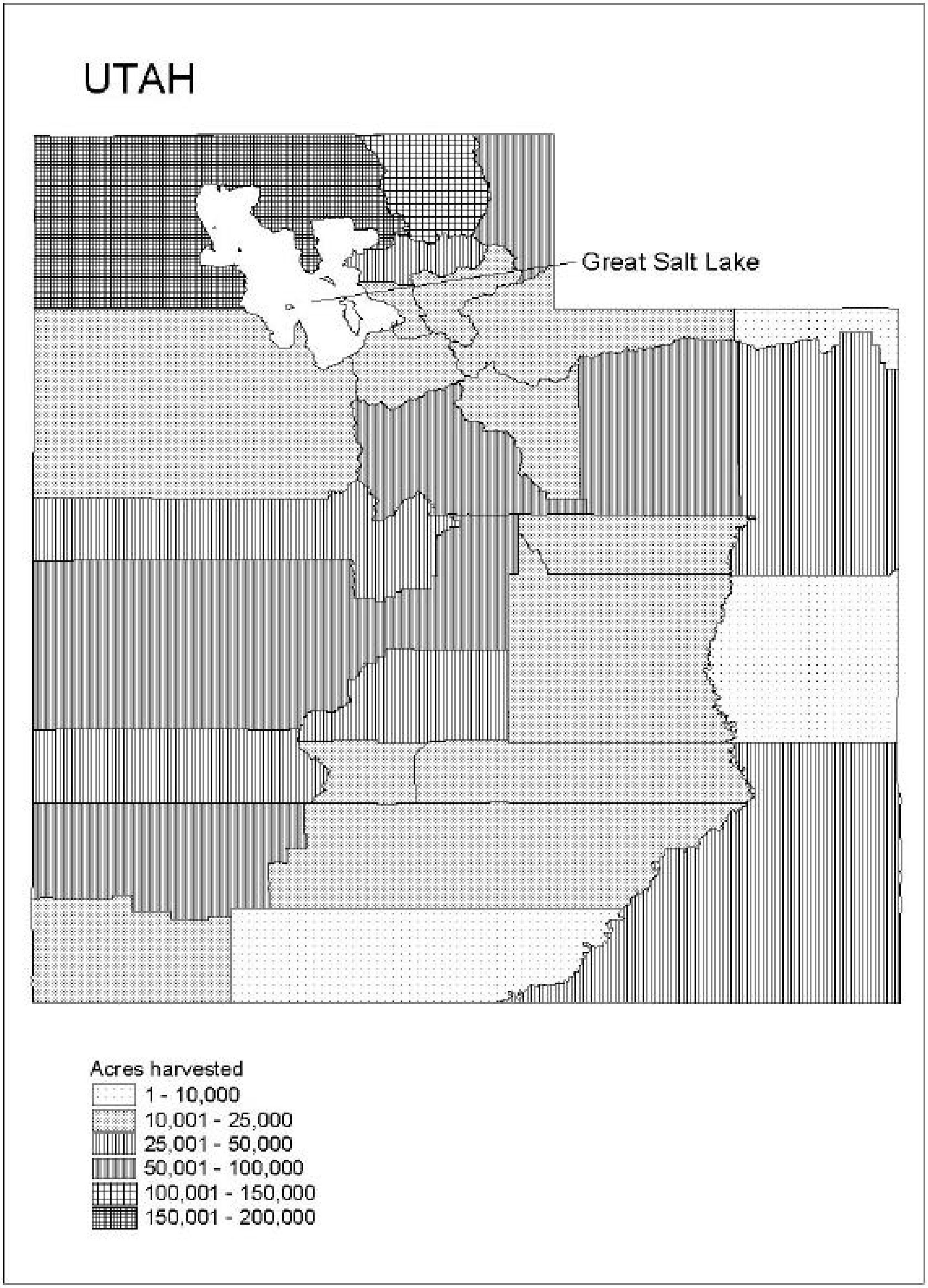
NEW MEXICO


Acres harvested
1 - 10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 200,000
200,001 - 300,000

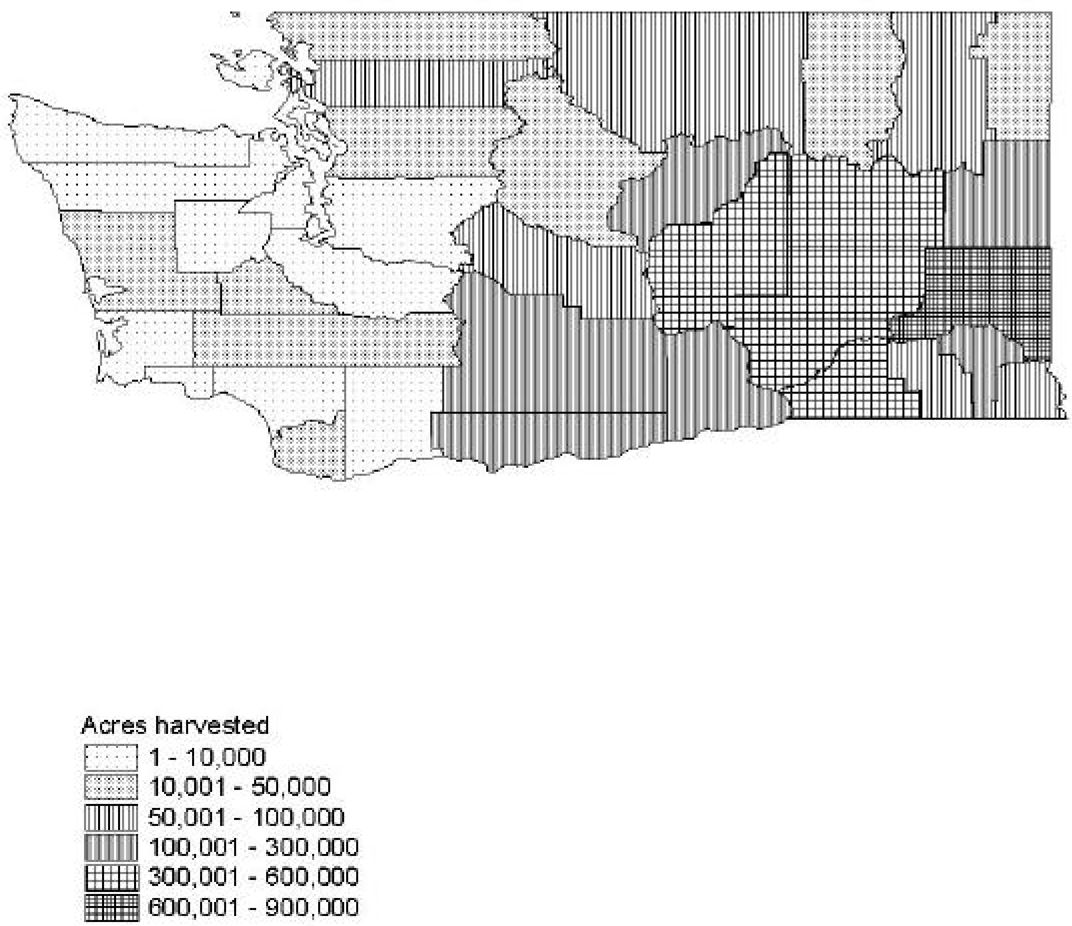

NORTH DAKOTA
Acres harvested
1 - 100,000
100,001 - 200,000
200,001 - 400,000
400,001 - 600,000
600,001 - 800,000
800,001 - 1,000,000


OREGON
Acres harvested
1 - 10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 200,000
200,001 - 300,000
300,001 - 400,000

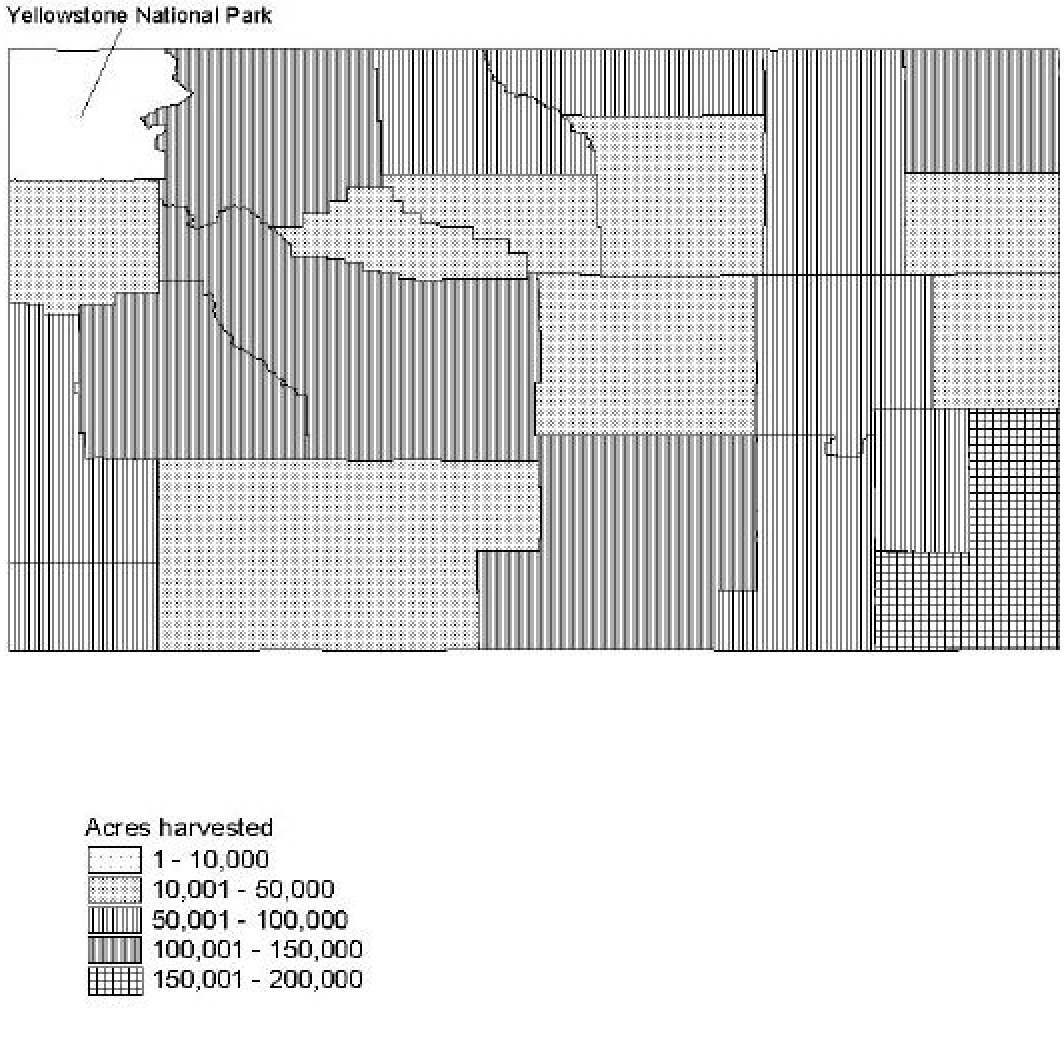

SOUTH DAKOTA
Acres harvested
1 - 50,000
50,001 - 100,000
100,001 - 200,000
200,001 - 300,000
300,001 - 500,000
500,001 - 700,000


UTAH
Great Salt Lake
Acres harvested
1 - 10,000
10,001 - 25,000
25,001 - 50,000
50,001 - 100,000
100,001 - 150,000
150,001 - 200,000

WASHINGTON


Acres harvested
1 - 10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 300,000
300,001 - 600,000
600,001 - 900,000

WYOMING


Yellowstone National Park
Acres harvested
1 - 10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 150,000
150,001 - 200,000

APPENDIX C

AGRICULTURAL RESIDUE BURN ACTIVITY DATA AND CROP BURN AVERAGES

ARIZONA

Residue Name	Crop Name	County	RL (tons / acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
apple trees	apples	Graham	2.3	32	2001	74	Daily A_BURN compiled by ADEQ (J.Graves)
	apples Total			**32**		**74**	
Jojoba Plant	beans; all dry edible	Yuma	2.5	120	2001	300	A_BURN from C.Foster, Yuma Co. FD
	beans; all dry edible Total			**120**		**300**	
citrus	citrus	Yuma	1	320	2001	320	A_BURN from L.Johnson, City Yuma FD
citrus trees	citrus	Yuma	1	217	2001	217	A_BURN from C.Foster, Yuma Co. FD
citrus trees	citrus	Yuma	1	3	2001	3	A_BURN from L.Johnson, City Yuma FD
citrus trees, 320	citrus	Yuma	1	8	2001	8	A_BURN from L.Johnson, City Yuma FD
	citrus Total			**548**		**548**	
corn stalks	corn; for grain	Graham	4.2	400	2001	1,680	Daily A_BURN compiled by ADEQ (J.Graves)
	corn; for grain Total			**400**		**1,680**	
Mesquite removed for agricultural pu	ditches and ditch banks-AZ	Cochise	1.6	2	2001	3	Daily A_BURN compiled by ADEQ (J.Graves)
Weeds along irrigation ditches	ditches and ditch banks-AZ	Cochise	1.6	1	2001	1	Daily A_BURN compiled by ADEQ (J.Graves)
Weeds along irrigation ditches, meso	ditches and ditch banks-AZ	Cochise	1.6	1	2001	2	Daily A_BURN compiled by ADEQ (J.Graves)
ditches around 62.8 acres	ditches and ditch banks-AZ	Graham	1.6	4	2001	8	Daily A_BURN compiled by ADEQ (J.Graves)
weeds along fenceline	ditches and ditch banks-AZ	Graham	1.6	1	2001	1	Daily A_BURN compiled by ADEQ (J.Graves)
weeds treelimbs and wood along fen	ditches and ditch banks-AZ	Graham	1.6	3	2001	4	Daily A_BURN compiled by ADEQ (J.Graves)
weeds	ditches and ditch banks-AZ	Pima	1.6	286	2001	458	A_BURN from M.Conrad, Pima Co. DEQ
ditches and ditch banks-AZ	ditches and ditch banks-AZ	Pinal	1.6	144	2000	231	A_BURN from D.Gabrielson, Pinal Co. AQCD
ditches and ditch banks-AZ	ditches and ditch banks-AZ	Pinal	1.6	295	2001	473	A_BURN from D.Gabrielson, Pinal Co. AQCD
ditchbanks	ditches and ditch banks-AZ	Yuma	1.6	27	2001	44	A_BURN from C.Foster, Yuma Co. FD
	ditches and ditch banks-AZ Total			**765**		**1,225**	
tamaracks along ditches	orchard pruning; unspecified	Graham	1.7	1	2001	2	Daily A_BURN compiled by ADEQ (J.Graves)
	orchard pruning; unspecified Total			**1**		**2**	
Pecan limbs from orchard	pecans	Cochise	1.7	4	2001	7	Daily A_BURN compiled by ADEQ (J.Graves)
	pecans Total			**4**		**7**	
Pistachio wood from pruning of orch	pistachio	Cochise	1.7	10	2001	17	Daily A_BURN compiled by ADEQ (J.Graves)
	pistachio Total			**10**		**17**	
Bermuda grass	seeds; other	Yuma	2	4,700	2001	9,400	A_BURN from B.Tickes, Yuma Co. Extension Agent
	seeds; other Total			**4,700**		**9,400**	
Robosa, Lehmann,s love grass, Mesq	seeds; unspecified	Cochise	2	807	2000	1,614	Daily A_BURN compiled by ADEQ (J.Graves)
Robosa, Lehmann,s love grass, Mesq	seeds; unspecified	Cochise	2	700	2001	1,400	Daily A_BURN compiled by ADEQ (J.Graves)
	seeds; unspecified Total			**1,507**		**3,014**	
Wheat stubble	wheat; all	Yuma	1.9	8,080	2001	15,352	A_BURN from B.Tickes, Yuma Co. Extension Agent
	wheat; all Total			**8,080**		**15,352**	
	Grand Total			**16,167**		**31,619**	

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
Almond	almonds	Butte	1	11,411	1996	11,411	Daily A_BURN provided by Fife, 2002
Almond	almonds	COLUSA	1	37	1996	37	Daily A_BURN provided by Fife, 2002
ALMOND PRUNING	almonds	FRESNO	1	64,478	1999	64,776	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ALMOND PRUNING	almonds	KERN	1	27,216	1999	40,315	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ALMOND PRUNING	almonds	KINGS	1	2,288	1999	2,536	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Almonds	almonds	Lake	1	71	1997	71	A_BURN data taken from WRAP/ECR (WRAP, 2001) survey which references "1997 Lake Co. AQMD Agricultural and Opening Burning Report"
ALMOND PRUNING	almonds	MADERA	1	37,416	1999	38,427	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ALMOND PRUNING	almonds	MERCED	1	37,433	1999	49,159	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Almond	almonds	Sacramento	1	9	1996	9	Daily A_BURN provided by Fife, 2002
ALMOND PRUNING	almonds	SAN JOAQUIN	1	20,131	1999	35,443	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ALMOND PRUNING	almonds	STANISLAUS	1	54,657	1999	56,408	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Almond	almonds	Sutter	1	103	1996	103	Daily A_BURN provided by Fife, 2002
Almond	almonds	Tehama	1	3,079	1996	3,079	Daily A_BURN provided by Fife, 2002
ALMOND PRUNING	almonds	TULARE	1	4,146	1999	6,881	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Almond	almonds	Yolo	1	2,183	1996	2,183	Daily A_BURN provided by Fife, 2002
	almonds Total			**264,657**		**310,836**	
Apple	apples	Butte	2.3	2	1996	3	Daily A_BURN provided by Fife, 2002
APPLE PRUNING	apples	FRESNO	2.3	1,296	1999	3,781	Daily A_BURN and/or R_BURN provided by SJVUAPCD
APPLE PRUNING	apples	KERN	2.3	128	1999	735	Daily A_BURN and/or R_BURN provided by SJVUAPCD
APPLE PRUNING	apples	KINGS	2.3	120	1999	288	Daily A_BURN and/or R_BURN provided by SJVUAPCD
APPLE PRUNING	apples	MADERA	2.3	331	1999	762	Daily A_BURN and/or R_BURN provided by SJVUAPCD
APPLE PRUNING	apples	MERCED	2.3	91	1999	217	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Apple	apples	Placer	2.3	32	1996	74	Daily A_BURN provided by Fife, 2002
apples	apples	Riverside	2.3		1999	7	Annual R_BURN provided by SCAQMD
Apple	apples	Sacramento	2.3	1	1996	1	Daily A_BURN provided by Fife, 2002
apples	apples	San Bernardino	2.3		1999	18	Annual R_BURN provided by SCAQMD
APPLE PRUNING	apples	SAN JOAQUIN	2.3	164	1999	798	Daily A_BURN and/or R_BURN provided by SJVUAPCD
APPLE PRUNING	apples	STANISLAUS	2.3	326	1999	780	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Apple	apples	Tehama	2.3	7	1996	16	Daily A_BURN provided by Fife, 2002
APPLE PRUNING	apples	TULARE	2.3	219	1999	590	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	apples Total			**2,715**		**8,071**	
APRICOT PRUNING	apricots	FRESNO	1.8	72	1999	144	Daily A_BURN and/or R_BURN provided by SJVUAPCD
APRICOT PRUNING	apricots	KERN	1.8	40	1999	121	Daily A_BURN and/or R_BURN provided by SJVUAPCD
APRICOT PRUNING	apricots	KINGS	1.8	100	1999	180	Daily A_BURN and/or R_BURN provided by SJVUAPCD
APRICOT PRUNING	apricots	MADERA	1.8	120	1999	216	Daily A_BURN and/or R_BURN provided by SJVUAPCD
APRICOT PRUNING	apricots	MERCED	1.8	126	1999	419	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Apricot	apricots	Sacramento	1.8	1	1996	1	Daily A_BURN provided by Fife, 2002
APRICOT PRUNING	apricots	SAN JOAQUIN	1.8	254	1999	636	Daily A_BURN and/or R_BURN provided by SJVUAPCD
APRICOT PRUNING	apricots	STANISLAUS	1.8	2,279	1999	4,203	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Apricot	apricots	Tehama	1.8	4	1996	7	Daily A_BURN provided by Fife, 2002
APRICOT PRUNING	apricots	TULARE	1.8	36	1999	89	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Apricot	apricots	Yolo	1.8	326	1996	587	Daily A_BURN provided by Fife, 2002
	apricots Total			**3,356**		**6,603**	
ASPARAGUS	asparagus	FRESNO	1.5	856	1999	1,314	Daily A_BURN and/or R_BURN provided by SJVUAPCD
asparagus	asparagus	IMPERIAL	1.5	4,872	1996	7,307	Daily A_BURN provided by ICUAPCD
ASPARAGUS	asparagus	KERN	1.5	95	1999	143	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ASPARAGUS	asparagus	SAN JOAQUIN	1.5	30	1999	45	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ASPARAGUS	asparagus	STANISLAUS	1.5	7	1999	11	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	asparagus Total			**5,860**		**8,819**	
AVOCADO PRUNING	avocado	FRESNO	1.5	25	1999	38	Daily A_BURN and/or R_BURN provided by SJVUAPCD

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
AVOCADO PRUNING	avocado	KERN	1.5	-	1999	1	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Avocado	avocado	Riverside	1.5		1999	10	Annual R_BURN provided by SCAQMD
Avocado	avocado	San Bernardino	1.5		1999	15	Annual R_BURN provided by SCAQMD
AVOCADO PRUNING	avocado	STANISLAUS	1.5	48	1999	74	Daily A_BURN and/or R_BURN provided by SJVUAPCD
AVOCADO PRUNING	avocado	TULARE	1.5	73	1999	1,234	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	avocado Total			**146**		**1,370**	
BARLEY	barley	FRESNO	1.7	80	1999	136	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BARLEY	barley	KERN	1.7	5	1999	9	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BARLEY	barley	KINGS	1.7	31	1999	57	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BARLEY	barley	MERCED	1.7	69	1999	123	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BARLEY	barley	SAN JOAQUIN	1.7	68	1999	146	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BARLEY	barley	STANISLAUS	1.7	184	1999	313	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BARLEY	barley	TULARE	1.7	62	1999	105	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	barley Total			**499**		**889**	
Bean	beans; all dry edible	COLUSA	2.5	15	1996	38	Daily A_BURN provided by Fife, 2002
BEAN	beans; all dry edible	FRESNO	2.5	480	1999	1,201	Daily A_BURN and/or R_BURN provided by SJVUAPCD
jojoba beans	beans; all dry edible	IMPERIAL	2.5	160	1996	400	Daily A_BURN provided by ICUAPCD
BEAN	beans; all dry edible	KERN	2.5	507	1999	1,272	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BEAN	beans; all dry edible	KINGS	2.5	40	1999	100	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BEAN	beans; all dry edible	MADERA	2.5	140	1999	350	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BEAN	beans; all dry edible	MERCED	2.5	130	1999	327	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BEAN	beans; all dry edible	SAN JOAQUIN	2.5	50	1999	125	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BEAN	beans; all dry edible	STANISLAUS	2.5	6	1999	15	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BEAN	beans; all dry edible	TULARE	2.5	240	1999	602	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	beans; all dry edible Total			**1,767**		**4,430**	
Berry	blueberries	Placer	1.7	14	1996	24	Daily A_BURN provided by Fife, 2002
	blueberries Total			**14**		**24**	
BUSHBERRY	bushberry	FRESNO	1.7	36	1999	61	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BUSHBERRY	bushberry	MADERA	1.7	4	1999	7	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BUSHBERRY	bushberry	MERCED	1.7	46	1999	92	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BUSHBERRY	bushberry	SAN JOAQUIN	1.7	-	1999	5	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BUSHBERRY	bushberry	STANISLAUS	1.7	70	1999	157	Daily A_BURN and/or R_BURN provided by SJVUAPCD
BUSHBERRY	bushberry	TULARE	1.7	1	1999	2	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	bushberry Total			**156**		**324**	
CHERRY PRUNING	cherries	FRESNO	1	287	1999	288	Daily A_BURN and/or R_BURN provided by SJVUAPCD
CHERRY PRUNING	cherries	KERN	1	25	1999	48	Daily A_BURN and/or R_BURN provided by SJVUAPCD
CHERRY PRUNING	cherries	KINGS	1	2	1999	17	Daily A_BURN and/or R_BURN provided by SJVUAPCD
CHERRY PRUNING	cherries	MADERA	1	200	1999	200	Daily A_BURN and/or R_BURN provided by SJVUAPCD
CHERRY PRUNING	cherries	MERCED	1	-	1999	95	Daily A_BURN and/or R_BURN provided by SJVUAPCD
CHERRY PRUNING	cherries	SAN JOAQUIN	1	2,030	1999	6,211	Daily A_BURN and/or R_BURN provided by SJVUAPCD
CHERRY PRUNING	cherries	STANISLAUS	1	427	1999	455	Daily A_BURN and/or R_BURN provided by SJVUAPCD
CHERRY PRUNING	cherries	TULARE	1	172	1999	199	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	cherries Total			**3,141**		**7,511**	
Citrus	citrus	Butte	1	4	1996	4	Daily A_BURN provided by Fife, 2002
CITRUS PRUNING	citrus	FRESNO	1	4,006	1999	5,022	Daily A_BURN and/or R_BURN provided by SJVUAPCD
CITRUS PRUNING	citrus	KERN	1	731	1999	2,612	Daily A_BURN and/or R_BURN provided by SJVUAPCD
CITRUS PRUNING	citrus	MADERA	1	228	1999	241	Daily A_BURN and/or R_BURN provided by SJVUAPCD
CITRUS PRUNING	citrus	MERCED	1	-	1999	1	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Citrus	citrus	Placer	1	20	1996	20	Daily A_BURN provided by Fife, 2002
Citrus	citrus	Riverside	1		1999	876	Annual R_BURN provided by SCAQMD
Citrus	citrus	Sacramento	1	1	1996	1	Daily A_BURN provided by Fife, 2002

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
CITRUS PRUNING	citrus	STANISLAUS	1	22	1999	22	Daily A_BURN and/or R_BURN provided by SJVUAPCD
CITRUS PRUNING	citrus	TULARE	1	3,597	1999	6,661	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	citrus Total			**8,607**		**15,459**	
Corn	corn; for grain	Butte	4.2	2	1996	6	Daily A_BURN provided by Fife, 2002
Corn	corn; for grain	COLUSA	4.2	43	1996	180	Daily A_BURN provided by Fife, 2002
Corn	corn; for grain	Glenn	4.2	937	1996	3,936	Daily A_BURN provided by Fife, 2002
corn	corn; for grain	IMPERIAL	4.2	249	1996	1,046	Daily A_BURN provided by ICUAPCD
CORN	corn; for grain	MERCED	4.2	20	1999	84	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Corn	corn; for grain	Sacramento	4.2	1,902	1996	7,988	Daily A_BURN provided by Fife, 2002
CORN	corn; for grain	SAN JOAQUIN	4.2	3,292	1999	15,277	Daily A_BURN and/or R_BURN provided by SJVUAPCD
CORN	corn; for grain	STANISLAUS	4.2	154	1999	645	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Corn	corn; for grain	Tehama	4.2	348	1996	1,462	Daily A_BURN provided by Fife, 2002
CORN	corn; for grain	TULARE	4.2	5	1999	23	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Corn	corn; for grain	Yolo	4.2	1,365	1996	5,733	Daily A_BURN provided by Fife, 2002
	corn; for grain Total			**8,316**		**36,380**	
Date	dates	Riverside	1		1999	168	Annual R_BURN provided by SCAQMD
	dates Total			**-**		**168**	
Brush	ditches and ditch banks	Butte	3.2	1,577	1996	5,045	Daily A_BURN provided by Fife, 2002
DITCHBANKS	ditches and ditch banks	Butte	3.2	689	1996	2,204	Daily A_BURN provided by Fife, 2002
Weeds	ditches and ditch banks	Butte	3.2	1,002	1996	3,205	Daily A_BURN provided by Fife, 2002
DITCHBANKS	ditches and ditch banks	COLUSA	3.2	294	1996	937	Daily A_BURN provided by Fife, 2002
Weeds	ditches and ditch banks	COLUSA	3.2	1,578	1996	5,050	Daily A_BURN provided by Fife, 2002
DITCHBANK & CANAL	ditches and ditch banks	FRESNO	3.2	1	1999	2	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Weeds	ditches and ditch banks	Glenn	3.2	5	1996	16	Daily A_BURN provided by Fife, 2002
BERMS	ditches and ditch banks	MADERA	3.2	1	1999	2	Daily A_BURN and/or R_BURN provided by SJVUAPCD
TULES	ditches and ditch banks	MERCED	3.2	30	1999	96	Daily A_BURN and/or R_BURN provided by SJVUAPCD
DITCHBANKS	ditches and ditch banks	Placer	3.2	96	1996	307	Daily A_BURN provided by Fife, 2002
Weeds	ditches and ditch banks	Placer	3.2	146	1996	467	Daily A_BURN provided by Fife, 2002
DITCHBANKS	ditches and ditch banks	Sacramento	3.2	33	1996	106	Daily A_BURN provided by Fife, 2002
Weeds	ditches and ditch banks	Sacramento	3.2	669	1996	2,141	Daily A_BURN provided by Fife, 2002
Weeds	ditches and ditch banks	Sutter	3.2	111	1996	355	Daily A_BURN provided by Fife, 2002
Brush	ditches and ditch banks	Tehama	3.2	1,342	1996	4,294	Daily A_BURN provided by Fife, 2002
DITCHBANKS	ditches and ditch banks	Tehama	3.2	10	1996	32	Daily A_BURN provided by Fife, 2002
BRUSH	ditches and ditch banks	TULARE	3.2	1	1999	2	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PASTURE/CORRAL TREES	ditches and ditch banks	TULARE	3.2	20	1999	64	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Weeds	ditches and ditch banks	Yuba	3.2	384	1996	1,229	Daily A_BURN provided by Fife, 2002
	ditches and ditch banks Total			**7,987**		**25,552**	
FIG PRUNING	figs	FRESNO	1.7	480	1999	875	Daily A_BURN and/or R_BURN provided by SJVUAPCD
FIG PRUNING	figs	KERN	1.7	32	1999	56	Daily A_BURN and/or R_BURN provided by SJVUAPCD
FIG PRUNING	figs	KINGS	1.7	25	1999	45	Daily A_BURN and/or R_BURN provided by SJVUAPCD
FIG PRUNING	figs	MADERA	1.7	4,160	1999	7,153	Daily A_BURN and/or R_BURN provided by SJVUAPCD
FIG PRUNING	figs	MERCED	1.7	2,101	1999	3,916	Daily A_BURN and/or R_BURN provided by SJVUAPCD
FIG	figs	Sacramento	1.7	1	1996	1	Daily A_BURN provided by Fife, 2002
FIG PRUNING	figs	STANISLAUS	1.7	16	1999	32	Daily A_BURN and/or R_BURN provided by SJVUAPCD
FIG PRUNING	figs	TULARE	1.7	-	1999	21	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	figs Total			**6,814**		**12,097**	
OtherVegetable	fruits and vegetables; other	Butte	1.47	5	1996	7	Daily A_BURN provided by Fife, 2002
VEGETABLE CROPS	fruits and vegetables; other	FRESNO	1.47	5	1999	7	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Vegetable Crops	fruits and vegetables; other	Riverside	1.47		1999	60	Annual R_BURN provided by SCAQMD
	fruits and vegetables; other Total			**10**		**74**	
Grape	grapes	Butte	2.5	1	1996	3	Daily A_BURN provided by Fife, 2002

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
Vines	grapes	Butte	2.5	1	1996	1	Daily A_BURN provided by Fife, 2002
Grape	grapes	COLUSA	2.5	8	1996	20	Daily A_BURN provided by Fife, 2002
GRAPE VINES/CANES	grapes	FRESNO	2.5	7,316	1999	18,368	Daily A_BURN and/or R_BURN provided by SJVUAPCD
GRAPE VINES/CANES	grapes	KERN	2.5	5,159	1999	13,651	Daily A_BURN and/or R_BURN provided by SJVUAPCD
GRAPE VINES/CANES	grapes	KINGS	2.5	298	1999	744	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Grapes	grapes	Lake	2.5	2,561	1997	6,403	A_BURN data taken from WRAP/ECR (WRAP, 2001) survey which references "1997 Lake Co. AQMD Agricultural and Opening Burning Report"
GRAPE VINES/CANES	grapes	MADERA	2.5	3,940	1999	9,906	Daily A_BURN and/or R_BURN provided by SJVUAPCD
GRAPE VINES/CANES	grapes	MERCED	2.5	3,543	1999	8,961	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Grape	grapes	Riverside	2.5		1999	1,152	Annual R_BURN provided by SCAQMD
Grape	grapes	Sacramento	2.5	69	1996	173	Daily A_BURN provided by Fife, 2002
GRAPE VINES/CANES	grapes	SAN JOAQUIN	2.5	2,501	1999	9,261	Daily A_BURN and/or R_BURN provided by SJVUAPCD
GRAPE VINES/CANES	grapes	STANISLAUS	2.5	1,752	1999	4,476	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Grape	grapes	Tehama	2.5	2	1996	5	Daily A_BURN provided by Fife, 2002
GRAPE STUMPS/STAKES	grapes	TULARE	2.5	2	1999	7	Daily A_BURN and/or R_BURN provided by SJVUAPCD
GRAPE VINES/CANES	grapes	TULARE	2.5	2,081	1999	5,732	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	grapes Total			**29,233**		**78,860**	
ALFALFA	hay; alfalfa	FRESNO	0.8	8,245	1999	6,596	Daily A_BURN and/or R_BURN provided by SJVUAPCD
alfalfa	hay; alfalfa	IMPERIAL	0.8	403	1996	323	Daily A_BURN provided by ICUAPCD
ALFALFA	hay; alfalfa	KERN	0.8	101	1999	90	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ALFALFA	hay; alfalfa	KINGS	0.8	7	1999	6	Daily A_BURN and/or R_BURN provided by SJVUAPCD
hay; alfalfa	hay; alfalfa	Lake	0.8	94	1997	75	A_BURN data taken from WRAP/ECR (WRAP, 2001) survey which references "1997 Lake Co. AQMD Agricultural and Opening Burning Report"
ALFALFA	hay; alfalfa	MADERA	0.8	76	1999	61	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ALFALFA	hay; alfalfa	MERCED	0.8	6	1999	6	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Alfalfa	hay; alfalfa	Placer	0.8	1	1996	1	Daily A_BURN provided by Fife, 2002
ALFALFA	hay; alfalfa	SAN JOAQUIN	0.8	-	1999	3	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ALFALFA	hay; alfalfa	STANISLAUS	0.8	28	1999	22	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Alfalfa	hay; alfalfa	Tehama	0.8	28	1996	22	Daily A_BURN provided by Fife, 2002
ALFALFA	hay; alfalfa	TULARE	0.8	10	1999	8	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	hay; alfalfa Total			**8,998**		**7,213**	
Hay-Wild	hay; all other	Butte	0.8	1	1996	1	Daily A_BURN provided by Fife, 2002
hay; other	hay; all other	Lake	0.8	400	1997	320	A_BURN data taken from WRAP/ECR (WRAP, 2001) survey which references "1997 Lake Co. AQMD Agricultural and Opening Burning Report"
Hay	hay; all other	Placer	0.8	50	1996	40	Daily A_BURN provided by Fife, 2002
	hay; all other Total			**451**		**361**	
Kiwi	kiwi	Butte	1.7	64	1996	109	Daily A_BURN provided by Fife, 2002
KIWI PRUNING	kiwi	FRESNO	1.7	22	1999	39	Daily A_BURN and/or R_BURN provided by SJVUAPCD
KIWI PRUNING	kiwi	MADERA	1.7	5	1999	9	Daily A_BURN and/or R_BURN provided by SJVUAPCD
KIWI PRUNING	kiwi	MERCED	1.7	-	1999	2	Daily A_BURN and/or R_BURN provided by SJVUAPCD
KIWI PRUNING	kiwi	SAN JOAQUIN	1.7	11	1999	20	Daily A_BURN and/or R_BURN provided by SJVUAPCD
KIWI PRUNING	kiwi	STANISLAUS	1.7	19	1999	32	Daily A_BURN and/or R_BURN provided by SJVUAPCD
KIWI PRUNING	kiwi	TULARE	1.7	83	1999	158	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	kiwi Total			**203**		**369**	
NECTARINE PRUNING	nectarines	FRESNO	1.7	2,129	1999	3,816	Daily A_BURN and/or R_BURN provided by SJVUAPCD
NECTARINE PRUNING	nectarines	KERN	1.7	155	1999	396	Daily A_BURN and/or R_BURN provided by SJVUAPCD
NECTARINE PRUNING	nectarines	KINGS	1.7	152	1999	265	Daily A_BURN and/or R_BURN provided by SJVUAPCD
NECTARINE PRUNING	nectarines	MADERA	1.7	44	1999	75	Daily A_BURN and/or R_BURN provided by SJVUAPCD
NECTARINE PRUNING	nectarines	MERCED	1.7	21	1999	79	Daily A_BURN and/or R_BURN provided by SJVUAPCD
NECTARINE PRUNING	nectarines	SAN JOAQUIN	1.7	5	1999	9	Daily A_BURN and/or R_BURN provided by SJVUAPCD
NECTARINE PRUNING	nectarines	STANISLAUS	1.7	28	1999	48	Daily A_BURN and/or R_BURN provided by SJVUAPCD

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
NECTARINE PRUNING	nectarines	TULARE	1.7	1,020	1999	2,264	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	nectarines Total			**3,554**		**6,951**	
Oats	oats	Butte	1.6	20	1996	32	Daily A_BURN provided by Fife, 2002
OATS	oats	FRESNO	1.6	83	1999	137	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OATS	oats	KERN	1.6	50	1999	80	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Oats	oats	Lake	1.6	82	1997	131	A_BURN data taken from WRAP/ECR (WRAP, 2001) survey which references "1997 Lake Co. AQMD Agricultural and Opening Burning Report"
OATS	oats	MADERA	1.6	255	1999	408	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OATS	oats	MERCED	1.6	372	1999	622	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OATS	oats	SAN JOAQUIN	1.6	299	1999	478	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OATS	oats	STANISLAUS	1.6	802	1999	1,283	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Oats	oats	Tehama	1.6	90	1996	144	Daily A_BURN provided by Fife, 2002
OATS	oats	TULARE	1.6	391	1999	628	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	oats Total			**2,444**		**3,944**	
Olive	olives	Butte	1.7	340	1996	577	Daily A_BURN provided by Fife, 2002
Olive	olives	COLUSA	1.7	5	1996	9	Daily A_BURN provided by Fife, 2002
OLIVE PRUNING	olives	FRESNO	1.7	181	1999	316	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OLIVE PRUNING	olives	KERN	1.7	41	1999	70	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OLIVE PRUNING	olives	KINGS	1.7	119	1999	202	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OLIVE PRUNING	olives	MADERA	1.7	308	1999	537	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OLIVE PRUNING	olives	MERCED	1.7	30	1999	55	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Olive	olives	Sacramento	1.7	2	1996	3	Daily A_BURN provided by Fife, 2002
OLIVE PRUNING	olives	SAN JOAQUIN	1.7	24	1999	48	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OLIVE PRUNING	olives	STANISLAUS	1.7	3	1999	5	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Olive	olives	Tehama	1.7	2,124	1996	3,610	Daily A_BURN provided by Fife, 2002
OLIVE PRUNING	olives	TULARE	1.7	1,085	1999	2,610	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	olives Total			**4,261**		**8,042**	
OtherPruning	orchard pruning; unspecified	Butte	1.7	229	1996	389	Daily A_BURN provided by Fife, 2002
OtherPruning	orchard pruning; unspecified	COLUSA	1.7	80	1996	139	Daily A_BURN provided by Fife, 2002
OTHER PRUNINGS	orchard pruning; unspecified	FRESNO	1.7	20	1999	36	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OTHER PRUNINGS	orchard pruning; unspecified	KERN	1.7	-	1999	1	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OTHER PRUNINGS	orchard pruning; unspecified	MADERA	1.7	7	1999	12	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OTHER PRUNINGS	orchard pruning; unspecified	MERCED	1.7	73	1999	285	Daily A_BURN and/or R_BURN provided by SJVUAPCD
X-Mas Trees	orchard pruning; unspecified	Placer	1.7	26	1996	44	Daily A_BURN provided by Fife, 2002
OtherPruning	orchard pruning; unspecified	Sacramento	1.7	98	1996	167	Daily A_BURN provided by Fife, 2002
CHRISTMAS TREES	orchard pruning; unspecified	SAN JOAQUIN	1.7	-	1999	12	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OTHER PRUNINGS	orchard pruning; unspecified	SAN JOAQUIN	1.7	600	1999	1,310	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OTHER PRUNINGS	orchard pruning; unspecified	STANISLAUS	1.7	125	1999	319	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OtherPruning	orchard pruning; unspecified	Tehama	1.7	623	1996	1,059	Daily A_BURN provided by Fife, 2002
OTHER PRUNINGS	orchard pruning; unspecified	TULARE	1.7	43	1999	75	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OtherPruning	orchard pruning; unspecified	Yolo	1.7	1,013	1996	1,722	Daily A_BURN provided by Fife, 2002
	orchard pruning; unspecified Total			**2,937**		**5,570**	
OrchardRemoval	orchard removal	Butte	15	207	1996	3,105	Daily A_BURN provided by Fife, 2002
ORCHARD REMOVAL	orchard removal	FRESNO	15	2,453	1999	36,800	Daily A_BURN and/or R_BURN provided by SJVUAPCD
VINEYARD REMOVAL	orchard removal	FRESNO	15	30	1999	450	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ORCHARD REMOVAL	orchard removal	KERN	15	157	1999	2,349	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ORCHARD REMOVAL	orchard removal	KINGS	15	747	1999	11,211	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ORCHARD REMOVAL	orchard removal	MADERA	15	1,270	1999	19,055	Daily A_BURN and/or R_BURN provided by SJVUAPCD
OrchardRemoval	orchard removal	Placer	15	1	1996	15	Daily A_BURN provided by Fife, 2002
OrchardRemoval	orchard removal	Sutter	15	100	1996	1,500	Daily A_BURN provided by Fife, 2002
ORCHARD REMOVAL	orchard removal	TULARE	15	506	1999	7,595	Daily A_BURN and/or R_BURN provided by SJVUAPCD

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
OrchardRemoval	orchard removal	Yuba	15	152	1996	2,280	Daily A_BURN provided by Fife, 2002
	orchard removal Total			**5,624**		**84,359**	
onion seed	other fruits and vegetables	IMPERIAL	1.5	126	1996	191	Daily A_BURN provided by ICUAPCD
	other fruits and vegetables Total			**126**		**191**	
Peach	peaches	Butte	2.5	175	1996	438	Daily A_BURN provided by Fife, 2002
PEACH PRUNING	peaches	FRESNO	2.5	2,922	1999	7,480	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PEACH PRUNING	peaches	KERN	2.5	420	1999	1,064	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PEACH PRUNING	peaches	KINGS	2.5	894	1999	2,356	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PEACH PRUNING	peaches	MADERA	2.5	377	1999	942	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PEACH PRUNING	peaches	MERCED	2.5	631	1999	1,678	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Peach	peaches	Placer	2.5	11	1996	28	Daily A_BURN provided by Fife, 2002
Peach	peaches	Sacramento	2.5	8	1996	20	Daily A_BURN provided by Fife, 2002
PEACH PRUNING	peaches	SAN JOAQUIN	2.5	112	1999	454	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PEACH PRUNING	peaches	STANISLAUS	2.5	1,146	1999	3,010	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Peach	peaches	Sutter	2.5	139	1996	348	Daily A_BURN provided by Fife, 2002
Peach	peaches	Tehama	2.5	31	1996	78	Daily A_BURN provided by Fife, 2002
PEACH PRUNING	peaches	TULARE	2.5	1,394	1999	4,947	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Peach	peaches	Yuba	2.5	40	1996	100	Daily A_BURN provided by Fife, 2002
	peaches Total			**8,299**		**22,940**	
PEANUTS	peanuts	MERCED	1.2	4	1999	5	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	peanuts Total			**4**		**5**	
Pear	pears	Butte	2.6	13	1996	34	Daily A_BURN provided by Fife, 2002
PEAR PRUNING	pears	FRESNO	2.6	48	1999	124	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PEAR PRUNING	pears	KERN	2.6	21	1999	68	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Pears	pears	Lake	2.6	5,249	1997	13,647	A_BURN data taken from WRAP/ECR (WRAP, 2001) survey which references "1997 Lake Co. AQMD Agricultural and Opening Burning Report"
PEAR PRUNING	pears	MADERA	2.6	1	1999	1	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PEAR PRUNING	pears	MERCED	2.6	1	1999	3	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Pear	pears	Placer	2.6	21	1996	55	Daily A_BURN provided by Fife, 2002
Pear	pears	Sacramento	2.6	262	1996	680	Daily A_BURN provided by Fife, 2002
PEAR PRUNING	pears	SAN JOAQUIN	2.6	19	1999	74	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PEAR PRUNING	pears	STANISLAUS	2.6	-	1999	3	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PEAR PRUNING	pears	TULARE	2.6	1,170	1999	3,061	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	pears Total			**6,804**		**17,748**	
PEA VINES	peas; dry edible	FRESNO	2.5	1	1999	1	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	peas; dry edible Total			**1**		**1**	
Pecan	pecans	Butte	1.7	11	1996	19	Daily A_BURN provided by Fife, 2002
Pecan	pecans	COLUSA	1.7	41	1996	71	Daily A_BURN provided by Fife, 2002
PECAN PRUNING	pecans	FRESNO	1.7	648	1999	1,106	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PECAN PRUNING	pecans	KERN	1.7	395	1999	673	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PECAN PRUNING	pecans	KINGS	1.7	44	1999	80	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PECAN PRUNING	pecans	MADERA	1.7	53	1999	90	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PECAN PRUNING	pecans	MERCED	1.7	5	1999	13	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PECAN PRUNING	pecans	SAN JOAQUIN	1.7	-	1999	7	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PECAN PRUNING	pecans	STANISLAUS	1.7	29	1999	51	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Pecan	pecans	Tehama	1.7	138	1996	235	Daily A_BURN provided by Fife, 2002
PECAN PRUNING	pecans	TULARE	1.7	455	1999	842	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	pecans Total			**1,819**		**3,186**	
Persimmon	persimmons	Butte	1.7	13	1996	21	Daily A_BURN provided by Fife, 2002
PERSIMMON PRUNING	persimmons	FRESNO	1.7	130	1999	228	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PERSIMMON PRUNING	persimmons	KERN	1.7	1	1999	2	Daily A_BURN and/or R_BURN provided by SJVUAPCD

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
PERSIMMON PRUNING	persimmons	MADERA	1.7	15	1999	26	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PERSIMMON PRUNING	persimmons	MERCED	1.7	1	1999	2	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Persimmon	persimmons	Placer	1.7	6	1996	10	Daily A_BURN provided by Fife, 2002
PERSIMMON PRUNING	persimmons	SAN JOAQUIN	1.7	-	1999	5	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PERSIMMON PRUNING	persimmons	STANISLAUS	1.7	127	1999	215	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PERSIMMON PRUNING	persimmons	TULARE	1.7	50	1999	123	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	persimmons Total			**342**		**631**	
Pistachio	pistachio	Butte	1.7	74	1996	125	Daily A_BURN provided by Fife, 2002
PISTACHIO PRUNING	pistachio	FRESNO	1.7	543	1999	957	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PISTACHIO PRUNING	pistachio	KERN	1.7	793	1999	1,872	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PISTACHIO PRUNING	pistachio	KINGS	1.7	872	1999	1,530	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PISTACHIO PRUNING	pistachio	MADERA	1.7	8,638	1999	15,828	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PISTACHIO PRUNING	pistachio	MERCED	1.7	1,473	1999	2,643	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PISTACHIO PRUNING	pistachio	SAN JOAQUIN	1.7	-	1999	13	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PISTACHIO PRUNING	pistachio	STANISLAUS	1.7	41	1999	75	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Pistachio	pistachio	Tehama	1.7	21	1996	35	Daily A_BURN provided by Fife, 2002
PISTACHIO PRUNING	pistachio	TULARE	1.7	410	1999	1,060	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	pistachio Total			**12,862**		**24,136**	
Plum	plums and prunes	Butte	1.2	5	1996	6	Daily A_BURN provided by Fife, 2002
Prune	plums and prunes	Butte	1.2	1,708	1996	2,050	Daily A_BURN provided by Fife, 2002
Prune	plums and prunes	COLUSA	1.2	872	1996	1,046	Daily A_BURN provided by Fife, 2002
PLUM PRUNING	plums and prunes	FRESNO	1.2	2,030	1999	3,427	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PLUOT PRUNING	plums and prunes	FRESNO	1.2	28	1999	34	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PRUNE PRUNING	plums and prunes	FRESNO	1.2	1,069	1999	1,300	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PLUM PRUNING	plums and prunes	KERN	1.2	152	1999	245	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PRUNE PRUNING	plums and prunes	KERN	1.2	70	1999	94	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PLUM PRUNING	plums and prunes	KINGS	1.2	129	1999	171	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PRUNE PRUNING	plums and prunes	KINGS	1.2	26	1999	31	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PLUM PRUNING	plums and prunes	MADERA	1.2	113	1999	135	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PRUNE PRUNING	plums and prunes	MADERA	1.2	611	1999	739	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PLUM PRUNING	plums and prunes	MERCED	1.2	38	1999	71	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PRUNE PRUNING	plums and prunes	MERCED	1.2	258	1999	382	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Plum	plums and prunes	Placer	1.2	13	1996	16	Daily A_BURN provided by Fife, 2002
Prune	plums and prunes	Placer	1.2	73	1996	88	Daily A_BURN provided by Fife, 2002
PLUM PRUNING	plums and prunes	SAN JOAQUIN	1.2	3	1999	9	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PLUOT PRUNING	plums and prunes	SAN JOAQUIN	1.2	1	1999	1	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PRUNE PRUNING	plums and prunes	SAN JOAQUIN	1.2	7	1999	49	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PLUM PRUNING	plums and prunes	STANISLAUS	1.2	4	1999	9	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PRUNE PRUNING	plums and prunes	STANISLAUS	1.2	-	1999	2	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Prune	plums and prunes	Sutter	1.2	346	1996	415	Daily A_BURN provided by Fife, 2002
Prune	plums and prunes	Tehama	1.2	4,821	1996	5,785	Daily A_BURN provided by Fife, 2002
PLUM PRUNING	plums and prunes	TULARE	1.2	2,319	1999	4,408	Daily A_BURN and/or R_BURN provided by SJVUAPCD
PRUNE PRUNING	plums and prunes	TULARE	1.2	1,386	1999	2,403	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Prune	plums and prunes	Yolo	1.2	1,751	1996	2,101	Daily A_BURN provided by Fife, 2002
Prune	plums and prunes	Yuba	1.2	113	1996	136	Daily A_BURN provided by Fife, 2002
	plums and prunes Total			**17,943**		**25,152**	
POMEGRANATE PRUNING	pomegranates	FRESNO	1.7	149	1999	256	Daily A_BURN and/or R_BURN provided by SJVUAPCD
POMEGRANATE PRUNING	pomegranates	KERN	1.7	100	1999	177	Daily A_BURN and/or R_BURN provided by SJVUAPCD
POMEGRANATE PRUNING	pomegranates	KINGS	1.7	22	1999	37	Daily A_BURN and/or R_BURN provided by SJVUAPCD
POMEGRANATE PRUNING	pomegranates	MADERA	1.7	54	1999	99	Daily A_BURN and/or R_BURN provided by SJVUAPCD
POMEGRANATE PRUNING	pomegranates	MERCED	1.7	-	1999	4	Daily A_BURN and/or R_BURN provided by SJVUAPCD

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
POMEGRANATE PRUNING	pomegranates	STANISLAUS	1.7	1	1999	2	Daily A_BURN and/or R_BURN provided by SJVUAPCD
POMEGRANATE PRUNING	pomegranates	TULARE	1.7	79	1999	310	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	pomegranates Total			**406**		**885**	
QUINCE	quinces	KINGS	1.7	3	1999	5	Daily A_BURN and/or R_BURN provided by SJVUAPCD
QUINCE	quinces	TULARE	1.7	14	1999	45	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	quinces Total			**17**		**51**	
Rice	rice; all	Butte	3	45,945	1996	137,835	Daily A_BURN provided by Fife, 2002
Rice-Wild	rice; all	Butte	3	753	1996	2,259	Daily A_BURN provided by Fife, 2002
Rice	rice; all	COLUSA	3	53,366	1996	160,098	Daily A_BURN provided by Fife, 2002
RICE	rice; all	FRESNO	3	8,578	1999	25,734	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Rice	rice; all	Glenn	3	50,576	1996	151,727	Daily A_BURN provided by Fife, 2002
Rice, wild	rice; all	Lake	3	60	1997	180	A_BURN data taken from WRAP/ECR (WRAP, 2001) survey which references "1997 Lake Co. AQMD Agricultural and Opening Burning Report"
RICE	rice; all	MERCED	3	4,110	1999	12,330	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Rice	rice; all	Placer	3	6,623	1996	19,869	Daily A_BURN provided by Fife, 2002
RICE	rice; all	Sacramento	3	6,631	1996	19,892	Daily A_BURN provided by Fife, 2002
RICE	rice; all	SAN JOAQUIN	3	5,151	1999	15,456	Daily A_BURN and/or R_BURN provided by SJVUAPCD
RICE	rice; all	STANISLAUS	3	3,466	1999	10,397	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Rice	rice; all	Sutter	3	42,112	1996	126,336	Daily A_BURN provided by Fife, 2002
Rice	rice; all	Tehama	3	704	1996	2,111	Daily A_BURN provided by Fife, 2002
Rice	rice; all	Yolo	3	7,737	1996	23,211	Daily A_BURN provided by Fife, 2002
Rice	rice; all	Yuba	3	18,953	1996	56,859	Daily A_BURN provided by Fife, 2002
	rice; all Total			**254,763**		**764,293**	
Rye	rye	Placer	1.9	65	1996	124	Daily A_BURN provided by Fife, 2002
	rye Total			**65**		**124**	
Safflower	safflower	Butte	1.3	20	1996	26	Daily A_BURN provided by Fife, 2002
Safflower	safflower	COLUSA	1.3	3,839	1996	4,991	Daily A_BURN provided by Fife, 2002
SAFFLOWER	safflower	FRESNO	1.3	337	1999	438	Daily A_BURN and/or R_BURN provided by SJVUAPCD
SAFFLOWER	safflower	KERN	1.3	2	1999	3	Daily A_BURN and/or R_BURN provided by SJVUAPCD
SAFFLOWER	safflower	KINGS	1.3	6	1999	8	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Safflower	safflower	Sacramento	1.3	54	1996	70	Daily A_BURN provided by Fife, 2002
SAFFLOWER	safflower	SAN JOAQUIN	1.3	367	1999	479	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Safflower	safflower	Sutter	1.3	301	1996	391	Daily A_BURN provided by Fife, 2002
Safflower	safflower	Tehama	1.3	15	1996	20	Daily A_BURN provided by Fife, 2002
Safflower	safflower	Yolo	1.3	201	1996	261	Daily A_BURN provided by Fife, 2002
	safflower Total			**5,142**		**6,686**	
Grass	seeds; other	Butte	2	614	1996	1,228	Daily A_BURN provided by Fife, 2002
Grass	seeds; other	COLUSA	2	130	1996	260	Daily A_BURN provided by Fife, 2002
bermuda	seeds; other	IMPERIAL	2	24,612	1996	49,224	Daily A_BURN provided by ICUAPCD
Clover	seeds; other	Placer	2	40	1996	80	Daily A_BURN provided by Fife, 2002
Grass	seeds; other	Placer	2	16	1996	32	Daily A_BURN provided by Fife, 2002
Grass	seeds; other	Tehama	2	1	1996	2	Daily A_BURN provided by Fife, 2002
GRASS	seeds; other	TULARE	2	1	1999	2	Daily A_BURN and/or R_BURN provided by SJVUAPCD
SUDAN	seeds; other	TULARE	2	7	1999	14	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	seeds; other Total			**25,421**		**50,842**	
SORGHUM (MILO)	sorghum	MERCED	2.9	-	1999	2	Daily A_BURN and/or R_BURN provided by SJVUAPCD
SORGHUM (MILO)	sorghum	SAN JOAQUIN	2.9	2	1999	6	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Milo	sorghum	Tehama	2.9	60	1996	174	Daily A_BURN provided by Fife, 2002
	sorghum Total			**62**		**182**	
sudan	sudan	IMPERIAL	2	2,283	1996	4,566	Daily A_BURN provided by ICUAPCD
SUDAN	sudan	Sacramento	2	595	1996	1,190	Daily A_BURN provided by Fife, 2002

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
	sudan Total			**2,878**		**5,756**	
SUGAR CANE	sugarcane	FRESNO	14	0	1999	4	Daily A_BURN and/or R_BURN provided by SJVUAPCD
	sugarcane Total			**0**		**4**	
OTHER-MISCELLANEOUS	unspecified	COLUSA		1,206	1996		Daily A_BURN provided by Fife, 2002
Unspecified	unspecified	FRESNO		-	1999	25	Daily A_BURN and/or R_BURN provided by SJVUAPCD
FERT/PESTICIDE SACKS	unspecified	KERN		-	1999	1	Daily A_BURN and/or R_BURN provided by SJVUAPCD
ROSE PRUNING	unspecified	KERN		-	1999	40	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Unspecified	unspecified	KERN		-	1999	3,038	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Unspecified	unspecified	MERCED		-	1999	2	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Miscellaneous	unspecified	Placer		2	1996	-	Daily A_BURN provided by Fife, 2002
FLOOD DEBRIS	unspecified	TULARE		-	1999	5	Daily A_BURN and/or R_BURN provided by SJVUAPCD
SLASH	unspecified	TULARE		-	1999	3	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Miscellaneous	unspecified	Yolo		2,312	1996		Daily A_BURN provided by Fife, 2002
	unspecified Total			**3,520**		**3,114**	
Walnut	walnuts	Butte	1.2	3,044	1996	3,653	Daily A_BURN provided by Fife, 2002
Walnut	walnuts	COLUSA	1.2	384	1996	461	Daily A_BURN provided by Fife, 2002
WALNUT PRUNING	walnuts	FRESNO	1.2	5,055	1999	6,117	Daily A_BURN and/or R_BURN provided by SJVUAPCD
WALNUT PRUNING	walnuts	KERN	1.2	171	1999	318	Daily A_BURN and/or R_BURN provided by SJVUAPCD
WALNUT PRUNING	walnuts	KINGS	1.2	6,027	1999	7,467	Daily A_BURN and/or R_BURN provided by SJVUAPCD
orchard removal	walnuts	Lake	15	700	1997	10,500	A_BURN data taken from WRAP/ECR (WRAP, 2001) survey which references "1997 Lake Co. AQMD Agricultural and Opening Burning Report"
Walnuts	walnuts	Lake	1.2	6,224	1997	7,469	A_BURN data taken from WRAP/ECR (WRAP, 2001) survey which references "1997 Lake Co. AQMD Agricultural and Opening Burning Report"
WALNUT PRUNING	walnuts	MADERA	1.2	956	1999	1,157	Daily A_BURN and/or R_BURN provided by SJVUAPCD
WALNUT PRUNING	walnuts	MERCED	1.2	1,988	1999	5,914	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Walnut	walnuts	Placer	1.2	131	1996	157	Daily A_BURN provided by Fife, 2002
Walnut	walnuts	Sacramento	1.2	1	1996	1	Daily A_BURN provided by Fife, 2002
WALNUT PRUNING	walnuts	SAN JOAQUIN	1.2	7,838	1999	25,004	Daily A_BURN and/or R_BURN provided by SJVUAPCD
WALNUT PRUNING	walnuts	STANISLAUS	1.2	13,809	1999	20,659	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Walnut	walnuts	Sutter	1.2	418	1996	502	Daily A_BURN provided by Fife, 2002
Walnut	walnuts	Tehama	1.2	3,254	1996	3,905	Daily A_BURN provided by Fife, 2002
WALNUT PRUNING	walnuts	TULARE	1.2	10,884	1999	16,931	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Walnut	walnuts	Yolo	1.2	2,463	1996	2,956	Daily A_BURN provided by Fife, 2002
Walnut	walnuts	Yuba	1.2	45	1996	54	Daily A_BURN provided by Fife, 2002
	walnuts Total			**63,391**		**113,223**	
Other Field Crops	wheat; all	Butte	1.9	109	1996	207	Daily A_BURN provided by Fife, 2002
Wheat	wheat; all	Butte	1.9	2,888	1996	5,486	Daily A_BURN provided by Fife, 2002
Other Field Crops	wheat; all	COLUSA	1.9	1	1996	2	Daily A_BURN provided by Fife, 2002
Wheat	wheat; all	COLUSA	1.9	6,134	1996	11,655	Daily A_BURN provided by Fife, 2002
WHEAT	wheat; all	FRESNO	1.9	1,388	1999	2,637	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Wheat	wheat; all	Glenn	1.9	12	1996	23	Daily A_BURN provided by Fife, 2002
wheat	wheat; all	IMPERIAL	1.9	71,795	1996	136,395	Daily A_BURN provided by ICUAPCD
WHEAT	wheat; all	KERN	1.9	7,145	1999	13,595	Daily A_BURN and/or R_BURN provided by SJVUAPCD
WHEAT	wheat; all	KINGS	1.9	5,719	1999	10,866	Daily A_BURN and/or R_BURN provided by SJVUAPCD
WHEAT	wheat; all	MADERA	1.9	1,879	1999	3,570	Daily A_BURN and/or R_BURN provided by SJVUAPCD
WHEAT	wheat; all	MERCED	1.9	1,476	1999	2,804	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Wheat	wheat; all	Placer	1.9	21	1996	40	Daily A_BURN provided by Fife, 2002
Other Field Crops	wheat; all	Sacramento	1.9	3	1996	5	Daily A_BURN provided by Fife, 2002
Wheat	wheat; all	Sacramento	1.9	1,491	1996	2,832	Daily A_BURN provided by Fife, 2002
WHEAT	wheat; all	SAN JOAQUIN	1.9	2,917	1999	6,315	Daily A_BURN and/or R_BURN provided by SJVUAPCD
WHEAT	wheat; all	STANISLAUS	1.9	182	1999	346	Daily A_BURN and/or R_BURN provided by SJVUAPCD

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
Wheat	wheat; all	Sutter	1.9	414	1996	787	Daily A_BURN provided by Fife, 2002
Wheat	wheat; all	Tehama	1.9	1,215	1996	2,309	Daily A_BURN provided by Fife, 2002
WHEAT	wheat; all	TULARE	1.9	8,367	1999	16,021	Daily A_BURN and/or R_BURN provided by SJVUAPCD
Other Field Crops	wheat; all	Yolo	1.9	721	1996	1,369	Daily A_BURN provided by Fife, 2002
Wheat	wheat; all	Yolo	1.9	3,685	1996	7,002	Daily A_BURN provided by Fife, 2002
Other Field Crops	wheat; all	Yuba	1.9	234	1996	445	Daily A_BURN provided by Fife, 2002
	wheat; all Total			**117,794**		**224,709**	
	Grand Total			**893,405**		**1,898,134**	

COLORADO

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
wheat; other spring (irrigated)	wheat; other spring-CO	Mesa	4	500	Avg	2,000	A_BURN and RL per J.Sharkoffl, NRCS in CO.

HAWAII

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
pineapple	pineapple	Honolulu		7,000	1996		RL on pineapple is undetermined; Maui Pineapple Co. indicates 13,000 acres burned/year
pineapple	pineapple	Maui & Kalwao		6,000	1996		RL on pineapple is undetermined; Maui Pineapple Co. indicates 13,000 acres burned/year
	pineapple Total			**13,000**		**-**	
sugarcane	sugarcane	Hawaii	14	909	1996	12,727	Annual A_BURN from L.Young, HI Dept of Health
sugarcane	sugarcane	Honolulu	14	3,357	1996	46,993	Annual A_BURN from L.Young, HI Dept of Health
sugarcane	sugarcane	Kauai	14	11,678	1996	163,496	Annual A_BURN from L.Young, HI Dept of Health
sugarcane	sugarcane	Maui & Kalwao	14	14,056	1996	196,783	Annual A_BURN from L.Young, HI Dept of Health
	sugarcane Total			**30,000**		**420,000**	
	Grand Total			**43,000**		**420,000**	

IDAHO

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
alfalfa seed	seeds; alfalfa	Ada	0.8	202	1996	162	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Adams	0.8	53	1996	42	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Bannock	0.8	155	1996	124	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Bear Lake	0.8	263	1996	210	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Bingham	0.8	463	1996	370	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Blaine	0.8	143	1996	114	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Boise	0.8	18	1996	14	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Bonneville	0.8	250	1996	200	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Butte	0.8	229	1996	183	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Camas	0.8	370	1996	296	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Canyon	0.8	368	1996	294	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Caribou	0.8	217	1996	174	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Cassia	0.8	445	1996	356	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Clark	0.8	154	1996	123	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Custer	0.8	213	1996	170	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Elmore	0.8	310	1996	248	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Franklin	0.8	362	1996	290	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Fremont	0.8	190	1996	152	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Gem	0.8	121	1996	97	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Gooding	0.8	310	1996	248	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Jefferson	0.8	732	1996	586	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Jerome	0.8	329	1996	263	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Lemhi	0.8	194	1996	155	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Lincoln	0.8	154	1996	123	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Madison	0.8	154	1996	123	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Minidoka	0.8	223	1996	178	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Oneida	0.8	241	1996	193	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Owyhee	0.8	389	1996	311	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Payette	0.8	114	1996	91	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Power	0.8	77	1996	62	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Teton	0.8	135	1996	108	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Twin Falls	0.8	560	1996	448	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Valley	0.8	20	1996	16	Annual A_BURN provided by D.Riley IDEQ
alfalfa seed	seeds; alfalfa	Washington	0.8	218	1996	174	Annual A_BURN provided by D.Riley IDEQ
	seeds; alfalfa Total			**8,376**		**6,701**	
barley	barley	Ada	1.7	501	1996	851	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Adams	1.7	95	1996	161	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Bannock	1.7	1,353	1996	2,301	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Bear Lake	1.7	2,260	1996	3,842	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Benewah	1.7	663	1996	1,127	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Bingham	1.7	3,180	1996	5,406	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Blaine	1.7	2,287	1996	3,888	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Bonner	1.7	162	1996	276	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Bonneville	1.7	8,255	1996	14,034	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Boundary	1.7	826	1996	1,403	Annual A_BURN provided by D.Riley IDEQ

IDAHO

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
barley	barley	Butte	1.7	2,098	1996	3,566	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Camas	1.7	1,326	1996	2,255	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Canyon	1.7	1,123	1996	1,909	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Caribou	1.7	10,677	1996	18,152	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Cassia	1.7	3,519	1996	5,982	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Clark	1.7	149	1996	253	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Clearwater	1.7	798	1996	1,357	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Custer	1.7	433	1996	736	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Elmore	1.7	798	1996	1,357	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Franklin	1.7	2,625	1996	4,463	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Fremont	1.7	8,661	1996	14,724	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Gem	1.7	338	1996	575	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Gooding	1.7	731	1996	1,242	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Idaho	1.7	2,883	1996	4,900	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Jefferson	1.7	5,007	1996	8,512	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Jerome	1.7	2,016	1996	3,428	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Kootenai	1.7	541	1996	920	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Latah	1.7	3,397	1996	5,774	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Lemhi	1.7	95	1996	161	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Lewis	1.7	3,532	1996	6,005	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Lincoln	1.7	1,150	1996	1,956	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Madison	1.7	5,941	1996	10,100	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Minidoka	1.7	4,412	1996	7,500	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Nez Perce	1.7	3,302	1996	5,613	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Oneida	1.7	2,314	1996	3,934	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Owyhee	1.7	961	1996	1,633	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Payette	1.7	122	1996	207	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Power	1.7	1,326	1996	2,255	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Teton	1.7	4,899	1996	8,328	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Twin Falls	1.7	3,640	1996	6,189	Annual A_BURN provided by D.Riley IDEQ
barley	barley	Washington	1.7	392	1996	667	Annual A_BURN provided by D.Riley IDEQ
	barley Total			**98,790**		**167,943**	
bluegrass	seeds; KBG	Benewah	2	8,886	1996	17,771	Annual A_BURN provided by D.Riley IDEQ
bluegrass	seeds; KBG	Idaho	2	1,982	1996	3,965	Annual A_BURN provided by D.Riley IDEQ
bluegrass	seeds; KBG	Kootenai	2	26,223	1996	52,446	Annual A_BURN provided by D.Riley IDEQ
bluegrass	seeds; KBG	Latah	2	3,439	1996	6,877	Annual A_BURN provided by D.Riley IDEQ
bluegrass	seeds; KBG	Lewis	2	7,687	1996	15,375	Annual A_BURN provided by D.Riley IDEQ
bluegrass	seeds; KBG	Nez Perce	2	1,783	1996	3,566	Annual A_BURN provided by D.Riley IDEQ
	seeds; KBG Total			**50,000**		**100,000**	
ditchbank	ditches and ditch banks	Ada	3.2	1,271	1996	4,067	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Adams	3.2	441	1996	1,411	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Bannock	3.2	1,753	1996	5,610	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Bear Lake	3.2	962	1996	3,078	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Benewah	3.2	142	1996	454	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Bingham	3.2	3,156	1996	10,099	Annual A_BURN provided by D.Riley IDEQ

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
ditchbank	ditches and ditch banks	Blaine	3.2	735	1996	2,352	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Boise	3.2	63	1996	202	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Bonner	3.2	125	1996	400	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Bonneville	3.2	2,611	1996	8,355	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Boundary	3.2	126	1996	403	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Butte	3.2	643	1996	2,058	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Camas	3.2	901	1996	2,883	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Canyon	3.2	2,379	1996	7,613	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Caribou	3.2	2,218	1996	7,098	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Cassia	3.2	3,341	1996	10,691	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Clark	3.2	613	1996	1,962	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Clearwater	3.2	70	1996	224	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Custer	3.2	859	1996	2,749	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Elmore	3.2	1,022	1996	3,270	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Franklin	3.2	1,469	1996	4,701	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Fremont	3.2	1,549	1996	4,957	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Gem	3.2	489	1996	1,565	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Gooding	3.2	935	1996	2,992	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Idaho	3.2	419	1996	1,341	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Jefferson	3.2	1,978	1996	6,330	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Jerome	3.2	1,479	1996	4,733	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Kootenai	3.2	222	1996	710	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Latah	3.2	478	1996	1,530	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Lemhi	3.2	981	1996	3,139	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Lewis	3.2	321	1996	1,027	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Lincoln	3.2	743	1996	2,378	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Madison	3.2	1,520	1996	4,864	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Minidoka	3.2	1,690	1996	5,408	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Nez Perce	3.2	477	1996	1,526	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Oneida	3.2	1,778	1996	5,690	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Owyhee	3.2	1,413	1996	4,522	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Payette	3.2	648	1996	2,074	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Power	3.2	2,802	1996	8,966	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Shoshone	3.2	2	1996	6	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Teton	3.2	886	1996	2,835	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Twin Falls	3.2	2,745	1996	8,784	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Valley	3.2	561	1996	1,795	Annual A_BURN provided by D.Riley IDEQ
ditchbank	ditches and ditch banks	Washington	3.2	988	1996	3,162	Annual A_BURN provided by D.Riley IDEQ
	ditches and ditch banks Total			**50,004**		**160,013**	
mint	mint	Ada	0.5	192	1996	96	Annual A_BURN provided by D.Riley IDEQ
mint	mint	Butte	0.5	11	1996	6	Annual A_BURN provided by D.Riley IDEQ
mint	mint	Canyon	0.5	379	1996	190	Annual A_BURN provided by D.Riley IDEQ
mint	mint	Custer	0.5	23	1996	12	Annual A_BURN provided by D.Riley IDEQ
mint	mint	Owyhee	0.5	23	1996	12	Annual A_BURN provided by D.Riley IDEQ
mint	mint	Payette	0.5	71	1996	36	Annual A_BURN provided by D.Riley IDEQ

IDAHO

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
mint	mint	Washington	0.5	4	1996	2	Annual A_BURN provided by D.Riley IDEQ
	mint Total			**703**		**352**	
wheat	wheat; all	Ada	1.9	1,763	1996	3,350	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Bannock	1.9	6,254	1996	11,883	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Bear Lake	1.9	1,154	1996	2,193	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Benewah	1.9	4,047	1996	7,689	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Bingham	1.9	19,397	1996	36,854	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Blaine	1.9	330	1996	627	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Bonneville	1.9	9,464	1996	17,981	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Boundary	1.9	2,207	1996	4,194	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Butte	1.9	1,395	1996	2,651	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Camas	1.9	406	1996	771	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Canyon	1.9	5,848	1996	11,112	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Caribou	1.9	5,607	1996	10,654	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Cassia	1.9	15,210	1996	28,900	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Clark	1.9	1,916	1996	3,640	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Clearwater	1.9	926	1996	1,760	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Elmore	1.9	2,880	1996	5,471	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Franklin	1.9	2,791	1996	5,303	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Fremont	1.9	5,379	1996	10,220	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Gem	1.9	964	1996	1,832	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Gooding	1.9	2,093	1996	3,977	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Idaho	1.9	8,157	1996	15,498	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Jefferson	1.9	6,381	1996	12,124	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Jerome	1.9	5,480	1996	10,413	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Kootenai	1.9	3,108	1996	5,905	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Latah	1.9	11,963	1996	22,729	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Lewis	1.9	8,411	1996	15,980	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Lincoln	1.9	2,588	1996	4,917	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Madison	1.9	6,178	1996	11,738	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Minidoka	1.9	6,698	1996	12,726	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Nez Perce	1.9	12,052	1996	22,898	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Oneida	1.9	5,785	1996	10,991	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Owyhee	1.9	1,256	1996	2,386	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Payette	1.9	1,446	1996	2,748	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Power	1.9	17,608	1996	33,455	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Teton	1.9	1,142	1996	2,169	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Twin Falls	1.9	7,916	1996	15,040	Annual A_BURN provided by D.Riley IDEQ
wheat	wheat; all	Washington	1.9	1,700	1996	3,230	Annual A_BURN provided by D.Riley IDEQ
	wheat; all Total			**197,900**		**376,010**	
	Grand Total			**405,773**		**811,018**	

MONTANA

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
wheat; all (irrigated)	wheat; all	Beaverhead	1.9	80	1996	150	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Big Horn	1.9	130	1996	245	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Blaine	1.9	125	1996	235	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Broadwater	1.9	180	1996	340	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Carbon	1.9	25	1996	45	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Cascade	1.9	90	1996	170	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Chouteau	1.9	35	1996	65	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Custer	1.9	50	1996	95	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Daniels	1.9	5	1996	10	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Dawson	1.9	40	1996	75	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Deerlodge	1.9	15	1996	30	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Fergus	1.9	10	1996	20	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Flathead	1.9	75	1996	145	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Gallatin	1.9	165	1996	315	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Garfield	1.9	5	1996	10	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Glacier	1.9	50	1996	100	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Golden Valley	1.9	20	1996	40	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Hill	1.9	10	1996	20	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Jefferson	1.9	10	1996	20	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Judith Basin	1.9	5	1996	10	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Lake	1.9	135	1996	255	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Lewis And Clark	1.9	25	1996	50	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Liberty	1.9	20	1996	40	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Madison	1.9	80	1996	150	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	McCone	1.9	45	1996	85	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Meagher	1.9	10	1996	20	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Mineral	1.9	5	1996	10	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Missoula	1.9	15	1996	30	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Musselshell	1.9	5	1996	10	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Park	1.9	20	1996	40	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Petroleum	1.9	20	1996	40	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Phillips	1.9	55	1996	105	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Pondera	1.9	210	1996	400	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ

MONTANA

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
wheat; all (irrigated)	wheat; all	Powder River	1.9	10	1996	20	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Powell	1.9	5	1996	10	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Prairie	1.9	50	1996	95	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Ravalli	1.9	15	1996	30	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Richland	1.9	180	1996	340	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Roosevelt	1.9	40	1996	75	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Rosebud	1.9	45	1996	85	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Sanders	1.9	10	1996	20	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Sheridan	1.9	30	1996	55	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Stillwater	1.9	15	1996	30	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Sweet Grass	1.9	10	1996	20	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Teton	1.9	175	1996	330	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Toole	1.9	5	1996	10	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Treasure	1.9	40	1996	75	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Valley	1.9	175	1996	330	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Wheatland	1.9	10	1996	20	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Wibaux	1.9	5	1996	10	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
wheat; all (irrigated)	wheat; all	Yellowstone	1.9	65	1996	125	A_BURN based on estimate of 1% of irrigated wheat burned per J.Coeffield, MTDEQ
	wheat; all Total			**2,655**		**5,055**	
	Grand Total			**2,655**		**5,055**	

NORTH_DAKOTA

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
wheat; all	wheat; all	Barnes	1.9	18,855	Avg	35,826	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Benson	1.9	14,976	Avg	28,455	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Cass	1.9	24,066	Avg	45,726	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Cavalier	1.9	22,360	Avg	42,483	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Eddy	1.9	4,623	Avg	8,784	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Foster	1.9	8,164	Avg	15,513	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Grand Forks	1.9	11,742	Avg	22,311	A_BURN approx.10-12,000 acres (or 75% of gapfilling avg. 5.2% AH burned). Based on comment from NRCS/District Conservationist
wheat; all	wheat; all	Griggs	1.9	6,817	Avg	12,954	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Nelson	1.9	10,244	Avg	19,464	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Pembina	1.9	11,370	Avg	21,600	A_BURN approx.10-12,000 acres (or 75% of gapfilling avg. 5.2% AH burned). Based on comment from NRCS/District Conservationist
wheat; all	wheat; all	Ramsey	1.9	13,208	Avg	25,095	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Steele	1.9	8,928	Avg	16,965	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Stutsman	1.9	23,275	Avg	44,223	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Towner	1.9	14,123	Avg	26,835	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Traill	1.9	10,499	Avg	19,947	A_BURN based on gapfilling average, 5.2% of AH are burned.
wheat; all	wheat; all	Walsh	1.9	12,612	Avg	23,964	A_BURN approx.10-12,000 acres (or 75% of gapfilling avg. 5.2% AH burned). Based on comment from NRCS/District Conservationist
	wheat; all Total			**215,862**		**410,145**	
	Grand Total			**215,862**		**410,145**	

NEW_MEXICO

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
wheat; all	wheat; all	Chaves	1.5	48	Avg	72	RL per R.Shaw, NRCS (Shaver, 2002); A_BURN based on gap filling avg.,5.2% of AH are burned.
wheat; all	wheat; all	Curry	1.5	2,500	1996	3,752	RL per R.Shaw, NRCS (Shaver, 2002); A_BURN based on gap filling avg.,5.2% of AH are burned.
wheat; all	wheat; all	De Baca	1.5	8	Avg	12	RL per R.Shaw, NRCS (Shaver, 2002); A_BURN based on gap filling avg.,5.2% of AH are burned.
wheat; all	wheat; all	Dona Ana	1.5	140	Avg	212	RL per R.Shaw, NRCS (Shaver, 2002); A_BURN based on gap filling avg.,5.2% of AH are burned.
wheat; all	wheat; all	Eddy	1.5	4	Avg	8	RL per R.Shaw, NRCS (Shaver, 2002); A_BURN based on gap filling avg.,5.2% of AH are burned.
wheat; all	wheat; all	Guadalupe	1.5	56	Avg	84	RL per R.Shaw, NRCS (Shaver, 2002); A_BURN based on gap filling avg.,5.2% of AH are burned.
wheat; all	wheat; all	Harding	1.5	16	Avg	24	RL per R.Shaw, NRCS (Shaver, 2002); A_BURN based on gap filling avg.,5.2% of AH are burned.
wheat; all	wheat; all	Lea	1.5	124	Avg	188	RL per R.Shaw, NRCS (Shaver, 2002); A_BURN based on gap filling avg.,5.2% of AH are burned.
wheat; all	wheat; all	Quay	1.5	156	Avg	236	RL per R.Shaw, NRCS (Shaver, 2002); A_BURN based on gap filling avg.,5.2% of AH are burned.
wheat; all	wheat; all	Roosevelt	1.5	764	Avg	1,148	RL per R.Shaw, NRCS (Shaver, 2002); A_BURN based on gap filling avg.,5.2% of AH are burned.
wheat; all	wheat; all	Union	1.5	548	Avg	824	RL per R.Shaw, NRCS (Shaver, 2002); A_BURN based on gap filling avg.,5.2% of AH are burned.
	wheat; all Total			**4,364**		**6,560**	
	Grand Total			**4,364**		**6,560**	

NEVADA

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
unspecified	unspecified	Churchill		195	1998		A_BURN by county provided by C.Sergent, NDEP
unspecified	unspecified	Douglas		877	1998		A_BURN by county provided by C.Sergent, NDEP
unspecified	unspecified	Elko		144	1998		A_BURN by county provided by C.Sergent, NDEP
unspecified	unspecified	Eureka		765	1998		A_BURN by county provided by C.Sergent, NDEP
unspecified	unspecified	Humboldt		12,535	1998		A_BURN by county provided by C.Sergent, NDEP
unspecified	unspecified	Lander		150	1998		A_BURN by county provided by C.Sergent, NDEP
unspecified	unspecified	Lincoln		170	1998		A_BURN by county provided by C.Sergent, NDEP
unspecified	unspecified	Lyon		206	1998		A_BURN by county provided by C.Sergent, NDEP
unspecified	unspecified	Pershing		5,820	1998		A_BURN by county provided by C.Sergent, NDEP
unspecified	unspecified	Washoe		80	1998		A_BURN by county provided by C.Sergent, NDEP
unspecified	unspecified	White Pine		10	1998		A_BURN by county provided by C.Sergent, NDEP
	Grand Total			**20,952**		**Unknown**	

OREGON

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
Barley	barley	CLACKAMAS	1.7		1996	18	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	DOUGLAS	1.7		1996	9	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	GILLIAM	1.7		1996	6,183	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	HARNEY	1.7		1996	54	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	KLAMATH	1.7		1996	4,176	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	LINN	1.7		1996	153	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	MALHEUR	1.7		1996	1,179	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	MARION	1.7		1996	306	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	MORROW	1.7		1996	108	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	POLK	1.7		1996	9	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	SHERMAN	1.7		1996	1,035	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	UMATILLA	1.7		1996	4,086	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	UNION	1.7		1996	909	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	WALLOWA	1.7		1996	2,394	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	WASCO	1.7		1996	594	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	WHEELER	1.7		1996	9	Annual R_BURN provided by B.Finneran ODEQ
Barley	barley	YAMHILL	1.7		1996	225	Annual R_BURN provided by B.Finneran ODEQ
	barley Total					**21,429**	
cereal grain; unspecified	corn; for grain	CLACKAMAS	4.2		1996	18	Annual R_BURN provided by B.Finneran ODEQ
cereal grain; unspecified	corn; for grain	GILLIAM	4.2		1996	36	Annual R_BURN provided by B.Finneran ODEQ
cereal grain; unspecified	corn; for grain	KLAMATH	4.2		1996	27	Annual R_BURN provided by B.Finneran ODEQ
cereal grain; unspecified	corn; for grain	LINN	4.2		1996	81	Annual R_BURN provided by B.Finneran ODEQ
cereal grain; unspecified	corn; for grain	MALHEUR	4.2		1996	2,700	Annual R_BURN provided by B.Finneran ODEQ
cereal grain; unspecified	corn; for grain	MARION	4.2		1996	153	Annual R_BURN provided by B.Finneran ODEQ
cereal grain; unspecified	corn; for grain	MORROW	4.2		1996	81	Annual R_BURN provided by B.Finneran ODEQ
cereal grain; unspecified	corn; for grain	UMATILLA	4.2		1996	1,971	Annual R_BURN provided by B.Finneran ODEQ
cereal grain; unspecified	corn; for grain	UNION	4.2		1996	36	Annual R_BURN provided by B.Finneran ODEQ
cereal grain; unspecified	corn; for grain	WASCO	4.2		1996	9	Annual R_BURN provided by B.Finneran ODEQ
	corn; for grain Total					**5,112**	
Oats	oats	CLACKAMAS	1.6		1996	288	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	DOUGLAS	1.6		1996	9	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	GILLIAM	1.6		1996	297	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	HARNEY	1.6		1996	18	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	KLAMATH	1.6		1996	999	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	LINN	1.6		1996	927	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	MALHEUR	1.6		1996	81	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	MARION	1.6		1996	3,645	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	POLK	1.6		1996	126	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	SHERMAN	1.6		1996	9	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	UMATILLA	1.6		1996	18	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	UNION	1.6		1996	45	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	WALLOWA	1.6		1996	36	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	WASCO	1.6		1996	18	Annual R_BURN provided by B.Finneran ODEQ
Oats	oats	YAMHILL	1.6		1996	1,386	Annual R_BURN provided by B.Finneran ODEQ

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
	oats Total					**7,902**	
grasses; unspecified (field burning)	seeds; unspecified	BENTON	2		1996	37,116	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (propaning)	seeds; unspecified	BENTON	2		1996	45	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (stack burning)	seeds; unspecified	BENTON	2		1996	1,728	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (field burning)	seeds; unspecified	CLACKAMAS	2		1996	9,270	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (propaning)	seeds; unspecified	CLACKAMAS	2		1996	252	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (stack burning)	seeds; unspecified	CLACKAMAS	2		1996	594	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (field burning)	seeds; unspecified	CROOK	2		1996	45	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (field burning)	seeds; unspecified	DOUGLAS	2		1996	351	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (field burning)	seeds; unspecified	HARNEY	2		1996	36	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (field burning)	seeds; unspecified	JEFFERSON	2		1996	46,899	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (field burning)	seeds; unspecified	LANE	2		1996	31,662	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (propaning)	seeds; unspecified	LANE	2		1996	9	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (stack burning)	seeds; unspecified	LANE	2		1996	2,430	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (field burning)	seeds; unspecified	LINN	2		1996	267,897	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (propaning)	seeds; unspecified	LINN	2		1996	1,566	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (stack burning)	seeds; unspecified	LINN	2		1996	4,266	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (field burning)	seeds; unspecified	MARION	2		1996	139,836	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (propaning)	seeds; unspecified	MARION	2		1996	873	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (stack burning)	seeds; unspecified	MARION	2		1996	14,004	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (field burning)	seeds; unspecified	POLK	2		1996	15,138	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (propaning)	seeds; unspecified	POLK	2		1996	36	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (stack burning)	seeds; unspecified	POLK	2		1996	11,016	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (field burning)	seeds; unspecified	UMATILLA	2		1996	1,863	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (field burning)	seeds; unspecified	UNION	2		1996	6,597	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (propaning)	seeds; unspecified	UNION	2		1996	378	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (stack burning)	seeds; unspecified	WASHINGTON	2		1996	45	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (field burning)	seeds; unspecified	YAMHILL	2		1996	12,906	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (propaning)	seeds; unspecified	YAMHILL	2		1996	45	Annual R_BURN provided by B.Finneran ODEQ
grasses; unspecified (stack burning)	seeds; unspecified	YAMHILL	2		1996	4,122	Annual R_BURN provided by B.Finneran ODEQ
	seeds; unspecified Total					**611,025**	
Wheat	wheat; all	BAKER	1.9		1996	1,998	Annual R_BURN provided by B.Finneran ODEQ
Wheat	wheat; all	CROOK	1.9		1996	342	Annual R_BURN provided by B.Finneran ODEQ
Wheat	wheat; all	DESCHUTES	1.9		1996	36	Annual R_BURN provided by B.Finneran ODEQ
Wheat	wheat; all	GILLIAM	1.9		1996	20,682	Annual R_BURN provided by B.Finneran ODEQ
Wheat	wheat; all	JACKSON	1.9		1996	8,829	Annual R_BURN provided by B.Finneran ODEQ
Wheat	wheat; all	JEFFERSON	1.9		1996	85,041	Annual R_BURN provided by B.Finneran ODEQ
Wheat	wheat; all	KLAMATH	1.9		1996	1,143	Annual R_BURN provided by B.Finneran ODEQ
Wheat	wheat; all	MALHEUR	1.9		1996	21,771	Annual R_BURN provided by B.Finneran ODEQ
Wheat	wheat; all	MORROW	1.9		1996	3,276	Annual R_BURN provided by B.Finneran ODEQ
Wheat	wheat; all	SHERMAN	1.9		1996	9,252	Annual R_BURN provided by B.Finneran ODEQ
Wheat	wheat; all	UMATILLA	1.9		1996	64,701	Annual R_BURN provided by B.Finneran ODEQ
Wheat	wheat; all	UNION	1.9		1996	10,179	Annual R_BURN provided by B.Finneran ODEQ
Wheat	wheat; all	WALLOWA	1.9		1996	1,683	Annual R_BURN provided by B.Finneran ODEQ

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
Wheat	wheat; all	WASCO	1.9		1996	15,822	Annual R_BURN provided by B.Finneran ODEQ
	wheat; all Total					**244,755**	
	Grand Total					**890,223**	

SOUTH_DAKOTA

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
barley	barley	Aurora	1.7	176	Avg	299	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Beadle	1.7	88	Avg	150	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Bon Homme	1.7	88	Avg	150	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Brookings	1.7	56	Avg	95	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Brown	1.7	968	Avg	1,646	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Brule	1.7	128	Avg	218	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Campbell	1.7	560	Avg	952	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Charles Mix	1.7	96	Avg	163	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Clark	1.7	64	Avg	109	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Codington	1.7	400	Avg	680	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Davison	1.7	60	Avg	102	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Day	1.7	528	Avg	898	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Deuel	1.7	80	Avg	136	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Douglas	1.7	88	Avg	150	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Edmunds	1.7	608	Avg	1,034	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Faulk	1.7	448	Avg	762	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Hand	1.7	432	Avg	734	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Hanson	1.7	64	Avg	109	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Hughes	1.7	88	Avg	150	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Hutchinson	1.7	48	Avg	82	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Hyde	1.7	208	Avg	354	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Jerauld	1.7	144	Avg	245	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Kingsbury	1.7	56	Avg	95	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Marshall	1.7	208	Avg	354	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	McPherson	1.7	816	Avg	1,387	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Miner	1.7	60	Avg	102	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Potter	1.7	416	Avg	707	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Roberts	1.7	656	Avg	1,115	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Sanborn	1.7	56	Avg	95	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Spink	1.7	224	Avg	381	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Turner	1.7	40	Avg	68	A_BURN based on gapfilling avg., 8.0% of AH are burned.
barley	barley	Walworth	1.7	376	Avg	639	A_BURN based on gapfilling avg., 8.0% of AH are burned.
	barley Total			**8,328**		**14,158**	

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
wheat; winter all	wheat; winter all	Aurora	1.9	1,492	Avg	2,834	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Beadle	1.9	2,584	Avg	4,910	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Bon Homme	1.9	380	Avg	722	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Brookings	1.9	94	Avg	178	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Brown	1.9	348	Avg	662	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Brule	1.9	2,564	Avg	4,872	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Buffalo	1.9	328	Avg	624	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Campbell	1.9	510	Avg	970	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Charles Mix	1.9	2,678	Avg	5,088	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Clark	1.9	728	Avg	1,384	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Clay	1.9	62	Avg	118	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Codington	1.9	124	Avg	236	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Davison	1.9	1,488	Avg	2,828	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Day	1.9	182	Avg	346	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Deuel	1.9	42	Avg	80	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Douglas	1.9	1,550	Avg	2,946	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Edmunds	1.9	722	Avg	1,372	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Faulk	1.9	858	Avg	1,630	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Grant	1.9	68	Avg	130	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Hamlin	1.9	120	Avg	228	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Hand	1.9	3,308	Avg	6,286	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Hanson	1.9	812	Avg	1,542	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Hughes	1.9	3,504	Avg	6,658	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Hutchinson	1.9	1,180	Avg	2,242	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Hyde	1.9	1,778	Avg	3,378	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Jerauld	1.9	1,004	Avg	1,908	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Kingsbury	1.9	890	Avg	1,692	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Lake	1.9	78	Avg	148	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Lincoln	1.9	52	Avg	98	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Marshall	1.9	162	Avg	308	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	McCook	1.9	72	Avg	136	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	McPherson	1.9	166	Avg	316	A_BURN based on gapfilling avg., 5.2% of AH are burned.

SOUTH_DAKOTA

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
wheat; winter all	wheat; winter all	Miner	1.9	162	Avg	308	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Minnehaha	1.9	10	Avg	20	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Moody	1.9	10	Avg	20	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Potter	1.9	3,812	Avg	7,242	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Roberts	1.9	20	Avg	38	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Sanborn	1.9	494	Avg	938	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Spink	1.9	2,116	Avg	4,020	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Sully	1.9	7,150	Avg	13,586	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Turner	1.9	16	Avg	30	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Union	1.9	26	Avg	50	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Walworth	1.9	500	Avg	950	A_BURN based on gapfilling avg., 5.2% of AH are burned.
wheat; winter all	wheat; winter all	Yankton	1.9	36	Avg	68	A_BURN based on gapfilling avg., 5.2% of AH are burned.
	wheat; winter all Total			**44,280**		**84,140**	
	Grand Total			**52,608**		**98,298**	

UTAH

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
barley	barley	Box Elder	1.7	1,476	1996	2,511	A_BURN provided by Veryl Peterson, NRCS
barley	barley	Cache	1.7	1,170	1996	1,998	A_BURN provided by Kerry Goodrich, NRCS
barley	barley	Weber	1.7	99	1996	162	A_BURN provided by Kerry Goodrich, NRCS
	barley Total			**2,745**		**4,671**	
ditches and fenceline	ditches and ditch banks-UT	Beaver	0.75	129	1996	97	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Box Elder	0.75	528	1996	396	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Cache	0.75	372	1996	279	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Carbon	0.75	27	1996	20	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Daggett	0.75	25	1996	19	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Davis	0.75	75	1996	56	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Duchesne	0.75	257	1996	193	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Emery	0.75	96	1996	72	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Garfield	0.75	67	1996	50	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Grand	0.75	13	1996	10	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Iron	0.75	245	1996	184	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Juab	0.75	91	1996	68	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Kane	0.75	14	1996	10	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Millard	0.75	424	1996	318	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Morgan	0.75	36	1996	27	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Piute	0.75	45	1996	34	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Rich	0.75	235	1996	177	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Salt Lake	0.75	46	1996	34	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	San Juan	0.75	28	1996	21	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Sanpete	0.75	250	1996	188	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Sevier	0.75	153	1996	115	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Summit	0.75	84	1996	63	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Tooele	0.75	61	1996	46	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Uintah	0.75	192	1996	144	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Utah	0.75	293	1996	219	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Wasatch	0.75	40	1996	30	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Washingon	0.75	46	1996	35	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Wayne	0.75	62	1996	46	A_BURN provided by Kerry Goodrich, NRCS
ditches and fenceline	ditches and ditch banks-UT	Weber	0.75	105	1996	79	A_BURN provided by Kerry Goodrich, NRCS
	ditches and ditch banks-UT Total			**4,040**		**3,030**	
orchard replacement	orchard removal	Box Elder	15	108	1996	1,620	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	Cache	15	6	1996	90	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	Carbon	15	3	1996	45	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	Davis	15	16	1996	225	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	Emery	15	2	1996	45	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches

UTAH

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
orchard replacement	orchard removal	Garfield	15	3	1996	45	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	Grand	15	3	1996	45	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	Iron	15	3	1996	60	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	Kane	15	6	1996	90	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	Salt Lake	15	6	1996	90	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	San Juan	15	3	1996	45	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	Utah	15	540	1996	8,100	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	Washington	15	30	1996	450	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	Wayne	15	6	1996	90	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
orchard replacement	orchard removal	Weber	15	15	1996	225	Annual A_BURN provided by K.Goodrich, NRCS (15,000/20years); distributed A_BURN over counties harvesting apples, cherries, peaches
	orchard removal Total			**750**		**11,265**	
wheat	wheat; all	Box Elder	1.9	7,560	1996	14,364	A_BURN provided by Veryl Peterson, NRCS
wheat	wheat; all	Cache	1.9	1,386	1996	2,637	A_BURN provided by Kerry Goodrich, NRCS
wheat	wheat; all	Weber	1.9	198	1996	378	A_BURN provided by Kerry Goodrich, NRCS
	wheat; all Total			**9,144**		**17,379**	
	Grand Total			**16,679**		**36,345**	

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
orchard (maintainence - no removal)	apples	Yakima	2.3	382	1999	879	Daily A_BURN provided in permit database from S.Nolph WDOE
	apples Total			**382**		**879**	
asparagus	asparagus	Franklin	1.5	14	1999	21	Daily A_BURN provided in permit database from S.Nolph WDOE
	asparagus Total			**14**		**21**	
buu - barley - unknown - unknown	barley	Adams	1.7	263	1999	446	Daily A_BURN provided in permit database from S.Nolph WDOE
bsu - barley - spring - unknown	barley	Columbia	1.7	5,509	1999	9,366	Daily A_BURN provided in permit database from S.Nolph WDOE
buu - barley - unknown - unknown	barley	Columbia	1.7	799	1999	1,358	Daily A_BURN provided in permit database from S.Nolph WDOE
bui - barley - unknown - irrigated	barley	Lincoln	1.7	195	1999	332	Daily A_BURN provided in permit database from S.Nolph WDOE
buu - barley - unknown - unknown	barley	Lincoln	1.7	45	1999	77	Daily A_BURN provided in permit database from S.Nolph WDOE
bwd - barley - winter - dryland	barley	Lincoln	1.7	20	1999	34	Daily A_BURN provided in permit database from S.Nolph WDOE
bsu - barley - spring - unknown	barley	Walla Walla	1.7	466	1999	792	Daily A_BURN provided in permit database from S.Nolph WDOE
buu - barley - unknown - unknown	barley	Walla Walla	1.7	200	1999	340	Daily A_BURN provided in permit database from S.Nolph WDOE
bsu - barley - spring - unknown	barley	Whitman	1.7	4,914	1999	8,354	Daily A_BURN provided in permit database from S.Nolph WDOE
buu - barley - unknown - unknown	barley	Whitman	1.7	201	1999	342	Daily A_BURN provided in permit database from S.Nolph WDOE
bwu - barley - winter - unknown	barley	Whitman	1.7	460	1999	782	Daily A_BURN provided in permit database from S.Nolph WDOE
	barley Total			**13,072**		**22,223**	
beans	beans; all dry edible	Grant	2.5	65	1999	163	Daily A_BURN provided in permit database from S.Nolph WDOE
legumes	beans; all dry edible	Lincoln	2.5	33	1999	83	Daily A_BURN provided in permit database from S.Nolph WDOE
	beans; all dry edible Total			**98**		**245**	
canola	canola	Lincoln	1.3	12	1999	16	Daily A_BURN provided in permit database from S.Nolph WDOE
	canola Total			**12**		**16**	
orchard (maintainence - no removal)	cherries	Yakima	1	88	1999	88	Daily A_BURN provided in permit database from S.Nolph WDOE
	cherries Total			**88**		**88**	
corn	corn; for grain	Franklin	4.2	312	1999	1,310	Daily A_BURN provided in permit database from S.Nolph WDOE
corn	corn; for grain	Franklin	4.2	476	1999	1,999	Daily A_BURN provided in permit database from S.Nolph WDOE
	corn; for grain Total			**788**		**3,310**	
crp - Conservation Reserve Program (CRP) conversion	CRP	Adams	2.6	9,573	1999	24,889	Daily A_BURN provided in permit database from S.Nolph WDOE
crp - Conservation Reserve Program (CRP) conversion	CRP	Asotin	2.6	1,347	1999	3,502	Daily A_BURN provided in permit database from S.Nolph WDOE
crp - Conservation Reserve Program (CRP) conversion	CRP	Columbia	2.6	3,366	1999	8,753	Daily A_BURN provided in permit database from S.Nolph WDOE
crp - Conservation Reserve Program (CRP) conversion	CRP	Douglas	2.6	4,490	1999	11,673	Daily A_BURN provided in permit database from S.Nolph WDOE
crp - Conservation Reserve Program (CRP) conversion	CRP	Franklin	2.6	1,342	1999	3,489	Daily A_BURN provided in permit database from S.Nolph WDOE
crp - Conservation Reserve Program (CRP) conversion	CRP	Garfield	2.6	193	1999	502	Daily A_BURN provided in permit database from S.Nolph WDOE
pasture	CRP	Garfield	2.6	40	1999	104	Daily A_BURN provided in permit database from S.Nolph WDOE
pasture	CRP	Grant	2.6	70	1999	182	Daily A_BURN provided in permit database from S.Nolph WDOE
crp - Conservation Reserve Program (CRP) conversion	CRP	Lincoln	2.6	5,062	1999	13,161	Daily A_BURN provided in permit database from S.Nolph WDOE
pasture	CRP	Lincoln	2.6	45	1999	117	Daily A_BURN provided in permit database from S.Nolph WDOE

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
crp - Conservation Reserve Program (CRP) conversion	CRP	Stevens	2.6	40	1999	104	Daily A_BURN provided in permit database from S.Nolph WDOE
crp - Conservation Reserve Program (CRP) conversion	CRP	Walla Walla	2.6	292	1999	759	Daily A_BURN provided in permit database from S.Nolph WDOE
crp - Conservation Reserve Program (CRP) conversion	CRP	Whitman	2.6	3,212	1999	8,352	Daily A_BURN provided in permit database from S.Nolph WDOE
pasture	CRP	Whitman	2.6	94	1999	244	Daily A_BURN provided in permit database from S.Nolph WDOE
pasture	CRP	Yakima	2.6	102	1999	265	Daily A_BURN provided in permit database from S.Nolph WDOE
	CRP Total			**29,268**		**76,096**	
berries - blueberries - raspberries - blackberries	fruits and vegetables; other	Franklin	1.47	3	1999	4	Daily A_BURN provided in permit database from S.Nolph WDOE
berries - blueberries - raspberries - blackberries	fruits and vegetables; other	Pierce	1.47	17	1999	24	Daily A_BURN provided in permit database from S.Nolph WDOE
onions	fruits and vegetables; other	Walla Walla	1.47	51	1999	75	Daily A_BURN provided in permit database from S.Nolph WDOE
	fruits and vegetables; other Total			**71**		**104**	
grapes	grapes	Yakima	2.5	205	1999	513	Daily A_BURN provided in permit database from S.Nolph WDOE
	grapes Total			**205**		**513**	
hau - hay - alfalfa - unknown	hay; alfalfa	Adams	0.8	55	1999	44	Daily A_BURN provided in permit database from S.Nolph WDOE
hai - hay - alfalfa - irrigated	hay; alfalfa	Grant	0.8	80	1999	64	Daily A_BURN provided in permit database from S.Nolph WDOE
hau - hay - alfalfa - unknown	hay; alfalfa	Grant	0.8	10	1999	8	Daily A_BURN provided in permit database from S.Nolph WDOE
hai - hay - alfalfa - irrigated	hay; alfalfa	Lincoln	0.8	58	1999	46	Daily A_BURN provided in permit database from S.Nolph WDOE
hau - hay - alfalfa - unknown	hay; alfalfa	Walla Walla	0.8	3,399	1999	2,719	Daily A_BURN provided in permit database from S.Nolph WDOE
	hay; alfalfa Total			**3,602**		**2,882**	
hti - hay - timothy - irrigated	hay; all other	Kittitas	0.8	51	1999	41	Daily A_BURN provided in permit database from S.Nolph WDOE
hui - hay - unknown - irrigated	hay; all other	Kittitas	0.8	120	1999	96	Daily A_BURN provided in permit database from S.Nolph WDOE
hud - hay - unknown - dryland	hay; all other	Lincoln	0.8	45	1999	36	Daily A_BURN provided in permit database from S.Nolph WDOE
htd - hay - timothy - dryland	hay; all other	Whitman	0.8	73	1999	58	Daily A_BURN provided in permit database from S.Nolph WDOE
huu - hay - unknown- unknown	hay; all other	Whitman	0.8	120	1999	96	Daily A_BURN provided in permit database from S.Nolph WDOE
	hay; all other Total			**409**		**327**	
hops	hops	Yakima	1.9	229	1999	435	Daily A_BURN provided in permit database from S.Nolph WDOE
	hops Total			**229**		**435**	
oats	oats	Columbia	1.6	628	1999	1,005	Daily A_BURN provided in permit database from S.Nolph WDOE
oats	oats	Franklin	1.6	10	1999	16	Daily A_BURN provided in permit database from S.Nolph WDOE
	oats Total			**638**		**1,021**	
christmas trees	orchard pruning; unspecifie	Pierce	1.7	270	1999	459	Daily A_BURN provided in permit database from S.Nolph WDOE
	orchard pruning; unspecified Total			**270**		**459**	
orchard tree removal	orchard removal	Chelan	15	232	1999	3,476	Daily A_BURN provided in permit database from S.Nolph WDOE
orchard tree removal	orchard removal	Douglas	15	394	1999	5,915	Daily A_BURN provided in permit database from S.Nolph WDOE
orchard tree removal	orchard removal	Franklin	15	90	1999	1,346	Daily A_BURN provided in permit database from S.Nolph WDOE
orchard tree removal	orchard removal	Garfield	15	40	1999	600	Daily A_BURN provided in permit database from S.Nolph WDOE
orchard tree removal	orchard removal	Grant	15	337	1999	5,052	Daily A_BURN provided in permit database from S.Nolph WDOE
orchard tree removal	orchard removal	Kittitas	15	20	1999	300	Daily A_BURN provided in permit database from S.Nolph WDOE

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
orchard tree removal	orchard removal	Okanogan	15	5	1999	72	Daily A_BURN provided in permit database from S.Nolph WDOE
orchard tree removal	orchard removal	Yakima	15	1,018	1999	15,263	Daily A_BURN provided in permit database from S.Nolph WDOE
	orchard removal Total			**2,135**		**32,024**	
orchard (maintainence - no removal)	peaches	Yakima	2.5	21	1999	52	Daily A_BURN provided in permit database from S.Nolph WDOE
	peaches Total			**21**		**52**	
orchard (maintainence - no removal)	pears	Yakima	2.6	152	1999	395	Daily A_BURN provided in permit database from S.Nolph WDOE
	pears Total			**152**		**395**	
peas	peas; dry edible	Walla Walla	2.5	50	1999	125	Daily A_BURN provided in permit database from S.Nolph WDOE
peas	peas; dry edible	Whitman	2.5	148	1999	370	Daily A_BURN provided in permit database from S.Nolph WDOE
	peas; dry edible Total			**198**		**495**	
orchard (maintainence - no removal)	plums and prunes	Yakima	1.2	6	1999	7	Daily A_BURN provided in permit database from S.Nolph WDOE
	plums and prunes Total			**6**		**7**	
hasi - hay - alfalfa seed - irrigated	seeds; alfalfa	Franklin	0.8	993	1999	794	Daily A_BURN provided in permit database from S.Nolph WDOE
hasi - hay - alfalfa seed - irrigated	seeds; alfalfa	Grant	0.8	326	1999	260	Daily A_BURN provided in permit database from S.Nolph WDOE
hasu - hay - alfalfa seed - unknown	seeds; alfalfa	Walla Walla	0.8	1,130	1999	904	Daily A_BURN provided in permit database from S.Nolph WDOE
	seeds; alfalfa Total			**2,449**		**1,959**	
gsbu - grass seed - bluegrass - unknown	seeds; KBG	Garfield	2	73	1999	146	Daily A_BURN provided in permit database from S.Nolph WDOE
gsbu - grass seed - bluegrass - unknown	seeds; KBG	Whitman	2	302	1999	604	Daily A_BURN provided in permit database from S.Nolph WDOE
	seeds; KBG Total			**375**		**750**	
gsbru - grass seed - brome - unknown	seeds; other	Columbia	2	62	1999	124	Daily A_BURN provided in permit database from S.Nolph WDOE
turnip - seed	seeds; other	Franklin	2	25	1999	50	Daily A_BURN provided in permit database from S.Nolph WDOE
turnip - seed	seeds; other	Grant	2	3	1999	6	Daily A_BURN provided in permit database from S.Nolph WDOE
gcd - grass cover - dryland	seeds; other	Klickitat	2	107	1999	214	Daily A_BURN provided in permit database from S.Nolph WDOE
	seeds; other Total			**197**		**394**	
gsuu - grass seed - unknown - unknown	seeds; unspecified	Columbia	2	64	1999	128	Daily A_BURN provided in permit database from S.Nolph WDOE
gsuu - grass seed - unknown - unknown	seeds; unspecified	Garfield	2	20	1999	40	Daily A_BURN provided in permit database from S.Nolph WDOE
gsuu - grass seed - unknown - unknown	seeds; unspecified	Walla Walla	2	59	1999	118	Daily A_BURN provided in permit database from S.Nolph WDOE
gsuu - grass seed - unknown - unknown	seeds; unspecified	Whitman	2	128	1999	256	Daily A_BURN provided in permit database from S.Nolph WDOE
	seeds; unspecified Total			**271**		**542**	
spot burning	unspecified	Adams		298	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
spot burning	unspecified	Asotin		60	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
CAUTION: not listed on internal permit	unspecified	Columbia		44	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
CAUTION: not listed on outside permit	unspecified	Columbia		500	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
spot burning	unspecified	Columbia		55	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
spot burning	unspecified	Douglas		4	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
CAUTION: not listed on internal permit	unspecified	Grant		105	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
CAUTION: not listed on outside permit	unspecified	Grant		24	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
spot burning	unspecified	Grant		25	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
spot burning	unspecified	Lincoln		63	1999		Daily A_BURN provided in permit database from S.Nolph WDOE

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
CAUTION: not listed on outside permit	unspecified	Snohomish		11	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
CAUTION: not listed on internal permit	unspecified	Walla Walla		280	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
CAUTION: not listed on outside permit	unspecified	Walla Walla		350	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
spot burning	unspecified	Whatcom		10	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
CAUTION: not listed on internal permit	unspecified	Whitman		581	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
CAUTION: not listed on outside permit	unspecified	Whitman		375	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
spot burning	unspecified	Whitman		3,395	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
spot burning	unspecified	Yakima		853	1999		Daily A_BURN provided in permit database from S.Nolph WDOE
	unspecified Total			**7,032**		**-**	
wsu - wheat - spring - unknown	wheat; other spring	Adams	1.9	52	1999	99	Daily A_BURN provided in permit database from S.Nolph WDOE
wsd - wheat - spring - dryland	wheat; other spring	Asotin	1.9	99	1999	188	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - spring - unknown	wheat; other spring	Columbia	1.9	1,717	1999	3,262	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - spring - unknown	wheat; other spring	Douglas	1.9	903	1999	1,716	Daily A_BURN provided in permit database from S.Nolph WDOE
wsi - wheat - spring - irrigated	wheat; other spring	Franklin	1.9	3,591	1999	6,823	Daily A_BURN provided in permit database from S.Nolph WDOE
wsi - wheat - spring - irrigated	wheat; other spring	Grant	1.9	1,613	1999	3,065	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - spring - unknown	wheat; other spring	Grant	1.9	743	1999	1,412	Daily A_BURN provided in permit database from S.Nolph WDOE
wsd - wheat - spring - dryland	wheat; other spring	Lincoln	1.9	105	1999	200	Daily A_BURN provided in permit database from S.Nolph WDOE
wsi - wheat - spring - irrigated	wheat; other spring	Lincoln	1.9	457	1999	868	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - spring - unknown	wheat; other spring	Lincoln	1.9	189	1999	359	Daily A_BURN provided in permit database from S.Nolph WDOE
wsd - wheat - spring - dryland	wheat; other spring	Walla Walla	1.9	90	1999	171	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - spring - unknown	wheat; other spring	Walla Walla	1.9	355	1999	675	Daily A_BURN provided in permit database from S.Nolph WDOE
wsi - wheat - spring - irrigated	wheat; other spring	Whitman	1.9	293	1999	557	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - spring - unknown	wheat; other spring	Whitman	1.9	23,017	1999	43,732	Daily A_BURN provided in permit database from S.Nolph WDOE
	wheat; other spring Total			**33,224**		**63,125**	
wsu - wheat - unknown - unknown	wheat; unspecified	Adams	1.9	2,219	1999	4,216	Daily A_BURN provided in permit database from S.Nolph WDOE
wsd - wheat - unknown - dryland	wheat; unspecified	Asotin	1.9	70	1999	133	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - unknown - unknown	wheat; unspecified	Asotin	1.9	773	1999	1,468	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - unknown - unknown	wheat; unspecified	Columbia	1.9	1,488	1999	2,827	Daily A_BURN provided in permit database from S.Nolph WDOE
wsd - wheat - unknown - dryland	wheat; unspecified	Douglas	1.9	1,183	1999	2,248	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - unknown - unknown	wheat; unspecified	Douglas	1.9	1,454	1999	2,762	Daily A_BURN provided in permit database from S.Nolph WDOE
wsi - wheat - unknown - irrigated	wheat; unspecified	Franklin	1.9	948	1999	1,801	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - unknown - unknown	wheat; unspecified	Franklin	1.9	40	1999	76	Daily A_BURN provided in permit database from S.Nolph WDOE
pre-6/2/1999 value - wheat - dryland	wheat; unspecified	Grant	1.9	1,081	1999	2,054	Daily A_BURN provided in permit database from S.Nolph WDOE
pre-6/2/1999 value - wheat - irrigated	wheat; unspecified	Grant	1.9	65	1999	124	Daily A_BURN provided in permit database from S.Nolph WDOE
wsi - wheat - unknown - irrigated	wheat; unspecified	Grant	1.9	20	1999	38	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - unknown - unknown	wheat; unspecified	Grant	1.9	763	1999	1,450	Daily A_BURN provided in permit database from S.Nolph WDOE
wsi - wheat - unknown - irrigated	wheat; unspecified	Lincoln	1.9	25	1999	48	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - unknown - unknown	wheat; unspecified	Lincoln	1.9	170	1999	323	Daily A_BURN provided in permit database from S.Nolph WDOE

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
pre-6/2/1999 value - wheat - dryland	wheat; unspecified	Okanogan	1.9	10	1999	19	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - unknown - unknown	wheat; unspecified	Walla Walla	1.9	1,973	1999	3,749	Daily A_BURN provided in permit database from S.Nolph WDOE
pre-6/2/1999 value - wheat - dryland	wheat; unspecified	Whitman	1.9	2,450	1999	4,655	Daily A_BURN provided in permit database from S.Nolph WDOE
wsi - wheat - unknown - irrigated	wheat; unspecified	Whitman	1.9	80	1999	152	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - unknown - unknown	wheat; unspecified	Whitman	1.9	10,426	1999	19,808	Daily A_BURN provided in permit database from S.Nolph WDOE
wsu - wheat - unknown - unknown	wheat; unspecified	Yakima	1.9	90	1999	171	Daily A_BURN provided in permit database from S.Nolph WDOE
	wheat; unspecified Total			**25,327**		**48,121**	
wwu - wheat - winter - unknown	wheat; winter all	Adams	1.9	573	1999	1,089	Daily A_BURN provided in permit database from S.Nolph WDOE
wwd - wheat - winter - dryland	wheat; winter all	Asotin	1.9	148	1999	280	Daily A_BURN provided in permit database from S.Nolph WDOE
wwu - wheat - winter - unknown	wheat; winter all	Asotin	1.9	453	1999	860	Daily A_BURN provided in permit database from S.Nolph WDOE
wwi - wheat - winter - irrigated	wheat; winter all	Columbia	1.9	110	1999	209	Daily A_BURN provided in permit database from S.Nolph WDOE
wwu - wheat - winter - unknown	wheat; winter all	Columbia	1.9	44,672	1999	84,877	Daily A_BURN provided in permit database from S.Nolph WDOE
wwi - wheat - winter - irrigated	wheat; winter all	Douglas	1.9	115	1999	219	Daily A_BURN provided in permit database from S.Nolph WDOE
wwi - wheat - winter - irrigated	wheat; winter all	Franklin	1.9	1,809	1999	3,437	Daily A_BURN provided in permit database from S.Nolph WDOE
wwu - wheat - winter - unknown	wheat; winter all	Garfield	1.9	288	1999	546	Daily A_BURN provided in permit database from S.Nolph WDOE
wwi - wheat - winter - irrigated	wheat; winter all	Grant	1.9	2,061	1999	3,916	Daily A_BURN provided in permit database from S.Nolph WDOE
wwu - wheat - winter - unknown	wheat; winter all	Grant	1.9	254	1999	483	Daily A_BURN provided in permit database from S.Nolph WDOE
wwd - wheat - winter - dryland	wheat; winter all	Lincoln	1.9	11,980	1999	22,761	Daily A_BURN provided in permit database from S.Nolph WDOE
wwi - wheat - winter - irrigated	wheat; winter all	Lincoln	1.9	1,813	1999	3,445	Daily A_BURN provided in permit database from S.Nolph WDOE
wwu - wheat - winter - unknown	wheat; winter all	Lincoln	1.9	125	1999	238	Daily A_BURN provided in permit database from S.Nolph WDOE
wwd - wheat - winter - dryland	wheat; winter all	Walla Walla	1.9	90	1999	171	Daily A_BURN provided in permit database from S.Nolph WDOE
wwu - wheat - winter - unknown	wheat; winter all	Walla Walla	1.9	792	1999	1,505	Daily A_BURN provided in permit database from S.Nolph WDOE
wwu - wheat - winter - unknown	wheat; winter all	Whatcom	1.9	60	1999	114	Daily A_BURN provided in permit database from S.Nolph WDOE
wwi - wheat - winter - irrigated	wheat; winter all	Whitman	1.9	85	1999	162	Daily A_BURN provided in permit database from S.Nolph WDOE
wwu - wheat - winter - unknown	wheat; winter all	Whitman	1.9	52,399	1999	99,559	Daily A_BURN provided in permit database from S.Nolph WDOE
	wheat; winter all Total			**117,825**		**223,868**	
	Grand Total			**238,356**		**480,349**	

WYOMING

Residue Name	Crop Name	County	RL (tons/acre)	A_BURN (acres)	Year Burned	R_BURN (tons)	Comments
barley	barley	Fremont	1.7	1,800	1998	3,060	A_BURN from WESTAR, 1999 (from Ron Cunningham, Coop Ext. Service)
	barley Total			**1,800**		**3,060**	
seeds; alfalfa	seeds; alfalfa	Big Horn	0.8	8,994	1998	7,195	WESTAR, 1999 (from Fred Hopkin, Pres., WY Alfalfa Seed & Leaf Cutter Bee Asssn.
seeds; alfalfa	seeds; alfalfa	Hot Springs	0.8	99	1998	79	WESTAR, 1999 (from Fred Hopkin, Pres., WY Alfalfa Seed & Leaf Cutter Bee Asssn.
seeds; alfalfa	seeds; alfalfa	Park	0.8	2,907	1998	2,326	WESTAR, 1999 (from Fred Hopkin, Pres., WY Alfalfa Seed & Leaf Cutter Bee Asssn.
	seeds; alfalfa Total			**12,000**		**9,600**	
seeds; other	seeds; other	Park	2	1,000	1998	2,000	A_BURN from WESTAR, 1999 (from Kelly Spiering)
	seeds; other Total			**1,000**		**2,000**	
	Grand Total			**14,800**		**14,660**	

State	Wheat			
	AH	A_BURN	Average	Comments
AZ	178,000	8,080	4.5%	A_BURN for Yuma Co.
CA	688,000	117,794	17.1%	A_BURN counties: Imperial, Colusa, Kern, Kings, Fresno, Madera, Merced, San Joaquin, Stanislaus, Tulare.
CO	2,268,000	500	0.0%	A_BURN for Mesa Co.
ID	1,560,000	197,900	12.7%	
MT	6,360,000	2,650	0.0%	est. of 1% of irrigated wheat is burned
ND	12,515,000	215,862	1.7%	A_BURN based on gap filling
NM	110,000	4,364	4.0%	A_BURN based on gap filling
OR	920,000	128,816	14.0%	
SD	3,854,000	44,280	1.1%	A_BURN based on gap filling (winter wheat, only)
UT	185,000	9,144	4.9%	
WA	2,745,000	176,366	6.4%	
WY	236,000	-	0.0%	None burned
otal or Average	**31,619,000**	**905,756**	**2.9%**	

State	Barley			
	AH	A_BURN	Average	Comments
AK	6,900	0	0.0%	None burned
AZ	54,000	-	0.0%	None burned
CA	109,000	523	0.5%	A_BURN counties: Fresno, Tulare, Merced, Stanislaus, Kings, San Joaquin, Kern
CO	92,000	-	0.0%	None burned
ID	730,000	98,790	13.5%	
MT	1,150,000	-	0.0%	None burned
ND	2,600,000	-	0.0%	None burned
OR	150,000	12,614	8.4%	
SD	145,000	8,328	5.7%	A_BURN based on gap filling
UT	100,000	2,745	2.7%	
WA	440,000	13,072	3.0%	
WY	120,000	1,800	1.5%	
otal or Average	**5,696,900**	**137,872**	**2.4%**	

State	Sugarcane			
	AH	A_BURN	Average	Comments
HI	42,900	30,000	69.9%	
otal or Average	**42,900**	**30,000**	**69.9%**	Only HI burns

State	Corn (for grain)			
	AH	A_BURN	Average	Comments
AZ	40,000	-	0.0%	None burned
CA	220,000	8,663	3.9%	Glenn, Sacramento, Tehama, Yolo, San Joaquin,
CO	890,000	-	0.0%	None burned
ID	40,000	-	0.0%	None burned
MT	15,000	-	0.0%	None burned
ND	600,000	-	0.0%	None burned
NM	84,000	-	0.0%	None burned

OR	37,000	1,217	3.3%	
SD	3,650,000	-	0.0%	None burned
UT	20,000	-	0.0%	None burned
WA	120,000	788	0.7%	
WY	50,000	-	0.0%	None burned
otal or Average	**5,766,000**	**10,668**	**0.2%**	

State	Ditches and Ditchbanks	
	A_BURN	Comments
AZ	765	Yuma and Pinal counties
CA	7,988	Butte, Colusa, Fresno, Glenn, Madera, Merced, Placer, Sacramento, Sutter, Tehama, Tulare, Yuba counties
ID	50,000	
UT	4,040	Estimated based on 1% of irrigated crop land
otal or Average	**62,793**	

State	Conservation Reserve Program (CRP)			
	Acres in CRP in 1996	A_BURN	Average	Comments
CA	2,400	-	0.0%	None burned
CO	2,080	-	0.0%	None burned
ID	3,229	-	0.0%	None burned
MT	33,037	-	0.0%	None burned
ND	19,180	-	0.0%	None burned
NM	3,425	-	0.0%	None burned
OR	13	-	0.0%	None burned
SD	8,071	-	0.0%	None burned
WA	214,073	28,917	13.5%	
WY	666	-	0.0%	None burned
otal or Average	**286,174**	**28,917**	**10.1%**	Only WA burned in 1996

State	Orchards (includes trees, bushes, vines)			
	AH	A_BURN	Average	Comments
AZ	45,240	-	0.0%	None burned
CA	2,097,734	523,269	24.9%	A_BURN counties include:Butte, Colusa, Sacramento, Sutter, Tehama, Placer, Yolo, Lake, Riverside, San Bernardino, Fresno, Kern, Kings, Madera, Merced, San Joaquin, Stanislaus, Tulare
HI	20,200	-	0.0%	None burned
NM	24,380	-	0.0%	None burned
OR	65,197	-	0.0%	None burned
UT	9,484	-	0.0%	None burned
WA	235,532	6,831	2.9%	
otal or Average	**2,497,767**	**530,100**	**21.2%**	

State	Rice			
	AH	A_BURN	Average	Comments

CA	500,000	254,706	50.9%	A_BURN counties include: Butte, Colusa, Glenn, Placer, Sacramento, Sutter, Tehama, Yolo, Yuba, Fresno, Merced Stanislaus, San Joaquin
otal or Average	**500,000**	**254,706**	**50.9%**	

State	**Grasses and Seeds**			
	AH	A_BURN	Average	Comments
AZ	6,223	4,700	75.5%	A_BURN (bermuda) includes Yuma Co.
CA	131,298	28,299	21.6%	A_BURN counties include: Imperial (bermuda and sudan); Butte, Colusa, Placer, Tehama, Sacramento (grasses, sudan); Tulare (grasses)
CO	8,111	-	0.0%	None burned
ID	81,635	58,376	71.5%	alfalfa seed, KBG burned
MT	22,346	-	0.0%	None burned
NV				Burning occurs, but no A_BURN data are available
OR	541,509	286,410	52.9%	A_BURN includes field burning and propaning; does not include stack burning (~ 38,200 tons/year)
SD	25,036	-	0.0%	None burned
UT	7,132	-	0.0%	None burned
WA	71,993	3,292	4.6%	alfalfa seed, KBG, other burned
WY	4,693	13,000	277.0%	AH<A_BURN
otal or Average	**899,976**	**394,077**	**43.8%**	

Notes: AH = Acres Harvested
A_BURN = Acres Burned
Average = A_BURN/AH for each state
Total or Average = Total AH or A_BURN; or (Total A_BURN)/(Total AH) for each crop

Averages **do not include Nevada** since burned data were not reported for that state on a crop-specific basis.

**Gapfilling averages use data from areas where burning is known to occur.
Acres harvested include crop production in areas where burning occurs
and excludes states and counties (CA, only) where burning does not occur.
For example, WY produces wheat (236,000 acres harvested statewide in 1996);
however, WY data are not included in the gapfilling average calculation
since they do not burn wheat stubble.**

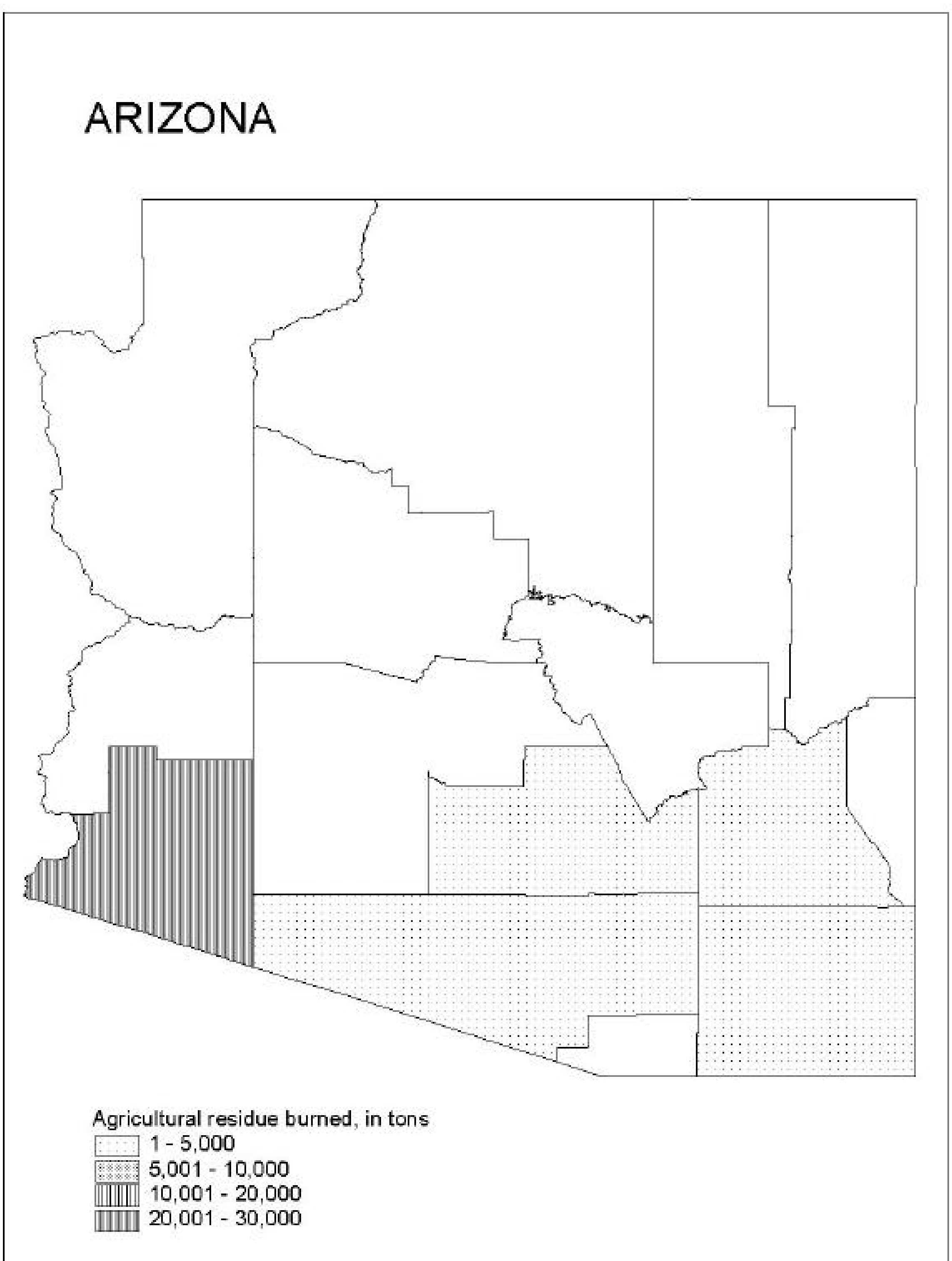
State/County	**Wheat**			
	AH	A_BURN	Average	Comments
AZ	50,000	8,080	16.2%	Yuma Co.
CA_Imperial	113,000	71,795	63.5%	
CA_Sac_Valley	195,500	16,926	8.7%	
CA_SJV	263,000	29,073	11.1%	
CO	3,000	500	16.7%	Mesa Co.
ID	1,560,000	197,900	12.7%	
MT	6,360,000	2,650	0.0%	est. of 1% of irrigated wheat is burned
ND				No data available
NM				No data available
NV				No data available
OR	920,000	128,816	14.0%	
SD				No data available
UT	185,000	9,144	4.9%	
WA	2,745,000	176,366	6.4%	
Total or Average	**12,394,500**	**641,250**	**5.2%**	

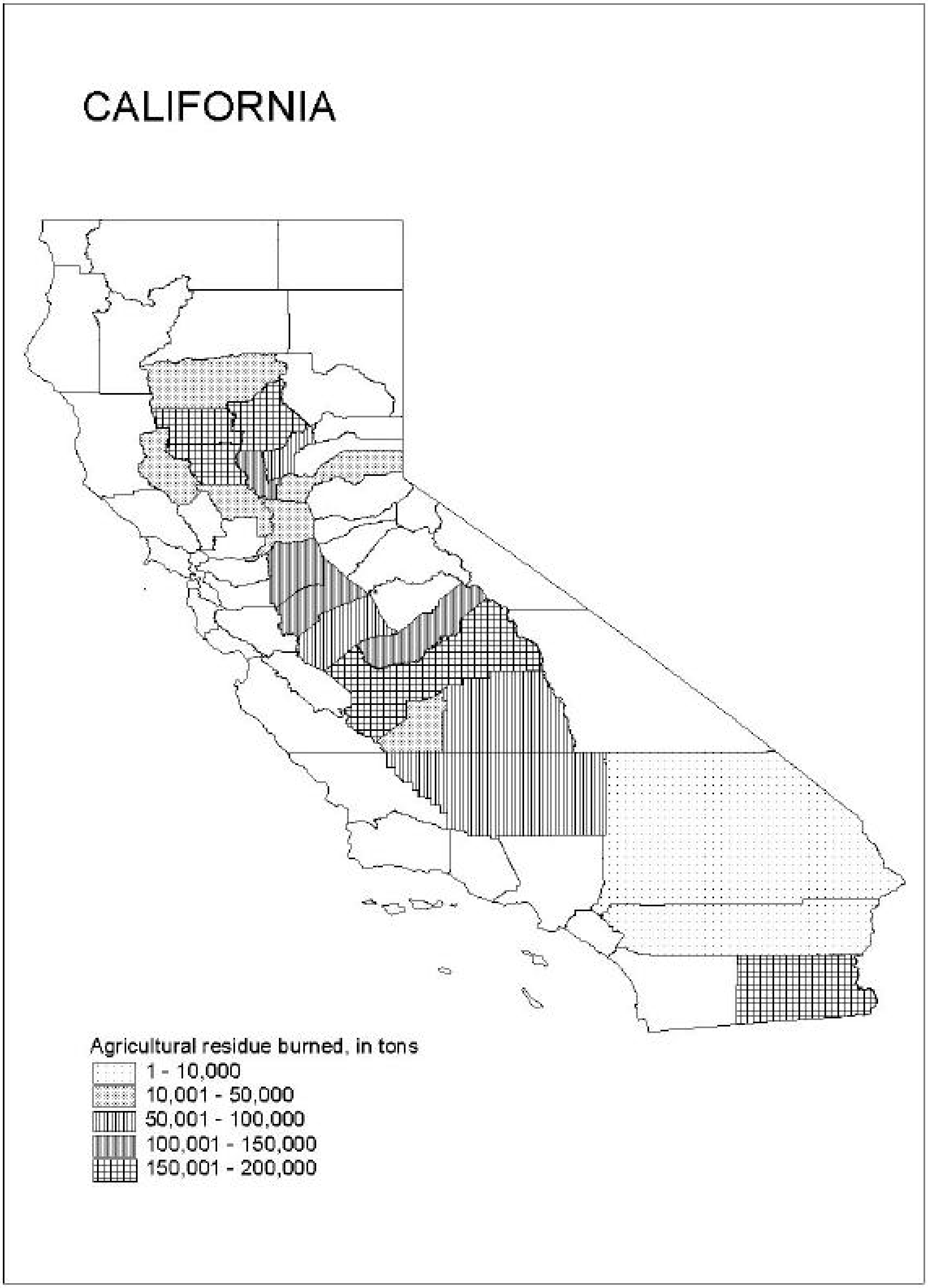
State/County	**Barley**			
	AH	A_BURN	Average	Comments
AZ				None burned
CA_Imperial				None burned
CA_Lake				None burned
CA_Sac_Valley				None burned
CA_So_Coast				None burned
CA_SJV	85,000	523	0.6%	1996 AH; 1999 burn data
CO				None burned
HI				None burned
ID	730,000	98,790	13.5%	
MT				None burned
ND				None burned
NM				None burned
OR	150,000	12,614	8.4%	
SD				No data available
UT	100,000	2,745	2.7%	
WA	440,000	13,072	3.0%	
WY	120,000	1,800	1.5%	
Total or Average	**1,625,000**	**129,544**	**8.0%**	

AH = Acres Harvested
A_BURN = Acres Burned
Average = A_BURN/AH for each state/county
ALL_AVG_%BURN = (sum of A_BURN)/(sum of AH)

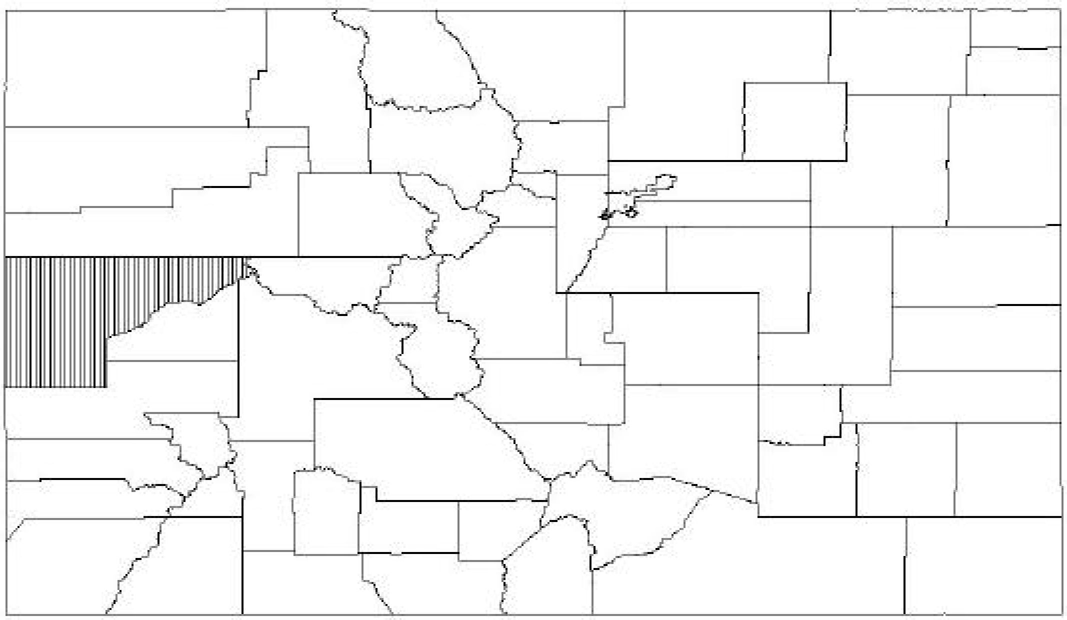
APPENDIX D

AGRICULTURAL RESIDUE BURN ACTIVITY MAPS

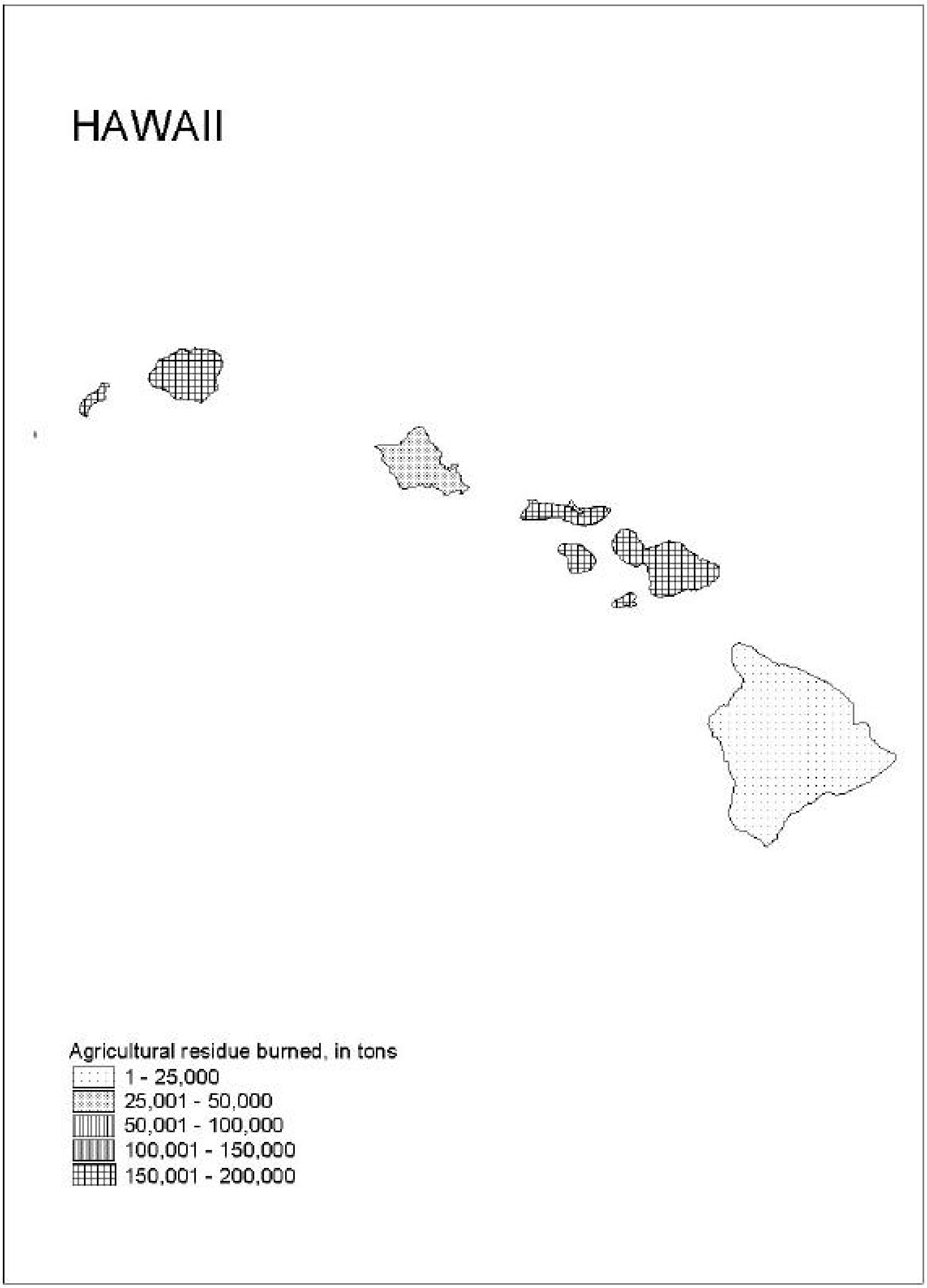

ARIZONA
Agricultural residue burned, in tons
1 - 5,000
5,001 - 10,000
10,001 - 20,000
20,001 - 30,000

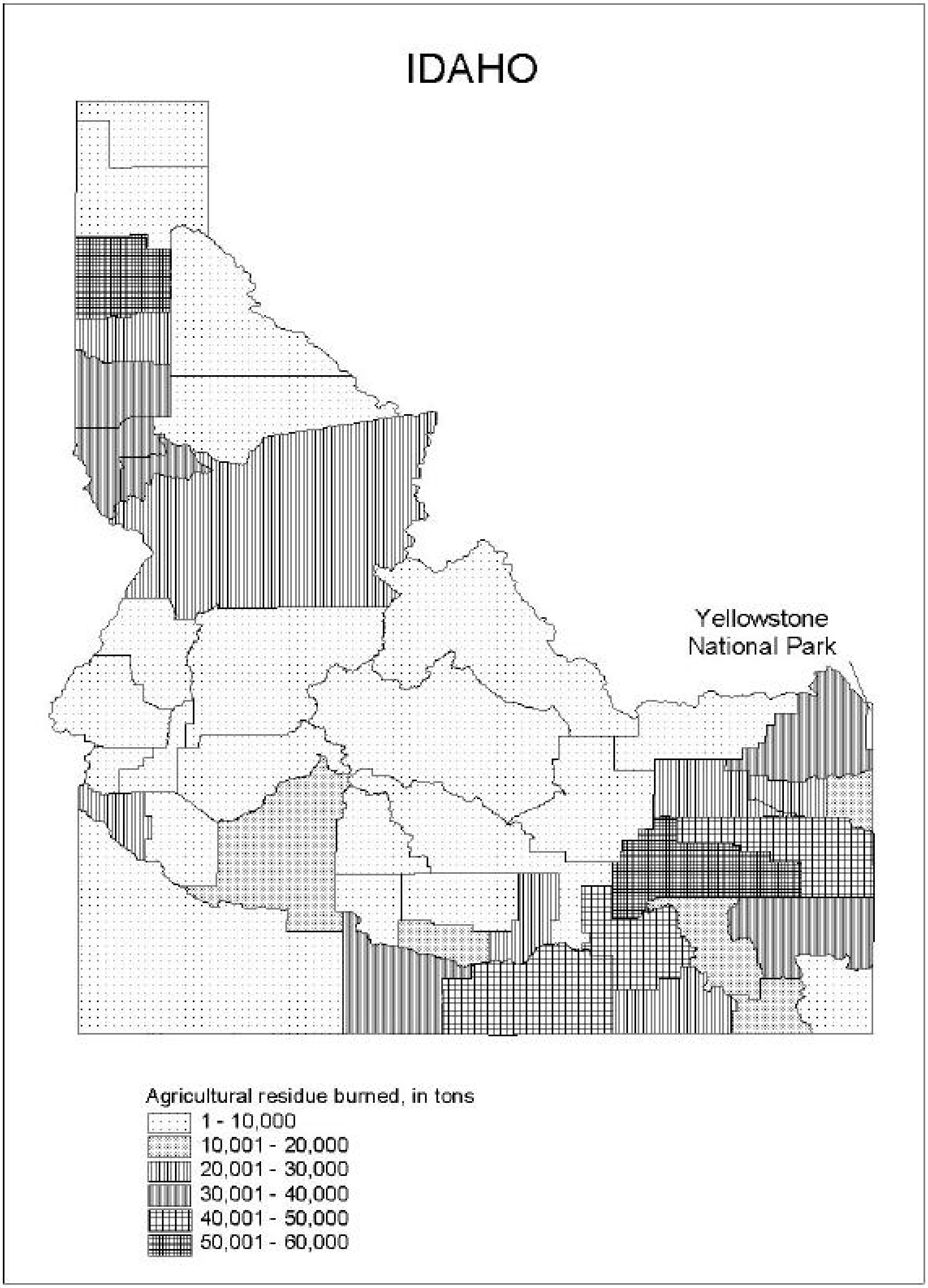

CALIFORNIA
Agricultural residue burned, in tons
1 - 10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 150,000
150,001 - 200,000

COLORADO

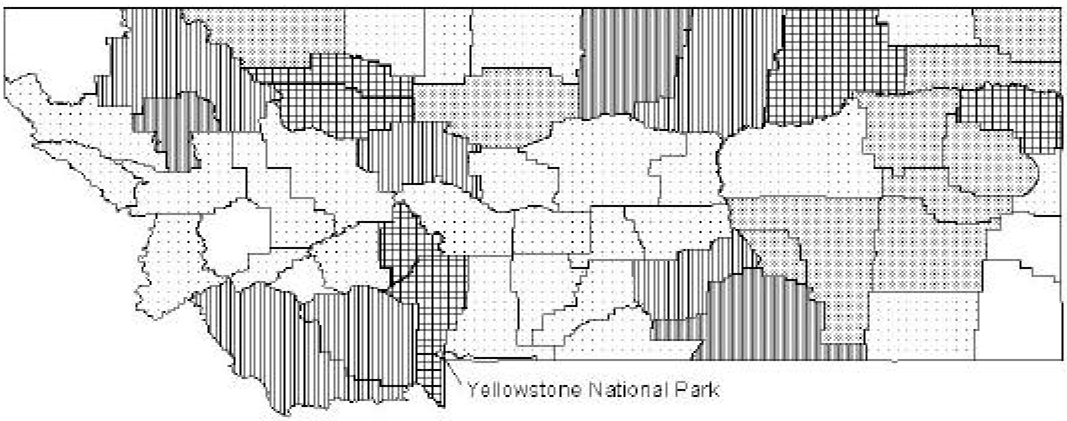


Agricultural residue burned, in tons
1 - 1,000
1,001 - 2,000
2,001 - 3,000
3,001 - 4,000

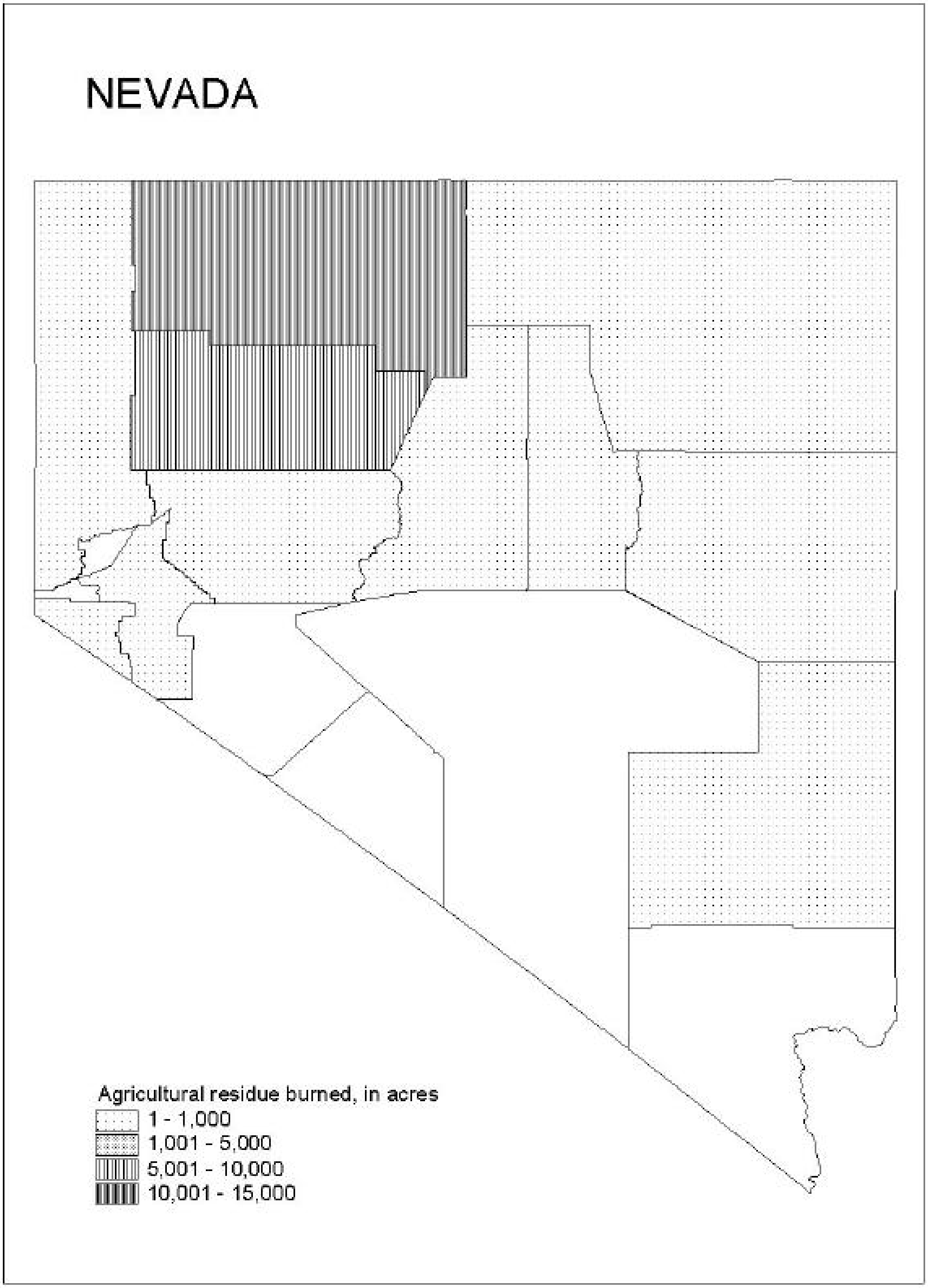

HAWAII
Agricultural residue burned, in tons
1 - 25,000
25,001 - 50,000
50,001 - 100,000
100,001 - 150,000
150,001 - 200,000

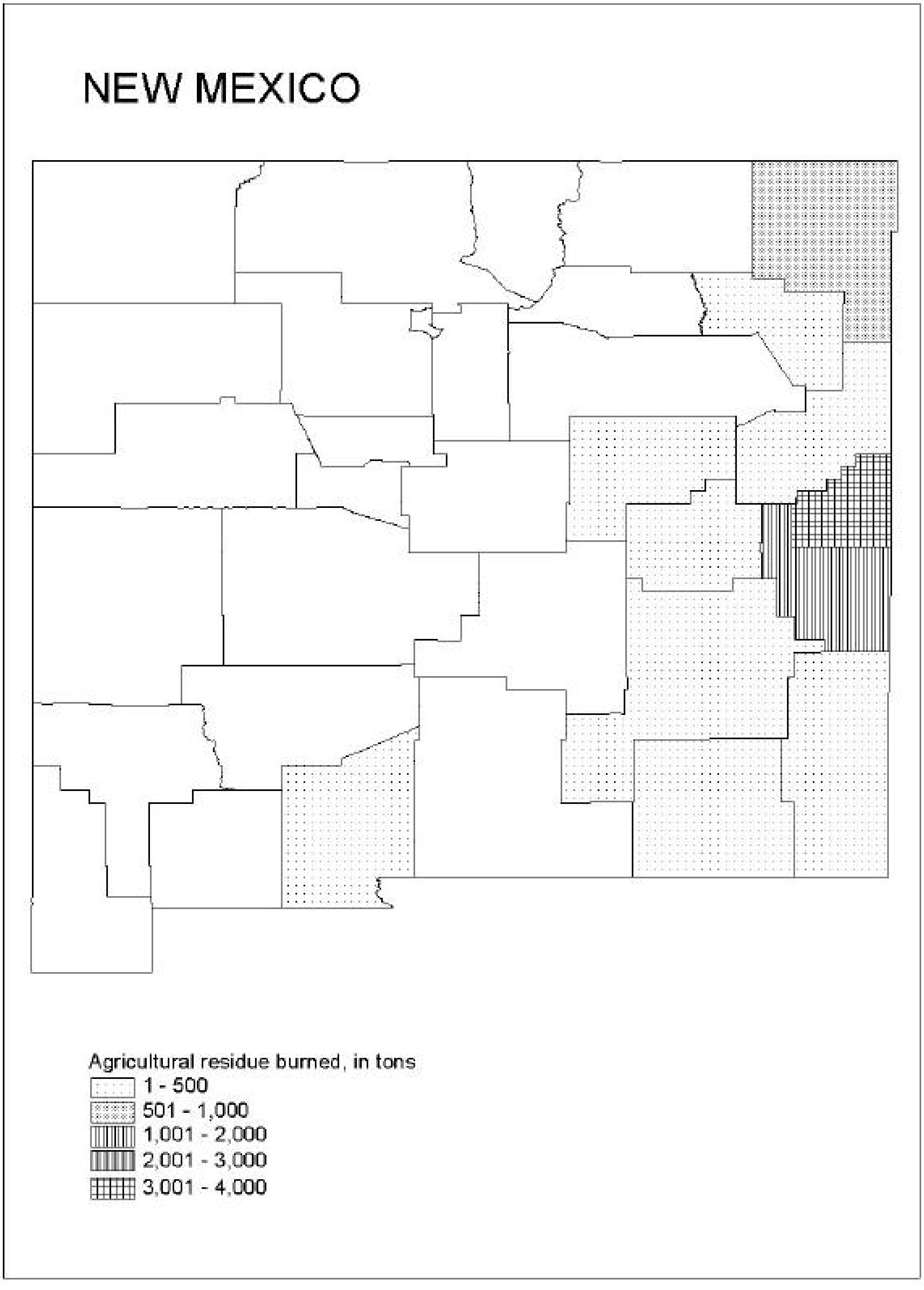

IDAHO
Yellowstone National Park
Agricultural residue burned, in tons
1 - 10,000
10,001 - 20,000
20,001 - 30,000
30,001 - 40,000
40,001 - 50,000
50,001 - 60,000

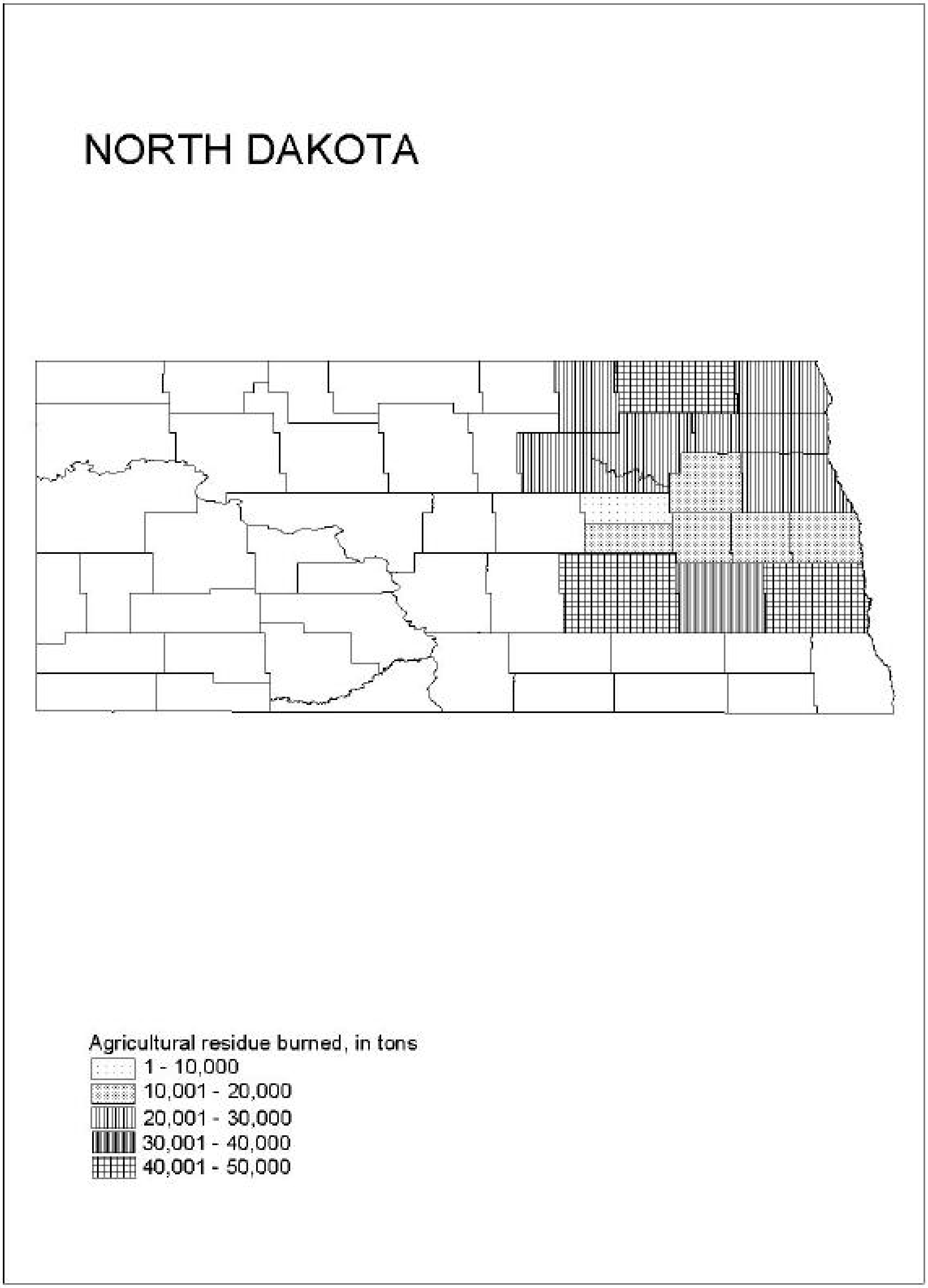
MONTANA

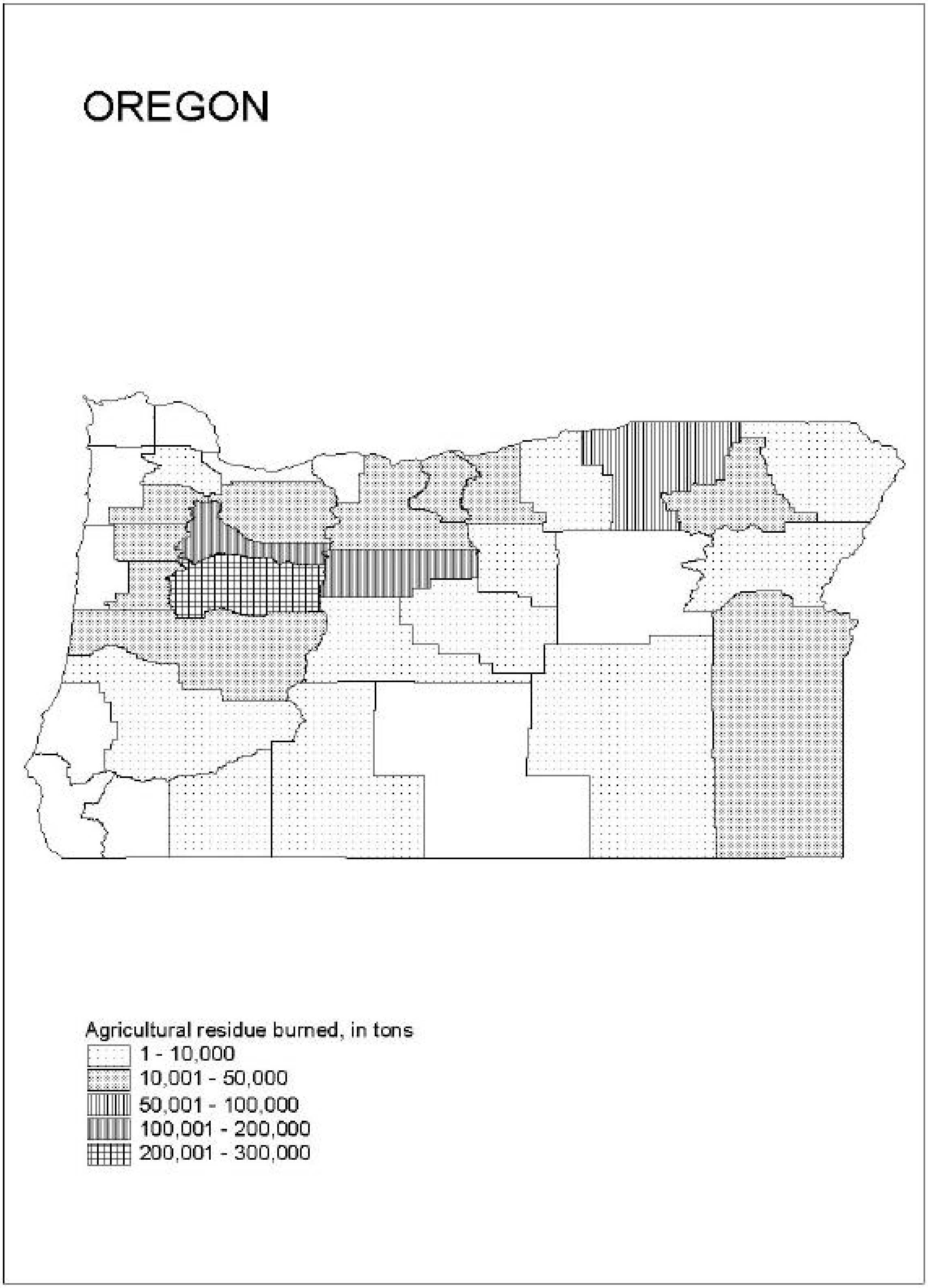


Agricultural residue burned, in tons
- 1 - 50
- 51 - 100
- 101 - 200
- 201 - 300
- 301 - 400

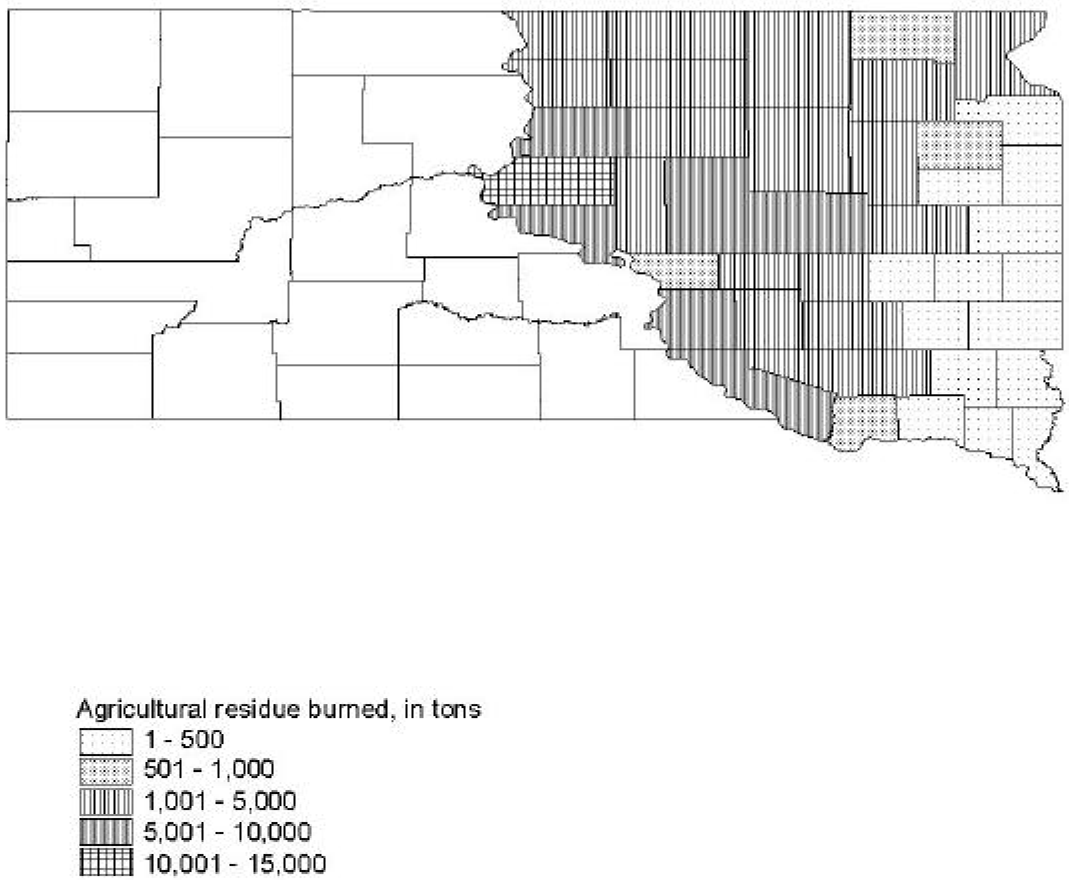

NEVADA
Agricultural residue burned, in acres
1 - 1,000
1,001 - 5,000
5,001 - 10,000
10,001 - 15,000

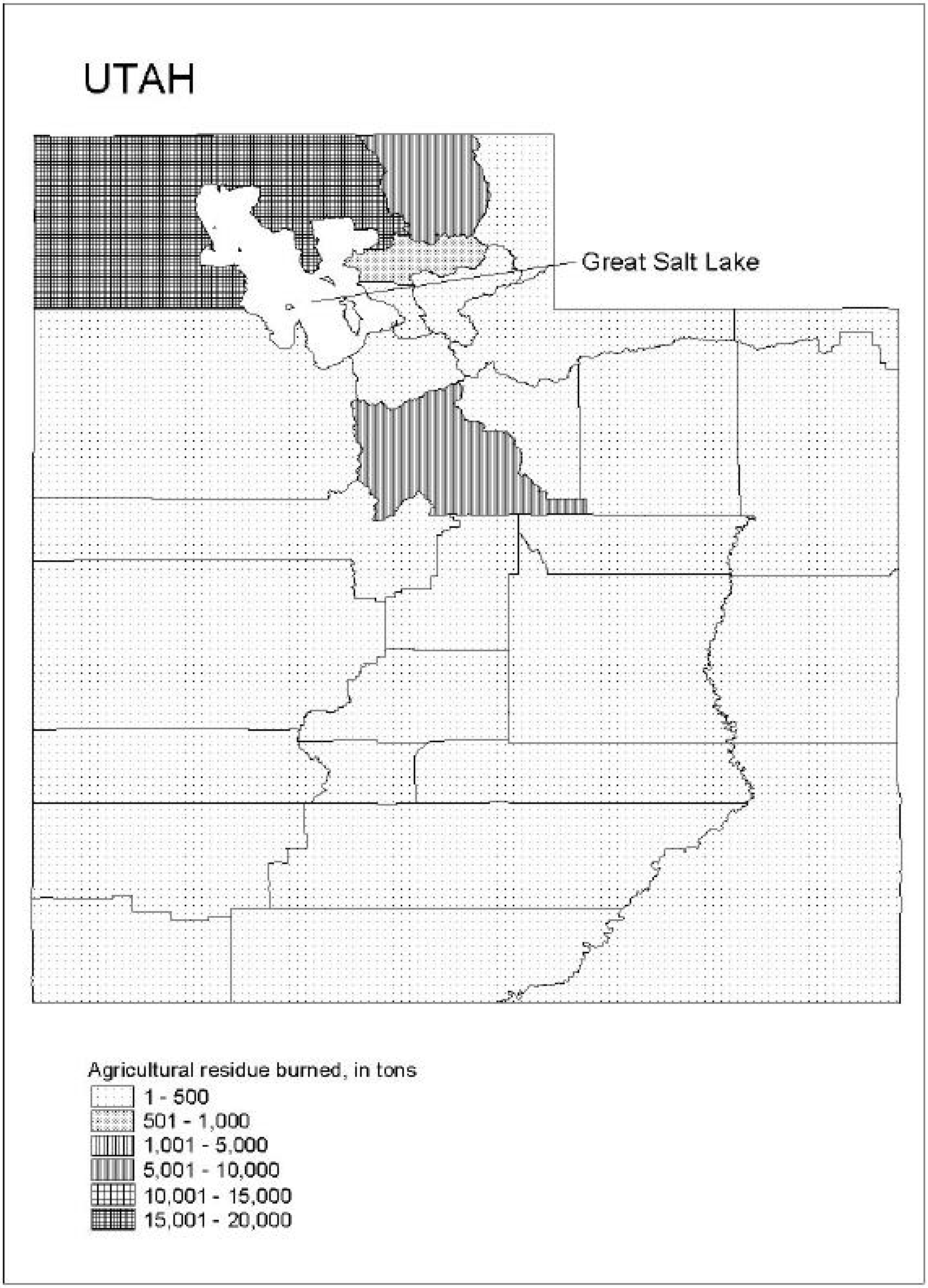

NEW MEXICO
Agricultural residue burned, in tons
1 - 500
501 - 1,000
1,001 - 2,000
2,001 - 3,000
3,001 - 4,000

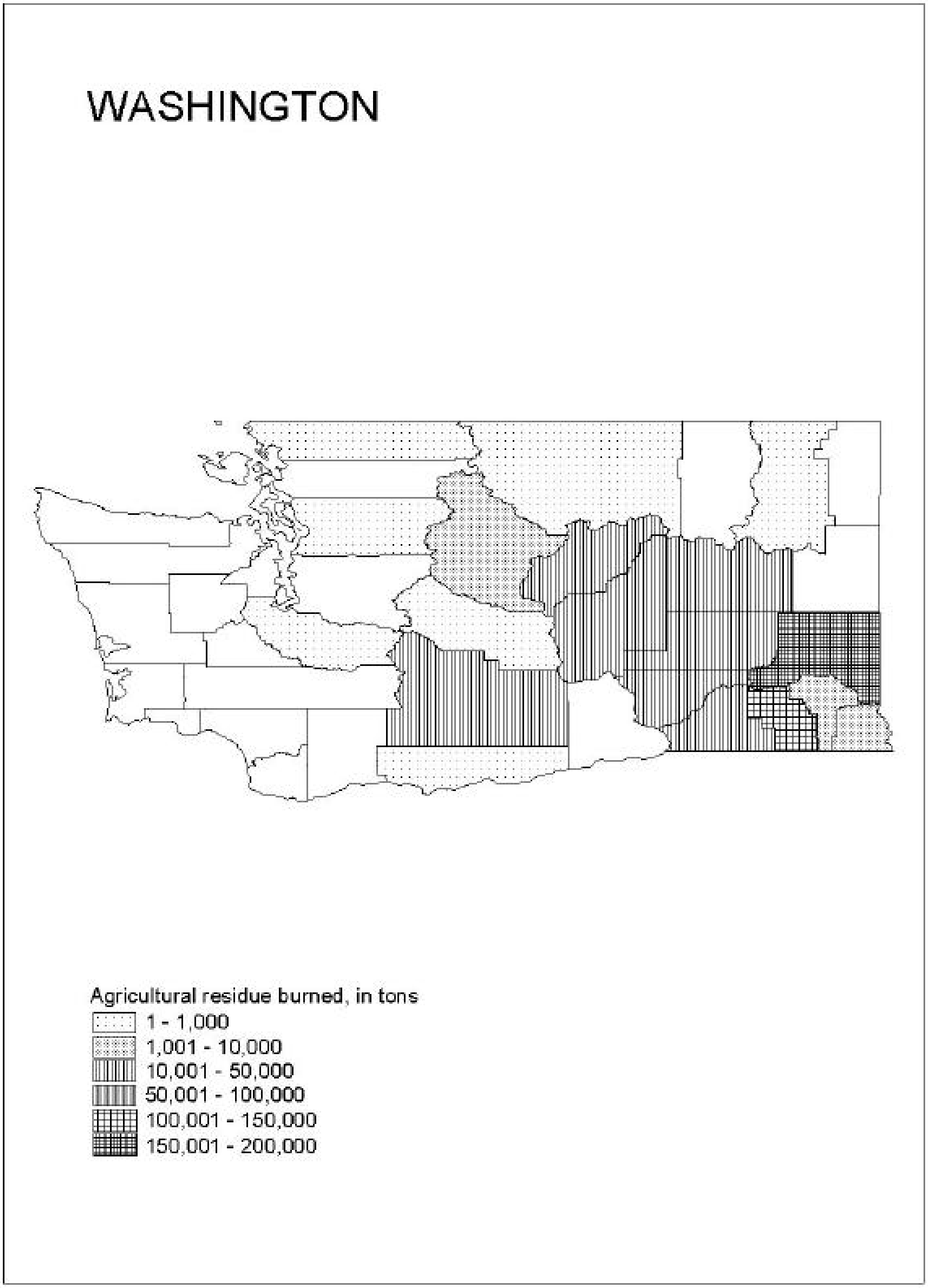

NORTH DAKOTA
Agricultural residue burned, in tons
1 - 10,000
10,001 - 20,000
20,001 - 30,000
30,001 - 40,000
40,001 - 50,000


OREGON
Agricultural residue burned, in tons
1 - 10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 200,000
200,001 - 300,000

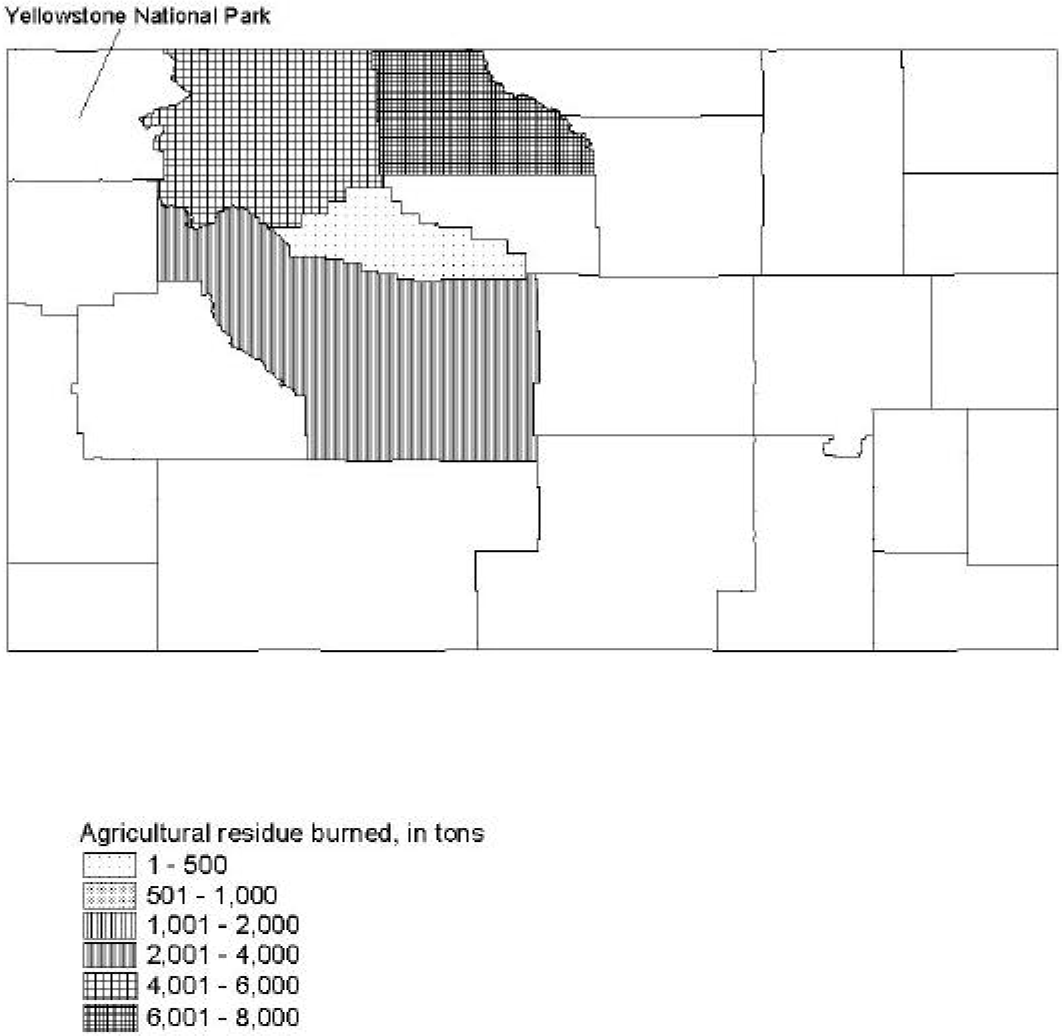
SOUTH DAKOTA




UTAH
Great Salt Lake
Agricultural residue burned, in tons
1 - 500
501 - 1,000
1,001 - 5,000
5,001 - 10,000
10,001 - 15,000
15,001 - 20,000


WASHINGTON
Agricultural residue burned, in tons
1 - 1,000
1,001 - 10,000
10,001 - 50,000
50,001 - 100,000
100,001 - 150,000
150,001 - 200,000

WYOMING


Yellowstone National Park
Agricultural residue burned, in tons
1 - 500
501 - 1,000
1,001 - 2,000
2,001 - 4,000
4,001 - 6,000
6,001 - 8,000

APPENDIX E

RELEVANT VOLUME II TABLES

Table 5-2. Accountability Mechanisms Important to the Use of Non-Burning Alternatives

State-County(ies) or Area	1 Agricultural Burning is Exempt from all Regulations or Rules	2 Agricultural Burning is Effectively Exempt from Regulations or Rules	3 Agricultural Burning is Included in Regulations or Rules	4 Specific Agricultural Burning Regulation or Rule	5 General Open Burning Regulation or Rule	6 Other Burning Sources More Important	7 Formal Agricultural Burn Approval Process	8 Agricultural Burning Permit is Required	9 Agricultural Burning Permit Fees are Charged	10 Smoke Management is Required	11 Agricultural Burn Activity Enforcement Process Exists	12 Requirement to Estimate Fuels, Acreage, & Emissions: Pre-Burn Permit	13 Requirement to Confirm Fuels, Acreage, & Emissions: Post Burn Report	14 Agricultural Burn Activity Data is Reviewed & Included in an Inventory	15 Requirements to Consider Use of Alternatives	16 Financial Incentive(s) are Available for Using Alternatives	17 List of Alternatives is Available	References	Comments
			Accountability Mechanisms that Support Identification and Use of Non-Burning Alternatives																
AK		✓	✓		✓		✓[2,3]	✓					✓		✓			WRAP, 2001a	1, 27
AZ		✓	✓		✓						✓	✓		✓					2, 28
AZ-Pima			✓[1]		✓[1]		✓[1]	✓[1]	✓[1]		✓[1]								3
AZ-Pinal			✓[1]		✓[1]		✓[1]	✓[1]	✓[1]										4
AZ-Yuma			✓[2]		✓[2]		✓[2]	✓[2]	✓[1]		✓[1]	✓[2]							5
AZ-Maricopa		✓			✓[1]														6
CA			✓		✓[1]			✓[1]	✓[1]	✓[1]	✓[1]			✓	✓	✓		WRAP, 2001a	7, 43
CA-Lake			✓[1]		✓[1]		✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	44
CA-Sacramento Valley Counties			✓[1]	✓[1]			✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	45
CA-San Joaquin Valley Counties			✓[1]		✓[1]		✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	46
CA-South Coast Counties			✓[1]		✓[1]		✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	8, 47
CO	✓					✓													9
HI			✓		✓			✓	✓		✓	✓			✓				10
ID			✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓			WESTAR, 1999	11, 30
MT		✓	✓		✓	✓		✓	✓		✓								12, 31

Table 5-2. Continued

State-County(ies) or Area	1 Agricultural Burning is Exempt from all Regulations or Rules	2 Agricultural Burning is Effectively Exempt from Regulations or Rules	3 Agricultural Burning is Included in Regulations or Rules	4 Specific Agricultural Burning Regulation or Rule	5 General Open Burning Regulation or Rule	6 Other Burning Sources More Important	7 Formal Agricultural Burn Approval Process	8 Agricultural Burning Permit is Required	9 Agricultural Burning Permit Fees are Charged	10 Smoke Management is Required	11 Agricultural Burn Activity Enforcement Process Exists	12 Requirement to Estimate Fuels, Acreage, & Emissions: Pre-Burn Permit	13 Requirement to Confirm Fuels, Acreage, & Emissions: Post Burn Report	14 Agricultural Burn Activity Data is Reviewed & Included in an Inventory	15 Requirements to Consider Use of Alternatives	16 Financial Incentive(s) are Available for Using Alternatives	17 List of Alternatives is Available	References	Comments
			Accountability Mechanisms that Support Identification and Use of Non-Burning Alternatives																
ND		✓	✓		✓		✓[1]				✓								13, 32
NM		✓	✓		✓										✓				14, 42
NV	✓													✓				WRAP, 2001a	15, 33
NV-Pershing	✓											✓						WRAP, 2001a	
OR			✓		✓			✓	✓	✓	✓	✓			✓	✓			16, 34, 35
OR-Jefferson			✓[1]		✓[1]			✓[2]	✓[1]	✓[1]	✓[1]	✓[1]				✓[1]		WRAP, 2001a	36
OR-Umatilla			✓[1]		✓[1]			✓[1]	✓[1]	✓[1]	✓[1]	✓[1]				✓[1]		WRAP, 2001a	36
OR-Union			✓[1]		✓[1]			✓[1]	✓[1]	✓[1]	✓[1]	✓[1]				✓[1]		WRAP, 2001a	36
OR-Willamette			✓[1]		✓[1]			✓[1]	✓[1]	✓[1]	✓[1]	✓[1]				✓[1]		WRAP, 2001a	36
SD	✓																		17, 37
UT	✓																	WESTAR, 1999	18, 38
WA			✓		✓			✓	✓		✓		✓	✓	✓		✓	WRAP, 2001a; WESTAR, 1999	19
WA -Benton			✓[1]	✓[1]				✓[1]	✓[1]		✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	20, 40
WA-Columbia			✓[1]	✓[1]				✓[1]	✓[1]		✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	21, 40
WA-NW region			✓[1]	✓[1]				✓[1]	✓[1]		✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	22, 40
WA-SW region			✓[1]	✓[1]				✓[1]	✓[1]		✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	23, 40
WA-Walla Walla			✓[1]	✓[1]				✓[1]	✓[1]		✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	24, 40

Table 5-2. Continued

State-County(ies) or Area	1	2	Accountability Mechanisms that Support Identification and Use of Non-Burning Alternatives															References	Comments
			3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
	Agricultural Burning is Exempt from all Regulations or Rules	Agricultural Burning is Effectively Exempt from Regulations or Rules	Agricultural Burning is Included in Regulations or Rules	Specific Agricultural Burning Regulation or Rule	General Open Burning Regulation or Rule	Other Burning Sources More Important	Formal Agricultural Burn Approval Process	Agricultural Burning Permit is Required	Agricultural Burning Permit Fees are Charged	Smoke Management is Required	Agricultural Burn Activity Enforcement Process Exists	Requirement to Estimate Fuels, Acreage, & Emissions: Pre-Burn Permit	Requirement to Confirm Fuels, Acreage, & Emissions: Post Burn Report	Agricultural Burn Activity Data is Reviewed & Included in an Inventory	Requirements to Consider Use of Alternatives	Financial Incentive(s) are Available for Using Alternatives	List of Alternatives is Available		
WY		✓			✓	✓													25, 41
Tribal	✓	✓[3]; ✓[4]; ✓[5]				✓[1]; ✓[2]; ✓[3]; ✓[4]; ✓[5]	✓[1]; ✓[2]; ✓[3]; ✓[4]; ✓[5]											WRAP, 2001b	26

Notes:

✓ = State Level
✓[1] = County or Local Authority
✓[2] = Rural Fire District
✓[3] = Natural Resources Authority
✓[4] = Tribal Authority
✓[5] = Federal Land Management Authority

AK = Alaska
AZ = Arizona
CA = California
CO = Colorado
HI = Hawaii
ID = Idaho
MT = Montana
ND = North Dakota

NM = New Mexico
NV = Nevada
OR = Oregon
SD = South Dakota
UT = Utah
WA = Washington
WY = Wyoming

Table 5-2a. Comments Key for Table 5-2

No.	Comments
1	Ann Lawton, AK State Dept. Env. Quality, ERG/ETC Informal Survey 2001 (see Appendix A): No agricultural crops burned. Limited burning conducted to date is for land clearing; may be more in future. Limited to fall and spring because of climate, tourism, and fire danger. Burning occurs in Delta Junction area only. Rest of AK no agricultural burning at all. Permits are required for burns greater than 40 acres in size only. Most of the smoke issues occur with non-permitted burns.
2	Varma Sunil, AZ State Dept. Env. Quality, ERG/ETC Informal Survey 2001: Typically agricultural burning is not addressed in statewide open burning smoke management program. Most burning occurs in Yuma county. 8,000 acre/yr limit via State Implementation Plan. Non-agricultural open burning is allowed in Yuma and Maricopa Counties.
3	Bill Maxwell, Pima County Dept Env. Quality, ERG/ETC Informal Survey 2001: Most burning is tumbleweeds, year round via open burn permit. Based on burn/no-burn days program. No smoke management plan is required and emissions are not tracked.
4	Donald Gabrielson, Pinal County Dept. Env. Quality, ERG/ETC Informal Survey 2001: Principal agricultural burning is for irrigation ditch bank clearing. Occurs in Spring. Most other permitted burning is for residential use burn barrels. Some rural agricultural burning. If okayed for agricultural, annual permit to burn anything up to 320 contiguous acres.
5	Varma Sunil, AZ State Dept. of Env. Quality and Kurt Foster, Yuma County Fire Dept, ERG/ETC Informal Survey 2001: Most burning is limited by the State Implementation Plan up to 8,000 acre/yr. It typically includes citrus and other orchard fuels burning for orchard retirement and removal. Often use a curtain air destructor.
6	Rick Hado, Maricopa County, ERG/ETC Informal Survey 2001: No burning for agricultural residues occurs in county. Majority of burning is for ditch banks, tumbleweeds, fenceline clearing and land clearing. Do often use high temperature propane burners for ditch banks and best management practices.
7	WRAP, 2001a: Agricultural burning is allowed under state law. It is typically permitted at the county air authority level. Many crops are burned, especially rice, wheat and other grains. Orchard prunings are also burned by permit. The newly adopted statewide Title 17 Smoke Management Guidelines for Agricultural and Prescribed burning in CA provides authority, direction and guidance to the local air authorities (air quality management and/or control districts) for the regulation and management of burning. Smoke management plans are required of each local air authority. There is considerable variability in the implementation of local rules and regs and little systematic statewide review of programs or emissions estimates.
8	WRAP, 2001a: Almost any crop can be burned any time of the year.
9	Coleen Campbell, CO State Dept. of Public Health and Phyllis Woodford, CO State Dept. of Public Health, ERG/ETC Informal Survey 2001: Burning occurs only of range land and irrigation ditches. Regulations exempt agricultural residues but do encourage good burning practices. Some spring wheat, corn and sunflower burning may occur in Western counties/Grand Junction area. Approval to burn via courtesy burn/no-burn calls.
10	Lisa Young, HI State Dept. of Health and Janet Ashman, HI Agricultural Research Center; ERG/ETC Informal Survey 2001: Two year crops, roughly half of the acres planted in any year would be burned the following year for both sugar cane and pineapples. Estimate 40,000 to 50,000 acres of sugarcane are in production. Roughly 30,000 acres sugarcane is burned in any given year. Acreage burned for pineapples is unknown. Sugarcane industry is having economic difficulties due to competition with sugarbeet production in other states. Sugarcane burning will likely decrease the future.
11	Diane Riley, ID State Dept. Env. Quality, ERG/ETC Survey 2001; Dan Redline, Coeur d'Alene Regional Office, ERG/ETC Informal Survey 2001; Curt Thornberg, ID Dept. of Agriculture, ERG/ETC Informal Survey 2001, Robert Wilkosz, ID Dept. Env. Quality, WESTAR (1999): Data not available for most of the state. Some data on grass and cereal grains is available for the Kootenai and Benewah counties. Voluntary smoke management plans are used in Kootenai and Benewah counties. Grass seed and cereal crops are burned in the fall (Aug-Sept). Alfalfa, mint and other perennial forage crops are burned in both the spring and fall. Ditch banks are burned in the spring. Individual burners make the burn/no-burn decisions. Open burning rule specifically allows burning of orchard clippings and burning for weed control.

Table 5-2a. Continued

No.	Comments
12	Bob Habeck, MT State Dept Environmental Quality, ERG/ETC Informal Survey 2001: Data on acreage burned are not tracked. State has permit authority Sept-Feb otherwise burner gets to decide when to burn and not burn. Program is geared toward wildlands and forest management, not agricultural. Rarely allowed to burn in summer months because of fire danger. Burning that does occur addresses ditches and sagebrush land conversion.
13	Chuck McDonald, ND State Health Dept., ERG/ETC Informal Survey 2001: Wheat is burned in fall and only in northeastern areas of Red River Valley. Yields are high, similar to rice in CA. Do not track emissions at all. Agriculture is exempt. Open burning is prohibited but variances are issued for prescribed burning of forest lands. One particle/fiberboard plant is highly successful in the state.
14	Brad Musick, NM State Dept of Environment, ERG/ETC Informal Survey 2001: Orchard prunings are the main issue. No emissions data is kept. Wheat is burned in eastern portion of the State. Pecans are the main crop. Prunings, hulls etc. are burned in the Dona Ana (Rio Grande) areas of state. Tumbleweeds and irrigation ditches are burned routinely as a way of life in some areas to supply pecan orchards with water.
15	Colleen Cripps, NV State Dept. Env. Quality, ERG/ETC Informal Survey 2001 and WRAP, 2001a: Agricultural burning is essentially not regulated. Some self regulation occurs in parts of the state with greater community concerns. This includes the Lovelock Valley.
16	Brian Finneran, OR State Dept. Env. Quality, ERG/ETC Informal Survey 2001: Grains burned July-Sept. Basically track emissions through three separate geographically distinct field burning programs. All three programs publish annual emissions reports. Largest source of burning is the Willamette Valley. Complex state run program. Orchard burning is typically allowed statewide.
17	Chris Hansen, SD Dept of Environment and Natural Resources, ERG/ETC Informal Survey 2001; Tim Rogers, SD State Dept of Environment and Natural Resources, ERG/ETC Informal Survey 2001: agricultural burning is not regulated in the state. No Tracking, no records kept, and no permits required for agricultural burning in the state. Grasses burned in spring (March - May) and fall (Sept - Oct). Grain is burned in March and April. Open burning of rubbish, treated woods, wastes, etc. is prohibited.
18	Francis Bernards, UT State Dept. Env. Quality, ERG/ETC Informal Survey 2001; Steven Parkin, UT State Division of Air Quality, WESTAR (1999): State does not track acres burned. Large agri-farming occurs in nearly every county. No burning occurs during Ozone season, (June - Aug). Burn season is Sept-May.
19	Grant Pfeifer, WA State Dept of Ecology, Agricultural Burn Task Force, ERG/ETC Informal Survey 2001; Chad Akins, WA State Dept of Ecology, WESTAR, 1999: Burning occurs in Benton, Columbia, Island, Skagit and Whatcom counties. Wheat is burned in March, April and July-Nov. Fall burning occurs Aug-Nov. Spring burning occurs March-May. Crops burned include wheat, barley, grass seed, pasture and alfalfa seed. A post-burn “Report Card” is required. Emissions from these sources are tracked. Burning incidental to agricultural residue is allowed without a permit. This type of burning includes orchard prunings, fencelines, irrigation and drainage ditches. Emissions are not tracked from these sources. State of WA does support research to explore alternatives to burning.
20	WRAP 2001a: Most of the burning in the county is orchard removal.
21	WRAP 2001a: Spring burning in March through April; Fall burning in Mid-Sept through October
22	WRAP 2001a: Very small amount of acreage burned. 475 total acres in year 2000.
23	WRAP, 2001a: Little agricultural burning occurs in this county. Less than 50 acres in 2000, none were grain or grass seed crops. Burning is allowed year round because so little occurs in the county.
24	WRAP, 2001a: Most burning is done in spring. Fall burning is being phased out.
25	Darla Potter, WY Dept. Env. Quality, ERG/ETC Informal Survey 2001: Emissions are not tracked at all. Burn permits are required for forestry and rangeland. Recently grass seed companies from OR and WA have been relocating to WY which may increase burn emissions from these sources.

Table 5-2a. Continued

No.	Comments
26	WRAP, 2001b: There are 240 Indian reservations in the Western Regional Air Partnership (WRAP) region representing more than 54 million acres of land. Historically each tribal entity manages their own lands independently. No centralized agricultural burning activity data presently exisits. Historically burning occurs on approximately 50% of the reservations within the WRAP region of the 15 Western states. Types of burning include wildland, rangeland and agricultural. Often burns are part of an overall annual burn or land management plan but some are completely independent. Most tribal entities do not have a formal smoke management program although some do. Coordination with other off-site land management entities and air quality authorities is highly variable among the tribes.
27	State of Alaska, Department of Environmental Conservation, Open Burning Policy and Guidelines document. http://www.state.ak.us/dec/dawq.
28	State of Arizona, Department of Environmental Quality, Arizona Guidelines for Open Burning and Permit Application Form, Title 49. http://www.adeq.state.az.us/environ/air.
29	State of Hawaii, Administrative Rules, 11-60.1-51: Open Burning, and Application for Agricultural Burning Permit, http://www.state.hi.us/doh/rules/emd/11-60.PDF.
30	State of Idaho, Statute Title 22, Agriculture and Horticulture, Chapter 48, Smoke Management and Crop Residue Disposal, http://www.state.id.us/idstat
31	State of Montana, Department of Environmental Quality, Rules Title 17, Chapter 8, Air Quality, Open Burning. http://www.deq.state.mt.us/dir/legal
32	State of North Dakota Air Pollution Control Rules, Chapter 33-15-04, Open Burning Restrictions, http://www.health.stat.nd.us/ndhd/environ
33	State of Nevada, Division of Environmental Protection, Smoke Management Program, NAC 445B.381 Open Burning, http://www.state.nv.us/ndep/bao/smoke1.htm.
34	State of Oregon, Department of Agriculture, “Field Burning Rules”, http://arcweb.sos.state.or.us/rules
35	State of Oregon, Department of Agriculture Natural Resources Division, http://www.oda.state.or.us/Natural_Resources/smoke.htm.
36	State of Oregon, Administrative Rules, Department of Environmental Quality, “Pollution Control Tax Credits”, http://arcweb.sos.state.or.us/rules/OARS_300/OAR_340/340_tofc.html
37	State of South Dakota, Department of Environment and Natural Resources, “Air Quality Guidelines for Open Burning”, http://www.state.sd.us/denr/DES/airquality/regulations
38	State of Utah, Administrative Code, Title R307, “Environmental Quality, Air Quality”, Section 307-202-1, http://www.rules.state.ut.us/publicat/code
39	State of Utah, Statute, Title 19, “Environmental Quality code” Chapter 2, “Air Conservation Act”, http://www.le.state.ut.us
40	State of Washington, Department of Air Quality, Best Management Practices and Administrative Code, “Agricultural Burning”, RCW 70.94.656 Open Burning, http://www.ecy.wa.gov
41	State of Wyoming, Air Quality Standards and Regulations, Chapter 10, Section 2, “Open Burning Restrictions”, http://deq.state.yw.us.
42	State of New Mexico, Environmental Protection Air Quality, “Open Burning”, Title 20, Chapter 2, Part 60.
43	State of California, Title 17 “Smoke Management Guidelines for Agricultural Burning and Prescribed Burning”, California Code of Regulations, Section 80100, et. Seq. California Air Resources Board, http://www.arb.ca.gov
44	State of California, Lake County Air Quality Management District, Rules and Regulations: Chapter VIII, Agricultural Burning, http://www.arb.ca.gov/DRDB/lak/CURHTML/LKRulebook7-13-01-PDF
45	State of California, Sacramento Metropolitan Air Quality Management District, Rule 407: Open Burning, http://www.arb.ca.gov/DRDB/SAC/CURHTML/R407.htm and Rule 501: Agricultural Burning, http://www.arb.ca.gov/DRDB/SAC/CURHTML/R501.htm
46	State of California, San Joaquin Valley Unified Air Pollution Control District, Rule 4103: Open Burning, http://www.arb.ca.gov/DRDB/SJU/CURHTML/R4103.PDF
47	State of California, South Coast Air Quality Management District, Rule 444: Open Fires, http://www.arb.ca.gov/DRDB/SC/CURHTML/R444.htm

Eastern Research Group, Inc.

Non-Burning Management Alternatives on Agricultural Lands in the Western United States

Volume II:

Non-Burning Management Alternatives and Implementation Plan Strategies

FINAL

Prepared for:

The Fire Emissions Joint Forum of the Western Regional Air Partnership

Enviro-Tech Communications

May 15, 2002

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FINAL

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Prepared by:

Eastern Research Group, Inc. (ERG)
8950 Cal Center Drive, Suite 260
Sacramento, California 95826

and

Enviro-Tech Communications
P.O. Box 593
Folsom, California 95763

May 15, 2002

DISCLAIMER

This document was developed for the Fire Emissions Joint Forum (FEJF) of the Western Regional Air Partnership (WRAP) by Eastern Research Group, Inc., (ERG) and Enviro-Tech Communications. Although the contents of this report have undergone extensive review by the FEJF, the opinions, findings, and conclusions expressed represent those of ERG and Enviro-Tech Communications and not necessarily those of the members of the FEJF.

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ACRONYMS

ADEC	Alaska Department of Environmental Conservation
AK	Alaska
ARMS	Agricultural Resource Management Study
ARS	Agricultural Research Service
AZ	Arizona
CA	California
CARB	California Air Resources Board
CDFA	California Department of Food and Agriculture
CGE	computable general equilibrium
CO	Colorado
CO_2	carbon dioxide
CRP	Conservation Reserve Program
DEQ	Department of Environmental Quality
ERG	Eastern Research Group, Inc.
ETC	Enviro-Tech Communications
FEJF	Fire Emissions Joint Forum
FSA	Farm Service Agency
GIS	geographical information system
HI	Hawaii
ID	Idaho
KBG	Kentucky bluegrass
MT	Montana
NASS	National Agricultural Statistics Service
ND	North Dakota

NM	New Mexico
NO_x	nitrogen oxides
NRCS	National Resources Conservation Commission
NV	Nevada
OR	Oregon
PM_{10}	particulate matter less than 10 microns in aerodynamic diameter
QA/QC	quality assurance/quality control
RIMSII	Regional Input Output Modeling System, version 2
RL	residue loading (tons/acre)
SD	South Dakota
UC	University of California
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
UT	Utah
WA	Washington
WESTAR	Western States Air Resources Council
WGA	Western Governors' Association
WRAP	Western Regional Air Partnership
WY	Wyoming

EXECUTIVE SUMMARY

The Western Regional Air Partnership and its Fire Emissions Joint Forum (WRAP/FEJF) sponsored this project to investigate the alternatives to agricultural burning. The geographical scope of the project includes the 15 Western states of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, North Dakota, New Mexico, Nevada, Oregon, South Dakota, Utah, Washington, Wyoming, and the tribal lands within these states.

The objectives of this project were designed to facilitate the development of crop production and agricultural burning activity data to support analysis of alternatives to burning, and they include:

- Development of a crop production database and an agricultural burning activity database;
- Identification of the "universe" of potential non-burning management alternatives;
- Design of a methodology to assess the impacts of alternatives (e.g., agronomic, environmental, economic, etc.);
- Identification of existing and potential accountability mechanisms for tracking if, and which, non-burning alternatives are used by federal, state, local, and tribal entities, and potential barriers to their implementation; and
- Development of a plan for implementing alternatives in the 15 Western states.

This analysis was supported by a three-tiered approach to research. The three tiers of sources included: (1) federal agencies such as the U.S. Department of Agriculture (USDA) and the National Agricultural Statistics Service (NASS); (2) agencies such as the University Agricultural Extension Services and state air agencies; and (3) private consortiums such as growers, producers, distributors, and information clearinghouses.

The results of this project are documented in two reports under the title "Non-Burning Management Alternatives on Agricultural Lands in the Western United States," Volume I and Volume II.

Volume I: Agricultural Crop Production and Residue Burning in the Western United States

The goal of the crop production database was to compile acres harvested by crop at the county level for all major crops harvested and/or crops known to be burned in each of the 15 Western states. The crop production database was developed from three main sources of information:

1. The NASS database;
2. State agricultural statistics data and reports; and
3. The 1997 Census of Agriculture.

Also, the Farm Service Agency (FSA) website was used to obtain information on lands included in the Conservation Reserve Program (CRP). Although the target year for these data was 1996, it was necessary to include 1997 data when 1996 data were missing for crops that were known to be burned. The crop database underwent an extensive quality assurance/quality control (QA/QC) process to ensure that at least 90 percent of the acres harvested of major (i.e., top 10) crops and 100 percent of all crops burned were accounted for in the database. In total, over 50 different crops were grown in the 15 Western states which amounted to nearly 77,000,000 acres harvested in a single year during the 1996/1997 timeframe. The resulting county-level data were mapped using a geographical information system (GIS) (see Appendix B).

The agricultural burning database was developed for purposes of identifying the extent of burning in the Western states, and to assist with the emissions inventory being developed by the WRAP/FEJF. The burning database was compiled from three types of data representing various geographical areas within the 15 Western states region:

- Burn permits issued or other mechanisms for determining actual burn activity;
- Emissions inventory estimates;
- Anecdotal information from surveys sponsored by the WRAP/FEJF, the Western States Air Resources Council (WESTAR); and
- Data resulting from peer review of the draft agricultural burn activity database prepared for this project.

Although a significant amount of data were obtained, burning was known to occur in certain counties and states for which data were unavailable. A gap filling technique was developed to provide estimates of acres and residues (tonnage) burned at the county level for those unaccounted areas (i.e., North Dakota, New Mexico, and South Dakota). Table ES-1 shows the results of the overall database in terms of average percentage of acres burned by crop. The resulting county-level data were mapped using GIS (see Appendix D).

Although the data that were collected and compiled were subject to specific QA/QC procedures, some of the data and results have inherent uncertainty. These uncertainties are due to such factors as use of "as is" data sets provided by the various sources and an inconsistent definition of "agricultural burning" within these data sets. Also, the gap filling averages used to provide missing data in some states cannot accurately depict actual burn activity that occurred in those states. Even for some areas where gap filling was not used, information originally provided for the draft database was revised with significantly different information obtained during the peer review process (e.g., Utah). While it can be concluded that the peer review process worked in this case, this result is illustrative of the need for a coordinated, systematic process to collect agricultural burning data, establish data quality objectives, and resolve conflicting data.

The researchers and peer reviewers contributing to the final agricultural burn activity database made the following recommendations pertaining to future improvements of this database:

1. Develop a mechanism (e.g., program, regulation, etc.) whereby the relevant state, county, tribal, agricultural, and stakeholder entities establish data quality objectives, define data sources, and compile data on a regular basis to estimate the extent of agricultural burning in the Western United States. Also, this mechanism should provide a consistent definition of the residue types to be included in the agricultural burning category.

2. Conduct research to identify and/or calculate specific yield-based RL factors for each geographical zone or area; and

3. Incorporate the impact of irrigated and nonirrigated land agricultural practices.

Table ES-1. Average Percentage of Acres Harvested that are Burned for Selected Crops in the Western United States

Crop	Acres Harvested[1]	Acres Burned	Overall Average Percentage of Acres Burned
Wheat	31,619,000	905,756	2.9%
Rice	500,000	254,706	50.9%
Corn	5,766,000	10,668	0.2%
Barley	5,696,900	137,872	2.4%
Sugarcane	42,900	30,000	69.9%
Orchards (Trees, Bushes, Vines)	2,497,767	530,100	21.2%
Grasses and Seeds	899,976	394,077	43.8%
CRP	286,174[2]	28,917	10.1%

Notes:

[1] Acres harvested and burned are for the 15 Western states, excluding Nevada because burning in that state was not identified for specific crops .

[2] Value represents number of acres in the Conservation Reserve Program (CRP).

Volume II: Non-Burning Management Alternatives and Implementation Plan Strategies

The majority of information collected and reviewed in this study suggests that states, local agencies, tribal communities, and fire control experts agree that the development and use of non-burning alternatives is desirable. However, identification, development, and use of these alternatives throughout the 15 Western states and tribal communities appears to be in the fundamental research stages. This fact, in combination with the lack in most states of formal requirements to implement non-burning alternatives, made identification and characterization of alternatives a difficult task. Over 20 different non-burning alternatives were identified in the following categories:

1. Leave residues in place either with or without infield residue treatment (e.g., cut, mulch, and drop in place; soil incorporation);
2. Improved management practices and scientific advancements in horticulture (e.g., genetic selection for disease/pest resistance or less fuel residual);
3. Alternative land use (i.e., conservation tillage; land conversion to non-agricultural use; and plant crops with residues that do not need to be burned); and
4. Residue collection and hauling for use offsite (e.g., haul to waste or landfill facility; haul to ethanol production facility).

In order to determine the reasonableness, or feasibility, of implementing non-burning management alternatives, it is important to assess the impacts they have on agriculture, the environment, and other aspects of society. In this study, the impacts to non-burning alternatives were defined and criteria were established for assessing their effects and determining the feasibility of implementation. The range of impacts due to implementation of non-burning alternatives included:

- Agronomic impacts—what happens to the agricultural production unit when an alternative is implemented, what the grower must do on the land and how does that change affect the productivity of the land;
- Environmental impacts—what effect does the alternative have on visibility, air quality, water quality, wildlife, and other vegetation;

- Health and safety impacts—what hazards do alternatives present in the workplace when implemented;

- Energy impacts—what are the impacts due to use of agricultural waste to produce energy;

- Economic impacts—what is the cost of implementation considering the difference in cost of agricultural operations between the traditional burning operation and the new alternative approach;

- Social and equity issues—beyond cost considerations, how are the growers, tribal communities, and other groups, affected by non-burning alternatives, and what is the equity of controlling some burning/crops and not others; and

- Political issues—when promotion of non-burning alternatives tends to antagonize farmers and agricultural interest groups.

Criteria were developed to evaluate each potential impact relative to a particular crop/alternative combination. A rating scheme using feasibility factors was developed that can be applied to the potential impacts relevant to each alternative being evaluated (e.g., 0 = No impact; 1 = Some impact/problem; 2 = Definite problem; and 3 = Major problem). High ratings indicate worse impacts relative to low ratings. This methodology is demonstrated in two case studies (for rice straw and grass seed) in order to show how to quantify some impacts (e.g., cost-effectiveness) and apply feasibility factors. As an example, the results showed for rice straw that the average feasibility factors for the non-burning alternatives ranged from 1.1 (least negative impact) for alternatives such as Cut/Collect and Haul to Ethanol Production Facility, to 2.1 (most negative impact) for Land Conversion to Non-Agriculture.

Accountability mechanisms are procedures used for tracking if, and to what extent, non-burning alternatives are used by local, state, tribal, or federal entities. In-place mechanisms are categorized and discussed. How the mechanisms support or promote the use of non-burning management alternatives is described in the implementation section (Section 7.0 of Volume II). The information gathered on accountability mechanisms came from state, county, local, and tribal environmental authorities representing all 15 Western states. The 17 different accountability mechanisms were identified in the following categories:

a. Accountability initiated at the state or regional level (i.e., exemption or inclusion of agricultural burning in regulations);

b. Accountability at the state or local level that supports active regulation of agricultural burning activities (e.g., existing regulations or rules addressing agricultural burning activities);

c. Accountability at a programmatic level that supports a formal approval and/or permitting process (e.g., smoke management programs);

d. Mechanisms that encourage accountability at the local level and provide information for applying non-burning alternatives to current agricultural burning practices (e.g., fuel types burned, emissions tracking); and

e. Mechanisms that facilitate and encourage the use of non-burning alternatives (e.g., pre-burn permits, financial assistance).

The presence, or in some cases absence, of accountability mechanisms appears to be an indicator of whether non-burning alternatives will be used in the Western states. In general, for states with aggressive mandates to reduce agricultural burning such as Washington, Oregon, and California, many accountability mechanisms are in place. These states also have the largest number of non-burning alternatives in use. An important finding, which served to complicate the identification and interpretation of information on accountability mechanisms, was the inconsistent definition of "agricultural burning" in the 15 Western states. For example, in some areas irrigation ditch, fenceline, and weed or land clearing for range land improvement is included in regulations covering agricultural burning; in other areas these are not addressed.

Non-statutory administrative barriers are those situations, circumstances, activities, or factors that serve to minimize, deter, or prevent the active use of non-burning alternatives. Eighteen barriers that fall into the following four categories were identified:

- *Economic challenges* including labor costs; increased liability; disposal, storage, packaging, or transport costs; availability and/or willingness of investors to provide capital for new technologies or non-traditional methods; market return; crop yield, quality, and production rates;

- *Geographical limits* due to climate or topography;

- *Political, cultural, or religious practices* including activities that center around agriculture/harvest activities or tribal ceremonies; historical promises of land as a lure to relocate;

- *Public acceptance* of a practice or program result (which may be closely tied to aesthetics); and

- *Aesthetics* including visual, olfactory, and auditory impacts, but possibly nuisance due to plant debris or dust in or near homes and businesses.

A strategy for increasing the development and use of non-burning alternatives is described as applicable to the 15 Western states. A detailed discussion lays out the critical elements of an effective implementation plan, including items such as developing a strategic plan, allocating resources, and providing consistent program implementation. Based on the results of this study and the suggested guidelines, recommendations were made for developing an successful non-burning alternatives program at the state, local, and tribal level:

1. Air quality or environmental program entities should conduct a focused review to identify the nature and extent to which agricultural burning contributes to air quality problems in the state, or local, or tribal area. A starting point for this review could be the evaluation of agricultural burning activity such as that presented in Section 3.0 of Volume II. A key element of this review that should be included is a careful consideration of the definition of “agricultural burning”. This is important so that accurate comparisons can be made between other state, local or tribal programs.

2. If agricultural burning does not contribute significantly to local or statewide air quality problems which fall under the jurisdiction of the state, local or tribal entity, it is still recommended that the focused program assessment also take into account, to the greatest extent possible, the potential impacts agricultural burning may have on interstate regional air quality.

3. If agricultural burning is not found to be a significant source of air pollution for a given state, local region, tribal entity, or interstate region, it may not be necessary to continue with non-burning alternatives program development.

4. If agricultural burning is found to make a significant contribution to air quality problems on either a local, state, tribal community, or regional level, then the air quality or environmental agencies in authority in the affected areas and the areas contributing to the problems should work together to define solutions and develop non-burning alternatives programs. This will help to ensure success on a regional level.

5. If agricultural burning is found to be a significant source of air pollution for a given state, local region, tribal entity or interstate region, or if a given entity desires to more effectively implement non-burning alternatives, then an overall air quality review should be conducted to determine how to integrate agricultural burning. One goal of this review would be to determine which of the accountability mechanisms identified in Section

5.0 of Volume II are in place and how they are being used. Table 5-2 of Volume II can be used to determine specific accountability mechanisms and tailor the agricultural burning program.

6. For those states, local regions, and tribal entities desiring to more effectively address the use of non-burning alternatives in general, it is recommended that a list of effective and economically viable non-burning alternatives be developed (ideally including non-burning alternatives for use by crop, by season, and by region or area). Table 2-1 of Volume II (listing of non-burning alternatives by crop) can be used to identify specific alternatives. The criteria, methodology, and case studies described in Sections 3.0 and 4.0 of Volume II can be used to determine feasibility.

7. It is further recommended that a list, or in some cases multiple lists, of feasible non-burning alternatives should be maintained and updated periodically by the participating lead public or private entity. The list(s) should be made available using a variety of common effective communication strategies, methods, and technologies.

8. If non-burning alternatives have not been previously identified or have not been characterized for practical use an area, it is recommended that air quality and environmental entities work closely with university and agricultural extension scientists, affected agricultural community stakeholders, and interested members of the public to identify and characterize non-burning alternatives for specific use in their state or region.

9. WRAP member states should form a technical working group or task force to systematically identify and review the current use of non-burning alternatives and to make recommendations, if desired, on how and where the use of these non-burning alternatives may be improved or enhanced in other states, local regions, and tribal communities.

10. WRAP member states should work together to begin to address ancillary non-emission related program implementation issues, such as assisting the affected agricultural community and local business developers with post-residue removal product development, manufacturing, distribution, and marketing. Although this often falls outside the traditional charter of most state air quality and environmental programs, it does not fall outside the realm of services offered by other state agencies, boards and environmental departments. Some states have taken steps to assist in the research and development stages but their efforts have not extended to distribution and marketing.

11. It is highly recommended that the results of this and any of the above mentioned program efforts be carried out in close coordination with a well defined stakeholder outreach, education and communication program.

The agency roles and responsibilities associated with the identification, development, and implementation of non-burning alternatives are not clearly identified for any of the 15 Western states. It is recommended that as non-burning alternatives programs are reviewed and developed in the future, that the air quality or environmental agency responsible for developing the non-burning alternatives program (see Recommendation 4 above) be the agency responsible for monitoring and implementation. Regional approaches to defining responsibility for non-burning alternatives programs are also needed. This is in response to instances such as the relocation of grass seed companies within the last five years from Washington and Oregon to Wyoming where there are relatively less stringent air quality regulations.

A well designed, closely coordinated, and consistently implemented stakeholder involvement, outreach, and communication effort is essential to the success of any non-burning alternatives program. Stakeholder involvement is not only an important way to encourage the use of non-burning alternatives, it will be key in developing future alternatives to infield burning of agricultural residues.

A number of directions for further research and information development are recommended for the Western states and tribal communities in order to increase knowledge and encourage use of feasible non-burning management alternatives:

- Better characterization of agricultural burning activities in the 15 Western states and tribal communities, including development of a consistent definition for "agricultural burning";
- More thorough collection and evaluation of agricultural burning activity data (e.g., daily acres burned by county, permits records, etc.) by regulatory agencies and stakeholders;
- More thorough assessment of the air quality impacts from agricultural burning;
- On-going investigation into effective non-burning alternatives;

- Effective inclusion of stakeholders in the identification and implementation of non-burning alternatives; and

- Development of a well designed, consistently implemented stakeholder outreach, education, and communication programs that address local, state, tribal, and regional issues pertaining non-burning alternative program implementation.

1.0 INTRODUCTION

Air emissions from burning agricultural residue, primarily consisting of fine particulate matter (CARB, 1996), can impact visibility in Class I areas located near burns, as well as those Class I areas located far away through regional transport. The Western Regional Air Partnership (WRAP) and its Fire Emissions Joint Forum (FEJF) sponsored this study to assess the non-burning alternatives to infield burning of agricultural residues, including their impacts on the environment, economy, health and safety, society, politics, and on the business and productivity of the agricultural industry. This study was performed under the Western Governors' Association (WGA) Contract 30203-31 by Eastern Research Group, Inc. (ERG) and Enviro-Tech Communications (ETC).

In the context of this study, "agricultural burning" is defined as the burning of organic crop residue consisting of field crops, wood, and leaves. Also, the burning of ditch banks adjacent to, or associated with, crop production are included in this evaluation of alternatives to agricultural burning. The geographical scope of the project includes the 15 Western states of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, North Dakota, New Mexico, Nevada, Oregon, South Dakota, Utah, Washington, and Wyoming, as well as tribal lands in these states.

The temporal scope of the data collected for this project was 1996, chosen to coincide with the WRAP base year emissions inventory effort. However, as described herein, it was necessary to use data from 1997 or other years in some cases when 1996 data were not available. This use of various years of data is an important limitation of the results of this project. There is no assurance that 1996 crop production acreage, for example, is indicative of 2001 acreage due to factors such as increasing urbanization and regulatory impacts. Also, crop rotations will impact year-to-year variations.

1.1 Study Objectives

The objectives of this study are diverse. They are designed to facilitate development of crop production and agricultural burning activity data to support analysis of the alternatives to burning—which is the main objective of this study. Also, these data are used for estimating emissions from agriculture burning under another project. The specific objectives of this study are as follows:

1. Identification of crops grown and the extent to which residue is disposed of through burning for the 15 Western states. The goal is to develop county-level estimates of acres harvested and acres (or residues) burned by crop for each of the 15 Western states.

2. Display of the crop and residue burned data using a geographical information system (GIS). The goal is to illustrate the level of crop production (acres harvested) and agricultural burning (acres or residues burned in tons) within the 15 Western states. The GIS maps provide a useful means to compare burning activity county-to-county, and to ensure that all available data are included and that gap-filling procedures provide accurate results.

3. Identification of potential alternatives to agricultural burning and characterization of their agronomic, environmental, health and safety, social, economic, and political impacts. A three-tiered approach to collecting information on the potential impacts to non-burning alternatives is employed. The three tiers include: (1) federal agencies such as the United State Department of Agriculture (USDA); (2) state agencies such as the University Agricultural Extension Services; and (3) private consortiums such as growers, producers, distributors, and information clearinghouses.

4. Development of criteria for selecting reasonable non-burning alternatives, cost-abatement curves (i.e., cost of alternative by crop), and examples of how to apply the criteria and cost-abatement curves (i.e., case studies) to evaluate alternatives. The goal is to develop a global methodology that can be used to assess the reasonableness of non-burning alternatives; thereby, minimizing the need for region-and crop-specific assessment when possible.

5. Identification of existing and potential accountability mechanisms for tracking if, and which, non-burning alternatives are used by federal, state, local, and tribal entities. The goal is to describe the specific mechanisms, mainly statutory and currently in-place (e.g., required burn permits, available financial incentives, agricultural burning exemptions, etc.), that support, promote, or hinder the implementation of non-burning alternatives.

6. Identification of existing and potential barriers to the use of non-burning alternatives including non-statutory barriers (e.g., public acceptance, cultural practices, etc.) and recommendations on how these can be overcome. This objective presents the “flip-side” of Objective 5

(accountability mechanisms) in order to understand the current limitations (i.e., non-regulatory) to new program development and implementation of non-burning alternatives.

7. Development of a plan for implementing a non-burning program based on the analysis, findings, and recommendations developed in this study. The goal of the implementation plan is to give the WRAP/FEJF a "course of action" for implementing the recommendations developed under this project. The plan recommends agency responsibilities for implementation, and methods for disseminating information to stakeholders such as private landowners and others who will ultimately be responsible for implementing non-burning strategies.

1.2 Data Collection Methodology

Data were collected for this project based on a three-tiered approach. The first-tier sources were expected to have the highest quality data; the second-tier sources were expected to have readily available data; and, the third-tier sources were anticipated to provide additional crop-, state-, or regional-specific information pertaining to the identification and use of non-burning management alternatives. The primary data sources used in this project were as follows:

- Tier 1 sources included the Farms Services Agency (FSA), Economic Research Service, National Agricultural Statistics Service (NASS), USDA within each state, several state Natural Resources Conservation Service (NRCS) offices, Federal Agricultural Research Centers;
- Tier 2 sources included land grant universities, joint agency working groups and task forces (e.g., California Advisory Committee on Alternatives to Rice Straw Burning), State Agricultural Research Centers, University Agricultural Extension Services, divisions or departments of pesticide management; and
- Tier 3 sources included various private consortiums, farmers, distributors, professional agricultural organizations, and information clearinghouses.

Specific data sources are discussed as they pertain to crop production and residue burning, and identification and implementation of non-burning management practices.

1.3 Document Organization

This document is organized into two volumes that address all of the objectives of the project. Earlier in-progress work was reported in three draft reports–the Task 1 Draft Report which addressed Objectives 1, 2, and 3; the Task 2 and Task 3 Draft Report which addressed Objectives 4, 5, and (partially) 6; and, a Draft Final report which provided a complete initial analysis addressing all objectives. A detailed description of the content of the final Volume I and Volume II reports, and how the study objectives are addressed within each report is as follows:

- Volume I: Agricultural Crop Production and Residue Burning in the Western United States:
  - Section 1.0 describes the project background and objectives. This section also explains the data collection methodology and organization and content of the Volume I and Volume II reports.
  - Section 2.0 describes the development and results of the crop production database (Objectives 1 and 2). This section quantifies the level of crop production in each of the 15 Western states, including the number of acres harvested by crop and county. The results are presented in various tables and maps. A detailed quality assurance/quality control (QA/QC) procedure ensures the accuracy of the results.
  - Section 3.0 describes the development and results of the agricultural burning database (Objectives 1 and 2). This section explains the data collection and compilation procedure used to compile the burn activity data (e.g., acres and residues [tons] burned by crop and county). Also, since only limited data on actual burn activity is available in the 15 Western states, a gap-filling procedure is employed to provide estimates in states/counties where burning is known to occur, but records on specific quantities are not tracked. The results are presented in various tables and maps.
  - Section 4.0 provides relevant conclusions and recommendations pertaining to the crop production and agricultural burning databases.
  - Section 5.0 lists the references used in the development of Volume I, including reports, journal articles, websites, and personal communication.
  - Appendix A contains a listing of the crop production data (i.e., acres harvested by crop, county, state).
  - Appendix B contains the crop production GIS maps for each state.

- Appendix C contains listings of the agricultural burning activity data (i.e., residues burned [tons] by crop, county, state).

- Appendix D contains the agricultural burning activity GIS maps for each state.

- Appendix E contains relevant tables from Volume II.

- Volume II: Non-Burning Management Alternatives and Implementation Plan Strategies:

  - Section 1.0 describes the project background and objectives. This section also explains the data collection methodology and organization and content of the Volume I and Volume II reports.

  - Section 2.0 describes the "universe" of non-burning alternatives which are in-use, or have been used in the past in the 15 Western states (Objective 3). The alternatives are listed in a table based on applicable crop and by category (i.e., leave in place, scientific improvements, alternative land use, cut or collection and haul).

  - Section 3.0 presents a methodology for assessing the impacts of non-burning alternatives (Objective 4). First, the different types of potential impacts are described (i.e., agronomic, environmental, health and safety, energy, economics, social and equity issues, and political). Criteria are presented to assist in evaluating the relative feasibility of implementing alternatives (e.g., agronomic–soil compression, increased water use; economic–not cost-effective, substantial farm stress, etc.). A table shows available sources of information and expected outcomes of the analysis for each of the impacts. A methodology that can be used to evaluate these impacts for various crops/alternatives is described.

  - Section 4.0 contains two case studies that illustrate the methodology developed to analyze the impacts of non-burning alternatives (Objective 4). Impacts of non-burning alternatives for two significant crops (rice and grass seed) are described. The criteria developed in Section 3.0 are used to evaluate the impacts. Cost curves display the economic impacts of implementing non-burning alternatives.

  - Section 5.0 presents the accountability mechanisms currently in place, or practiced in the past for implementing and tracking progress of alternatives to agricultural burning (Objective 5). A table lists the 17 mechanisms identified through an extensive research effort, along with the state/county where each mechanism is employed.

- Section 6.0 describes the non-statutory administrative barriers currently existing at the state level for each of the 15 Western states (Objective 6). Where they exist, county- and local-level barriers are discussed, along with barriers affecting tribal communities' ability to implement non-burning alternatives.

- Section 7.0 provides a summary of strategies for increasing the development and use of non-burning management alternatives on agricultural lands in the 15 Western states (Objective 7). A summary of the overall results of the entire project is presented along with conclusions and recommendations for future work. The contents for each section of a "state-specific" implementation plan are described, strategies to address stakeholder involvement are given, and suggestions for further research and information development are made.

- Section 8.0 lists the references used in the development of Volume II, including reports, journal articles, websites, and personal communication.

- Appendix A contains a detailed listing of the participants (i.e., name, affiliation, phone, fax, e-mail) contacted as part of the informal survey conducted for this study.

- Appendix B gives a project case study (Alaska Agriculture Project, Delta Junction) that presents realistic information on the success and challenges encountered when developing and implementing a non-burning program in the West.

- Appendix C contains relevant tables from Volume I.

2.0 IDENTIFICATION OF NON-BURNING ALTERNATIVES

This section describes the research approach used to identify and characterize non-burning alternatives to infield burning of agricultural residues. Non-burning alternatives that are currently in use, or have been used in the recent past, by crop residue (i.e., fuel type) within the Western states are discussed.

2.1 Research Strategy and Sources of Information

The identification of existing non-burning alternatives is a complex task. In some states, there are formal requirements to consider alternatives to infield agricultural burning of residues prior to conducting field burning activities; however, there are typically no formal requirements to actually implement non-burning alternatives. Information regarding the availability, applicability, and cost effectiveness of non-burning alternatives is typically not provided by the states. If alternatives are routinely used, the degree to which non-burning alternatives are implemented is often not formally tracked. To collect the desired information and to address the expectedly wide distribution of information sources, a systematic strategy to collect necessary data was developed.

A comprehensive three-tiered approach was employed to identify and research the various potential sources of information. The first level of sources included state environmental agencies, boards and departments; their respective published reports and documents; and articles and summary information posted on official state level websites. It was expected that if any requirements to implement non-burning alternatives were in place at the state level (and if any non-burning alternatives were identified, available, and in use) that this would be known by state environmental agency contacts who had responsibility for implementing the agricultural burning programs (Appendix A).

For states with aggressive mandates to reduce agricultural burning (e.g., Washington, Oregon and California) quality information on non-burning alternatives was readily available. For those states with less aggressive smoke reduction programs or no formal requirements to address agricultural burning, little or no direct information on non-burning alternatives was available. In these cases, additional contact persons and/or potential sources of related information were obtained by talking with contact persons at the state environmental agency, board and department level.

The additional contact persons and/or information sources identified were typically directly affiliated with state or federal agricultural agencies. These comprised the second level of information sources. The second level sources included state and federal agricultural research centers, state university agricultural extension services offices, individual university agricultural researchers, officially published research documents and reports, and information posted on agricultural research related websites. For some states, the second level sources extended to official state sanctioned or mandated, working groups that were examining agricultural burning. These working groups were usually comprised of representatives from the agricultural community, as well as state agricultural and state environmental agencies.

As the first and second level sources were investigated, a few third level sources were identified. The third level information sources included various private businesses and alternative agricultural information clearinghouses.

The first and second level sources which have provided information pertaining to the identification and use of non-burning alternatives in each of the 15 Western states and tribal lands, include in addition to other sources, the following:

- Informal telephone survey of state agencies (see Appendix A for a complete list of contacts).
- California Air Resources Board:
    - "The Economic Impacts of Alternatives to Open-Field Burning of Agricultural Residues" (CARB, 1993);
    - "Alternative Uses of Rice-Straw in California" (CARB, 1997a);
    - "Progress Report on the Phase Down of Rice Straw Burning in the Sacramento Valley Air Basin 1995-1996: 1997 Report to the Legislature" (CARB, 1997b);
    - "Rice Straw Diversion Plan" (CARB, 1998);

- USDA Agricultural Research and Other Services:
  - "ARS Helps Grass Seed Growers Produce Seed Without Field Burning" (USDA, 1997a);
  - "Less Fire, More Science for Grass Growers" (USDA, 1997b);
- Washington State Department of Ecology:
  - "Cereal Grain Crops Best Management Practices" (WDOE, 2001);
  - Washington Department of Ecology Agricultural Burning Task Force (Pfeifer, 2001);
- Other sources:
  - "Advisory Committee on Alternatives to Rice Straw Burning Report" (SCAC, 1995);
  - "Kentucky Bluegrass (KBG) Seed Crops–Agricultural Methodologies for Reducing Air Emissions," (USEPA, 2001a);
  - "Best Management Practices when Harvesting Surplus Cereal Straw," (GOS, 2000);
  - "Western States Agricultural Burning Survey", (WESTAR, 1999);
  - "Agricultural Burning Smoke Management Program Survey", 2001, Draft Final Report, Contract No. 30202-11, (WRAP, 2001a);
  - "Tribal Emission Inventories and Air Quality Data Gathering and Assessment Project, Draft Report" (WRAP, 2001b); and
  - "Earth Saver: Your Runoff and Sediment Control Solution", (Earth Saver, 2001).

2.2 Non-Burning Management Alternatives Identified

Historically, the types of non-burning agricultural management alternatives available and/or in use have fallen into two categories: soil incorporation of residues in place, and off-site residue use or disposal (CARB, 1993). However, currently non-burning alternatives available and in use today in the Western states typically fall into four different categories and they include:

- Leave residues in place either with or without infield residue treatment;
- Improved management practices and scientific advancements in agronomy and horticulture;
- Alternative land use; and
- Residue collection and hauling for use offsite.

A list of the non-burning alternatives identified by this project is shown in Table 2-1. These alternatives are discussed in detail below.

2.2.1 Leaving Residues in Place

This category of non-burning alternatives includes simple cut and drop in place residue treatments; more complex cut, mulch and drop in place methods; and traditional soil incorporation of residues (wet or dry) including crimp and roll methods. It also includes more complex field management strategies which utilize soil incorporation techniques coupled with deliberate non-burning crop rotation or fallow field practices. Other non-small grain crops in the rotations can utilize the residue quantity produced during the small grain sector soil incorporation of the non-burning rotation (USDA, 1997c). Non-burning alternatives in this category, if applicable to a given crop or fuel type, have the distinct advantage of being convenient and typically less expensive initially; however, increased incidence of insect pest and disease leading to reductions in crop quality and overall decreased profits have been identified.

Hidden costs associated with potential decreases in crop yields and increased use of fertilizers and pesticides have also been cited as drawbacks to widespread use of these non-burning alternatives. More creative and complex field management strategies such as deliberate fallow field or crop rotation practices to increase soil nutrients or break disease and pest cycles offer promising improvements in the implementation of alternatives (NRCS, 2002). Factors such as these are addressed during the assessment of impacts and barriers to the implementation of these and other alternatives in Sections 3.0 through 6.0 of this report.

2.2.2 Improved Management Practices and Scientific Advancements

Non-burning management alternatives in this category include scientific advances in horticulture which have led to the development of genetically distinct types of crops that have

Table 2-1. Non-Burning Alternatives Applicable by Fuel/Residue Type

Fuel/Residue	Leave Residues in Place				Scientific Improvements			Alternative Land Use			Cut or Collect Residues and Haul											
	Cut and Drop Residue in Place	Soil Incorporation: Wet or Dry	Soil Incorporation: Fallow Field, Crop Rotation	Cut, Mulch, Drop In Place; Leave Standing, Crimp or Roll	Genetic Selection: Less Fuel Residual	Genetic Selection: Disease/Pest Resistance	Genetic Selection: Other Tolerance	Plant Crops that do not Need to be Burned	Land Conversion to Non-Agricultural Use	Conservation Tillage Practices	Cut, Mulch, and Haul Residue	Haul to: Waste or Landfill Facility	Haul to: Permitted Burn Facility	Haul to: Power Generation Facility	Haul to: Ethanol Production Facility	Haul to: Redistribution Facility	Haul to: Manufacturing/Use Other[1]	Haul to: Fiberboard Facility	Haul to: Particleboard Facility	Haul to: Use as Compost or Mulch[2]	Haul to: Use as Animal Feed, Bedding	Haul to: Use as Erosion Control[3]
Grains and Hay																						
Barley	•	•	•		•	•	•	•	•	✓		•	•	•	•	•	AK[11]	•		•	AK[11]	•
Corn				•	•	•	•	•	•	✓	•	•	•	•	•	•	•			•		
Hay; Alfalfa[4]	•	•	•		•	•	•	•	•	✓		•	•	•	•	•	•			•	•	•
Hay; All Other	•	•	•		•	•	•	•	•	✓		•	•	•	•	•	•			•	•	•
Oats	•	•	•		•	•	•	•	•	✓		•	•	•	•	•	AK[11]	•		•	AK[11]	•
Rice	•	CA	•		CA	CA	•	CA	CA	✓		CA	CA	CA	CA	CA	CA	CA		CA	CA	CA
Sorghum	•	•	•		•	•	•	•	•	✓		•	•	•	•	•	•			•	•	•
Wheat All	•	CA, WA, ND[14] NM[12]	NM[12], ND[14]		•	CA, WA	•	CA	CA	✓		•	CA	CA, NM[12]	CA	CA	CA, AK[11], NM[12]	ND, NM[12]	WA, ND[14]	CA	CA, AK[11]	CA, NM[12]
Wheat; Winter All	•	ID[13]	ID[13]		•	•	•	•	•	✓		•	•	•	•	•	ID[13]	•		•	•	•
Wheat; Other Spring	•	•	•		•	•	•	•	•	✓		•	•	•	•	•	•	•		•	•	•
Grain Other[5]	•	•	•		•	•	•	•	•	✓		•	•	•	•	•	•	•		•	•	•
Grasses and Seeds																						
Seeds; Alfalfa[4]	WA[6]	•	•		•	•	•	•	•	✓		•	•	•	•	•	•	•		•	•	•
Seeds; Kentucky Bluegrass	•	•	WA, OR, ID	WA, OR, ID	•	WA, OR, ID	WA, OR, ID	•	•	✓		•	•	•	•	•	•			WA, OR, ID	WA, OR, ID	•
Seeds; Other[7]	•	•	WA, OR, ID	WA, OR, ID	•	OR	•	•	•	✓		•	•	•	•	•	AK[11]			WA, OR, ID	WA, OR, ID, AK[10]	•
Orchard																						
Almond				CA		•	•	•	•		•	CA	CA	CA		•	•	•	CA	•		
Apple				•		•	•	•	•		•	•	•	•		•	•	•	•	•		
Apricot				•		•	•	•	•		•	•	•	•		•	•	•	•	•		

Table 2-1. Continued

Fuel/Residue	Leave Residues in Place				Scientific Improvements			Alternative Land Use			Cut or Collect Residues and Haul											
	Cut and Drop Residue in Place	Soil Incorporation: Wet or Dry	Soil Incorporation: Fallow Field, Crop Rotation	Cut, Mulch, Drop In Place; Leave Standing, Crimp or Roll	Genetic Selection: Less Fuel Residual	Genetic Selection: Disease/Pest Resistance	Genetic Selection: Other Tolerance	Plant Crops that do not Need to be Burned	Land Conversion to Non-Agricultural Use	Conservation Tillage Practices	Cut, Mulch, and Haul Residue	Haul to: Waste or Landfill Facility	Haul to: Permitted Burn Facility	Haul to: Power Generation Facility	Haul to: Ethanol Production Facility	Haul to: Redistribution Facility	Haul to: Manufacturing/Use Other[1]	Haul to: Fiberboard Facility	Haul to: Particleboard Facility	Haul to: Use as Compost or Mulch[2]	Haul to: Use as Animal Feed, Bedding	Haul to: Use as Erosion Control[3]
Avocado				•		•	•	•	•		•	•	•	•		•	•	•	•	•		
Cherry				•		•	•	•	•		•	•	•	•		•	•	•	•	•		
Citrus				•		•	•	•	•		•	•	•	•		•	•	•	•	•		
Grapes				•		•	•	•	•		•	•	•	•		•	•	•	•	•		
Nectarines				•		•	•	•	•		•	•	•	•		•	•	•	•	•		
Olive				•		•	•	•	•		•	•	•	•		•	•	•	•	•		
Peach				•		•	•	•	•		•	•	•	•		•	•	•	•	•		
Pear				•		•	•	•	•		•	•	•	•		•	•	•	•	•		
Pecan				•		•	•	•	•		•	•	•	•		•	•	•	•	•		
Plum and Prune				•		•	•	•	•		•	•	•	•		•	•	•	•	•		
Walnut				•		•	•	•	•		•	CA	CA	CA		•	•	•	•	•		
Orchard Other[8]				•		•	•	•	•		•	•	•	•		•	•	•	•	•		
Other																						
Asparagus	•	•	•		•	•	•	•	•	✓												
Beans; Dry Edible		•	•		•	•	•	•	•	✓												
Blueberries										✓												
Canola										✓												
Cotton		•	•		•	•		•	•	✓												
Mint	•	•	•		•	•	•	•	•	✓												
Peas, Dry Edible		•	•		•	•	•	•	•	✓												
Peanuts										✓												
Pineapple		HI		•	•	•	•	•	•	✓	•	•	•	•		•	•					
Potatoes										✓												
Safflower		•	•	•	•	•		•	•	✓	•											
Soybeans		•	•		•	•	•	•	•	✓												
Sugarcane[9]					•	•	•	•	•	✓												
Other Fruits/Veg[10]										✓												

Table 2-1. Continued

Fuel/Residue	Leave Residues in Place				Scientific Improvements			Alternative Land Use			Cut or Collect Residues and Haul											
	Cut and Drop Residue in Place	Soil Incorporation: Wet or Dry	Soil Incorporation: Fallow Field, Crop Rotation	Cut, Mulch, Drop In Place; Leave Standing, Crimp or Roll	Genetic Selection: Less Fuel Residual	Genetic Selection: Disease/Pest Resistance	Genetic Selection: Other Tolerance	Plant Crops that do not Need to be Burned	Land Conversion to Non-Agricultural Use	Conservation Tillage Practices	Cut, Mulch, and Haul Residue	Haul to: Waste or Landfill Facility	Haul to: Permitted Burn Facility	Haul to: Power Generation Facility	Haul to: Ethanol Production Facility	Haul to: Redistribution Facility	Haul to: Manufacturing/Use Other[1]	Haul to: Fiberboard Facility	Haul to: Particleboard Facility	Haul to: Use as Compost or Mulch[2]	Haul to: Use as Animal Feed, Bedding	Haul to: Use as Erosion Control[3]
Other Agricultural Related Fuels[15]																						
Ditches	•			•																		
Land Clearing																						
Rangeland																						
Sagebrush	•	•		•																		
Weeds	•	•		•																		

• = Potentially Applicable

✔ = Currently in practice in most of the 15 Western states

WA, OR, etc. (i.e. State) = Currently in practice to some degree or previously in practice

[1] Includes cement products, building materials, paper packaging, and cardboard manufacturing

[2] Includes food production such as mushroom composting, compost for dairy facilities manure composting, animal bedding, landscaping

[3] Includes wind and soil erosion control, forestry rehabilitation, and landfill covering

[4] Per John Burton, University of Nevada, Agricultural Extension office: "There are no non-burning alternatives (in practice) for alfalfa in Nevada."

[5] Includes undefined grain and hay crops

[6] Per Mark Wagoner, alfalfa seed farmer, Touchet, Washington.

[7] Includes bermuda, fescue, rye, red clover and other grasses for seed production

[8] Includes pistachio, nectarine, persimmon, kiwi, fig and other undefined orchard crops/fuels

[9] Burning of sugarcane occurs prior to harvest so the use of non-burning alternatives that address residues are not applicable (HARC, 2001).

[10] Includes cabbage, carrots, lettuce, tomatoes, green peas, dry onions, melons, and coffee

[11] Per Phil Kaspari, University of Alaska Fairbanks, Agricultural Extension Office.

[12] Per Denise McWilliams, New Mexico Cooperative Extension Services.

[13] Per Roger Veseth, University of Idaho, Agricultural Extension Services: Usage of these practices is highly dependent on rainfall in a given zone. High soil erosion potential is also a limiting factor. Less than 2% is hauled to use in manufacturing or other products due to cost unfeasibility and limited markets for finished products.

[14] Per Duane Bergland, North Dakota University, Agricultural Extension Services.

[15] The use of herbicides, including defoliants and pre-emergent compounds, has been considered in some research applications as an alternative to burning crop residues or to address the problem of weeds. However, this practice was not typically found to be in use for agricultural field crops since the use of these chemicals may interfere with subsequent crops. The use of these chemicals may be explored further as an alternative to irrigation ditch burning.

been selected because they offer a variety of desirable traits. The desirable traits can decrease the need to burn subsequent crop residues. Such traits include increased plant resistance to pests and disease. The development of crop varieties with increased resistance to pests and disease increases the potential feasibility of implementing non-burning alternatives such as soil incorporation.

These desirable traits also include genetic selection for less fuel residue. Scientific advances such as this has made it possible to produce high quality grain, such as rice in California, on crop varieties with shorter stalks. When harvested, these short stalk varieties generate less residue (although this is somewhat offset by their relatively greater shoot density and resulting residue biomass density). Scientific advances in horticulture have also led to the genetic selection for such traits as increased tolerance to shade. For grass seed production in states such as Washington and Oregon, this reduces the need to burn grass seed production crops (i.e., ryegrass). Historically, agricultural burning was conducted to remove previous years' leafy residues and allow sunlight to reach the new growth areas. Removal via burning has also been practiced to help control insects and disease, initiate quick growth, reduce seeding problems, and increase seed production (USDA, 1997c).

This category also includes improved management practices such as crop rotation, crop residue and tillage management alternate management, practices in combination with limited burn activity, farm and equipment sanitation, and pest and nutrient management (NRCS, 2002). This category of alternatives is fairly new in its application to non-burning settings. It will likely change greatly over time, but it offers several of the most promising alternatives available to date. However, scientific improvements take time and a great deal of resources to develop. It can take 10 years or more to develop improved traits and/or varieties.

2.2.3 Alternative Land Use

This category includes the use of alternatives to burning that actively change how the agricultural land will be used. In some cases, growers and producers simply choose to plant crops that do not require burning. In these cases a variety of economic, social and political factors may play a role in the growers' and producers' decision. Such activity may come about in response to a variety of factors, only some of which may be related to environmental concerns and the need to reduce air pollutants from the burning of agricultural residues. This category also includes non-burning strategies which may take agricultural land completely out of crop production. Again, these practices may or may not come about in response to the need to reduce agricultural burning.

Based upon experience with agricultural burning practices and related issues throughout the West as well as ongoing research on this project, it can be concluded that non-burning alternatives in this category are being implemented. However, it has not yet been determined for what ultimate purpose and to what extent these non-burning alternative strategies are actually being implemented. This category is presently much less defined than the other three categories. Alternative agricultural non-burning land use decisions are expected to be more related to economics and crop production environments, as well as land use pressures such as urban growth and development, than they are to environmental pressures.

2.2.4 Residue Collection and Hauling for Use Offsite

This category of non-burning alternatives is quite broad in its applicability and potential for widespread implementation. All non-burning alternatives in this category are based on the premise that the crop residues, which remain after harvesting, are cut and/or otherwise collected from the field and then mechanically hauled offsite. In some cases residues may be collected and hauled away in alternate years in combination with some burning. Alternatives in this category are largely defined by what happens to the crop residue once it leaves the field. Non-burning management alternatives in this category include the following:

- General cut, mulch, and haul to some unspecified destination;
- Haul to a waste or landfill facility;
- Haul to a permitted burn facility;
- Haul to a power generation facility;
- Haul to fermentation facility for use in the production of ethanol and other chemicals used in automotive fuels production;
- Haul to a redistribution facility;

- Haul to a manufacturing or other use facility such as for cement, building materials, paper packaging or cardboard;
- Haul to a fiberboard production facility;
- Haul to a particleboard facility;
- Haul to use as compost or mulch for food production or horticultural practices;
- Haul to use as animal feed or bedding; and
- Haul to use for erosion control either as bales or as manufactured erosion control products.

A number of these non-burning alternatives have been identified as either being in use currently, or in use in the past, in Washington, California, North Dakota, Oregon and Idaho (NDSU, 1998; OSUES USDA-ARS, 1989; OSU USDA-ARS, 1994; OSU USDA-ARS, 1995). Decisions to implement alternatives from this category are related to economics, reliability of residue production, consistent quality of residues available, and market demands for products produced or the residue uses. These implications are addressed more extensively in Sections 3.0 through 7.0 of this report.

3.0 METHODOLOGY FOR ASSESSING IMPACTS OF NON-BURNING ALTERNATIVES

It is necessary to understand the impacts non-burning alternatives will have on farms, the environment, and the regional society in order to assess the reasonableness of adopting non-burning management alternatives. Often, in environmental policy, what seems like a good idea to address one problem creates numerous unforeseen consequences in other areas.

In this section, impacts are assessed in several different ways in order to develop reasonable criteria for use in determining adoption of non-burning alternatives. Also, the impacts and criteria are summarized in such a manner as to provide an overall methodology for assessing the impacts for different crop/non-burning alternative combinations. Section 4.0 contains two case studies that employ the criteria and methodology described here.

Changing agricultural practices affect not only the agronomy of the farm and its economic well being but also effect the environment as the landscape changes and through society as economic relationships shift and adjust. A shift to non-burning alternatives may have profound effects on sub-regions and cultures. In this study, consideration of these impacts is restricted in two ways.

First, this study does not consider changes in land use either as an alternative to agricultural burning or as a consequence of regulation of agricultural practices. It is unclear whether development of agricultural land for more urban uses reduces or increases overall air emissions in an area. Urban land does not require burning of crop residues but automobiles, home heating, barbecues, and lawn mowers contribute a variety of pollutants to the atmosphere. The loss of farmland also reduces opportunities for ozone absorption in the area. In addition, anecdotal evidence suggests that some growers, who find new burning regulation onerous, have moved to states with fewer regulations. The grower's decision to change crops or take land out of agriculture is complex. The decision depends on local conditions, the economics of substitute crops, the individual firm's investment in machinery and equipment, and the owner's attitude toward rural life. Analysis of the decision requires different analytical tools than the assessment of marginal changes in current practices. The decision analysis would entail modeling of all of the grower's options. These vary from crop to crop and region to region. Thus, likely price and production possibilities for many substitute operations in many different locations would need to developed. To make a complete assessment, estimates of the likely environmental impacts of the new crop's production process would also be needed. The analysis described in this section, and demonstrated in Section 4.0, is confined to the marginal changes in growing practices that can be addressed with simpler analytical tools.

Second, many alternative practices having applicability to crops grown in the Western states with implications for agricultural burning were identified (See Table 2-1). Section 2.0 showed that a large subset of these nearly 1,000 possible combinations are feasible non-burning alternative options. Since it is not possible to perform a detailed assessment of the impacts of all of the feasible options with the time and resources available, a broad assessment of the implications of adoption for all of the feasible combinations of crops and practices identified in Section 2.0 was performed. This analysis provides a qualitative assessment of the issues that would arise from promoting that crop-practice combination, and gives an indication of what may or may not work and its implications.

3.1 Defining and Establishing Criteria for Evaluating Impacts

This section describes various possible impacts due to implementation of non-burning management alternatives and presents some criteria for evaluating their effects. The list of impacts is not exhaustive, nor will all crops present the same effects. The assessment of any alternative must be based on site specific information for the particular crop of interest. Some of the elements which might be considered are summarized in Table 3-1 and discussed in detail below.

3.1.1 Agronomic Impacts

The first consideration is what happens to the agricultural production unit. How does changing to a non-burning alternative change what the grower must do on the land and how does that change affect the productivity of the land? For example, the results of implementing a non-burning alternative (e.g., cut and drop in place) on alfalfa seed residue resulted in increased costs due to additional cultivation, and pesticide and herbicide applications, and decreased yield (Wagoner, 2002). The field on which the alternative was used produced 1,070 tons/acre as compared to other fields (where the residues were burned which produced 1,200 tons/acre. Also,

Table 3-1. Impacts of Non-Burning Alternatives and Criteria for Assessing Their Effects

Impact	Criteria
Agronomic	Soil compression
	Soil erosion
	Increased water use
	Increased herbicide use
	Increased pesticide use
	Land constraint
	Time or equipment constraint
Environmental	Countervailing air emissions
	Negative wildlife impacts
	Water quality degradation
Health and Safety	Increased equipment use
	Increased chemical use
Energy	No contribution to energy production
	Increased energy use
Economics	Not cost-effective
	Moderate farm stress
	Substantial farm stress
	Negative regional impacts
Social and Equity Issues	Raises tribal/cultural/historical issues
	Raises small business issues
	Impacts low resource farms
Political Issues	Agricultural objections
	Environmental objections

since wheat was a rotation crop, additional land cultivation and water was needed to prepare soil for wheat planting. Conversely, non-burning alternatives may well improve the quality and structure of the soil. Each crop and region must be assessed independently to determine the possible consequences of adopting a new technology. Some of the possible effects are outlined here but the list is neither exhaustive nor all negative.

Farms may not have adequate land for storage of crop residue or labor time to transport it. The basic logistics of the alternatives need to be assessed along with growers' resources to accomplish them. For example, when ash is no longer left on the ground, soil nutrient levels may be reduced. Burning also reduces weeds and plant pathogens as well as removing refuges for insect pests. The alternative practice may require more passes over fields with heavy equipment and so may compact the soil. Growers may need to increase application of chemical fertilizers and pesticides to counteract these effects and maintain productivity over the long term. In such cases where elimination of burning is not possible or desirable, a feasible approach would be to combine burning with other non-burning management practices.

The results of field trials and experiences of early adopters of non-burning alternative practices can be used to assess the impact of wider adoption of the practice. Variation from place to place and crop to crop will need to be considered for each suggested alternative. No single approach will be appropriate for all crops or all regions. This report focuses on experiences in the 1990s. Time and budget constraints prevented a much deeper assessment of earlier efforts or traditional approaches. Many possible alternatives discussed in this report are somewhat speculative. Their assessment is based on anticipated changes in agriculture and experience with similar new technologies. While these approaches may not be suitable for adoption immediately, the charter for this project suggested the net be cast to include the broadest array of alternatives foreseeable.

Information collected from experts is used to assess the field-level impacts of each alternative. A more detailed assessment would require specific information from field trials of the alternative practice in the crop of interest. Long term information would be especially useful as long run productivity is the central agronomic impact. Substantiation and quantification of changes in long-run productivity and non-air impacts, such as increased pesticide and herbicide use, would improve upon the assessment of feasibility using multi-year crop budgets as was done in this study.

3.1.2 Environmental Impacts

The goal of promoting non-burning alternatives for agricultural activities is to reduce the environmental impact of burning on visibility and air quality. However, it is expected that the non-burning alternatives will entail new practices which may have their own environmental consequences. For example, with increased tractor operations and transportation of field and orchard debris, more diesel fuel will be burned. This may increase overall carbon dioxide (CO_2), nitrogen oxides (NO_x), and particulate matter in the air. Also, primary particulate matter from vehicle travel on paved and unpaved roads may increase. Additionally, increasing tilling would increase airborne particulate matter. If power plant emissions are poorly controlled, burning orchard or field crop wastes as fuel for electricity generation could reduce the benefits of decreased open burning. Thus, reductions in emissions released from each non-burning alternative vis-à-vis current practices were determined. Also, the implications of using agricultural waste for animal feed, mulch, and other uses were assessed by discussing the environmental consequences of these alternatives with appropriate experts.

Fire is a powerful agent of ecological change. Wildlife adapts to the agricultural practices in their environment. The timing of hay cutting, for example, has a tremendous effect on the survival of ground-nesting birds. Any changes in burn practices are likely to alter these adaptations. Follow-on effects from increased fertilizer and pesticide applications may have negative water quality effects in surface or groundwater. These effects should be noted in discussions with experts in the field who have experience with alternatives and highlighted where applicable to alternatives.

Environmental impacts present a challenge for more detailed case studies. Standard engineering data are used to estimate emissions increases from residue use that offset emission reductions. However, for other types of impacts, only the relative significance of adverse impacts (i.e., which non-burning alternatives raise the greatest environmental concerns) were assessed in this analysis.

3.1.3 Health and Safety Impacts

Alternatives must not increase the health or safety risks relative to current burning practices. A literature review and interviews with local experts form the basis for assessing qualitative changes in health and safety factors associated with current burning practices and the major alternatives. Safety impacts must be carefully assessed for each alternative considered. Where the alternative does not change the types of activities conducted appreciably, there is little change in safety. Where the alternative entails using unusual equipment or operating equipment in more perilous ways (e.g., driving tractors on steep slopes), then safety may be a serious concern.

3.1.4 Energy Impacts

Crop residues can provide a renewable source of biomass for power generation. Sugarcane bagasse and nutshell fueled furnaces have been added to sugar mills and nut processing plants for many years. Existing stand-alone biomass power plants rely on urban and lumber mill wood waste. They are capable of mixing in orchard prunings, but avoid non-woody crop residues.

Field crop residues present several challenges for electricity generation. First, they have a low heat content. It requires a large volume of straw to generate as much energy as a cubic foot of natural gas. Collection is, therefore, often costly. Large volume also creates handling problems in getting fuel into furnaces efficiently. Second, crop residues are seasonal. Large amounts of straw need to be removed from fields at certain times of the year and may not be available during the remainder of the year. Orchard pruning provides cuttings in late winter but not at other times. As a consequence, large quantities of fuel will typically need to be stored for considerable periods to keep a power plant operating continuously. Third, some residues must be dried, chipped, or otherwise pre-processed to be efficient fuels. If energy must be expended to process the residue, the possibility exists that it may require more energy to process the fuel than the fuel provides when it is burned.

Even with these management issues, persistent high wholesale electricity prices may make an agricultural residue burning power plant a viable option for some locations. CARB (1993) and other sources have evaluated the prospect for new biomass power plants. In this study, each crop's suitability as a fuel is scored. A detailed assessment would consider the feasibility of power plants for the specific crop given the characteristics of the residue and prior experience using it as a fuel.

3.1.5 Economic Impacts

The economic impact of adopting non-burning alternatives is an important consideration. One criterion for selecting the preferable options will be cost effectiveness, e.g., the lowest cost per ton of particulate emissions reduced, such as particulate matter less than 10 microns in aerodynamic diameter (PM_{10}). This is a useful standard since it can be used to directly compare the agricultural non-burning alternatives with industrial and automotive PM_{10} source reduction programs. Costs of adopting a non-burning agricultural alternative are measured by the difference in the cost of agricultural operations between the traditional burning operation and the new alternative approach. Each alternative is assessed at the enterprise, farm, and regional level. While the cost of implementing an alternative for a given farm field is a component of the selection among alternatives, the viability of any alternative also depends on the farm's ability to remain profitable given the new labor, capital, and land requirements of the new technology. The ability of farms to finance the change and continue in business must also be assessed. Regionally, the non-burning alternatives may shift employment and supply relationships.

In this analysis, information on whether the alternative is cost-effective, affordable, and regionally sustainable was requested during an informal survey of stakeholders affected by and knowledgeable of agricultural burning and alternatives (see Section 5.0). A more detailed assessment would include comparative enterprise budgets, financial ratio analysis, and regional impact analysis.

Cost-Effectiveness – Enterprise Level Assessment

Engineers can estimate the tonnage of PM_{10} released from agricultural burning of different crops each year using residue loading factors (tons of residue per acre) and emission factors (pounds of pollutant per ton of residue burned). (Usage of these factors is illustrated in Section 4.0 of this report.) Each fuel source has a characteristic profile of burn products. While the profile varies with weather conditions, average values will be used to estimate emissions per ton of fuel burned. This rate of emission can be expanded to an acreage basis using average fuel production per acre harvested. Burn reduction programs in Washington and Oregon have significantly reduced human exposure to particulates without eliminating burning by permitting burns when the wind will carry pollutants away from population centers (WDOE, 1998a). A detailed GIS system combined with regional wind pattern and population information could conceivably develop estimates of expected population exposed to smoke under different permitting scenarios. For alternative development, however, a reasonable goal is overall reduction in particulate emissions, and thus considers cost effectiveness in terms of reduced tonnage of emissions rather than reduced human exposures.

Crop production budgets are used to estimate the incremental costs per acre of the alternatives. Basically, a farmer has four options:

1. Leave the residue in place,
2. Haul it somewhere else,
3. Use varieties selected for characteristics that reduce the need to burn; or
4. Use the land for some other purpose that does not require burning, either a different crop or a non-agricultural use.

The first three options change operations on the farm and may affect operations elsewhere (e.g., wherever you haul the residue). While these may be costly changes, the producer continues to produce the same crop and the basic structure of the farm economy remains intact. The fourth option is much more consequential. Although changing crops may be a significant contributor to reduced particulate emissions, it raises large issues about the character of rural areas and the future of rural development.

For example, in Maricopa County, Arizona, cotton is being replaced with alfalfa resulting in a fewer air quality impacts to “neighbors” due to less frequent tillage and planting (i.e., every year with cotton as compared to every three or four years with alfalfa) (Rogers, 2002). Although this switch from cotton to alfalfa appears to be driven mainly by economics due to improving local markets for alfalfa, and is not related to implementation as a non-burning alternative, the air quality benefits appear to be substantial. Also, the economic benefits from the growing market for alfalfa is somewhat offset by the increased costs to farmers when switching due to several factors such as increased expenses associated with the need to buy new equipment, cost of alfalfa seed, and employing laser leveling.

Crop production budgets for current agricultural practices show all of the necessary tasks to raise the crop and their costs per acre by expenditure category for a well-run operation. Budgets do not represent the average but generally show an idealized production operation using the best practices suggested by the state cooperative extension service. Budgets have also been produced for some non-burning alternative practices.

Many enterprise budgets show a loss whether or not the crop is actually viable. A more accurate measure of profitability is revenues minus variable costs. Many growers will continue to operate at a paper loss as long as their cash flow is adequate to cover variable costs and the essential fixed costs (e.g. debt service). If the additional costs of the alternative practice make the variable costs greater than revenues, then that alternative is definitely not affordable. If the alternative practice reduces net income considerably, growers will reassess the profitability of that enterprise and may switch to another crop or to a different non-burning alternative.

Table 3-2 shows a budget for producing tall fescue seed. The propane burn alternative assumes straw is baled, stacked, and later burned or composted elsewhere on the farm. It incurs additional variable costs of $28.16/acre and additional fixed costs of $18.47/acre over the current open burn practice. Propane burn continues to have a positive net income and so is a viable alternative. Crew-cutting also involves baling excess straw followed by one pass over the field with a crew-cutter. The additional pass involves more equipment for a longer time period so fixed costs are higher than the other alternatives. Although variable costs are slightly lower than propane burning, the crew-cut alternative has a negative net income. However, crew cut gross income minus variable costs is greater than the propane burn approach so crew cut is also a viable option. This budget assumes yield is unchanged through time no matter which option is selected so a simple analysis of an annual budget is appropriate.

Several alternatives have the possibility of producing revenue from new by-products. A complete feasibility study should be conducted for any new product, including the costs of marketing and delivering it. Such studies are well beyond the scope of work for this project so this study only indicates where such opportunities may be available. In this study,

Table 3-2. Enterprise Budget for Tall Fescue Seed, Willamette Valley, Oregon (Dollars per Acre)

Budget Element	Alternative			Difference from Conventional	
	Open Burn	Propane Burn	Crew-Cut	Propane Burn	Crew-Cut
Total Gross Income	542.75	542.75	542.75	0	0
Total Variable Cost	278.75	306.91	304.24	28.16	25.49
Gross Income – Variable Cost	264.00	235.84	238.51	-28.16	-25.49
Total Fixed Cost	213.52	231.99	242.67	18.47	29.15
Total of All Costs	492.27	538.9	546.91	46.63	54.64
Net Projected Returns	50.48	3.85	-4.16	-46.63	-54.64

Source: Cross, et al.,1992.

current prices of similar products are used to indicate the possible net revenues given current market conditions. Where the alternative practice has long term effects on the productivity of the land, such as by promoting pest survival, costs will be annualized over the cropping cycle to determine the costs in terms of yield as well as the direct costs of the alternative. Annualization converts a flow of unequal payments through a period of time to an equivalent series of equal annual flows.

Cost effectiveness is measured as the change in budgeted expenditures to implement the alternative per ton of PM_{10} avoided by adopting the alternative practice. Most costs of the alternative practices are variable and emissions will be defined per acre, so abatement cost curves will be essentially linear. Key assumptions can be tested by sensitivity analysis.

Affordability – Farm Level

Growers will not adopt a new technology or practice unless it makes economic sense for their farm as a whole, thus the impact of the alternatives on the agricultural production farm's profitability and financial stability should be assessed. This is often evaluated in terms of changes in the farm's income and financial ratios. If income falls significantly, or financial ratios fall into a range where banks will hesitate to loan money, then the alternative may not be affordable and will not be widely adopted. Crop budgets are used to assess whether a typical well-managed operation would confront financial difficulties in implementing the alternative technologies. Balance sheets and other information from the USDA Agricultural Resource Management Study (ARMS), an annual survey, serve as a baseline for analysis (USDA, 2001).

The most intuitively direct measure of affordability is net income. As most farms are privately held and only report financial information for tax purposes, they have a disincentive to report positive net income. Percentage change limits are set such that a change in average revenues minus variable costs of a given percentage is considered to indicate a moderate affordability problem. U.S. EPA typically uses changes of 3 or 5 percent as indicators of moderate stress. Negative net revenue indicates severe stress (USEPA, 2001b).

Debt-to-asset ratios should also be considered. Banks and other lenders have criteria for lending to agricultural firms which include the levels of various asset ratios. If a farm's debts become too high in proportion to its total assets, the long-term burden of debt can require a large share of cash resources. The higher probability of default discourages banks from lending additional funds to the farm, making equipment replacement costly and difficult. The USDA considers a debt-to-asset ratio higher than 0.40 to be an indicator of financial distress (USDA, 1999).

Indirect Impacts – Regional Level

Changes in farm operations can have impacts in the regional economy. Collecting and transporting crop residue may require extra labor which may generate more income for farm workers. Demand for additional labor may raise wage rates, changing the cost structure for producers, and, ultimately, creating different optimal sizes and capitalization for farming operations. New equipment that might be needed or faster depreciation of old equipment may increase sales at agricultural implement dealers. Such effects generate ripple effects throughout the regional economy. The California Air Resources Board (CARB, 1993) used a computable general equilibrium (CGE) model to trace the impact on prices and quantities of adopting different policy options for burning crop residue. CGE is particularly useful in assessing agricultural income changes from switching crops or exiting agriculture. Only rice straw burning in the Sacramento Valley was assessed with CGE in the CARB report. Preliminary assessment of changes for other crops showed the regional impacts were unlikely to be significant and did not merit a full CGE analysis. However, regional dislocations from adoption of non-burning alternative practices can occur (e.g., relocation of grass seed production from Oregon and Washington to Wyoming, which is discussed in Section 5.0 of this report).

In those case studies where alternatives appear to generate changes that may ripple through the economy, publicly available multipliers from the Regional Input-Output Modeling System, Version 2 (RIMS II) (USDC, 1997) are used to derive a first approximation of the impact. The multiplier analysis will estimate indirect and induced changes in employment and output for all sectors of the economy from output changes in the farm sector. CGE modeling is more sophisticated than multiplier analysis and can answer a variety of questions about possible outcomes and the effects of changing assumptions. CGE analysis may be useful at a later stage in alternatives assessments to assess more detailed regulatory options.

3.1.6 Social and Equity Issues

There may be burning practices or non-burning alternatives that have cultural and/or historical implications unique to certain groups beyond cost considerations, such as small growers, culturally diverse groups, or residents of tribal lands. (Survey respondents were asked if they are aware of any special considerations with regard to non-burning alternatives; however, no particular issues were raised.) A more detailed analysis would indicate likely air quality results with and without a group's adoption of non-burning alternatives and will explore state options to address the issue.

3.1.7 Political Issues

Promotion of non-burning alternatives by government, even on a voluntary basis, has the potential to antagonize agricultural interest groups. Most growers, producers, and distributors are politically well organized. They routinely advocate their concerns in state legislatures through crop specific organizations and more general agricultural lobbies. Environmental and recreation interests are also well organized. Any effort to induce change may face political pressure on several fronts. Survey respondents were asked if they are aware of any specific groups with strong positions on agricultural burning. The strength and willingness to compromise of the various interest groups varies from state to state. While stakeholders can indicate potential pitfalls, governments seeking to implement a program of non-burning alternatives will need to make their own assessments of the political viability of any alternatives on a case-by-case basis.

3.2 Methodology for Assessing Impacts

Table 3-3 summarizes the potential impacts from implementing non-burning alternatives and their associated criteria for evaluation. Also, the table gives a summary of the methods and information sources needed to assess the impacts according to their applicable criteria. The methods include a combination of qualitative (e.g., stakeholder surveys and anecdotal information) and quantitative tools (i.e., crop budgets and RIMS multipliers) as described above. Expected results are provided in order to help the assessor of the impacts to focus the analysis on the most significant impacts, depending on the crop/alternative(s) chosen.

Table 3-3. Summary of Criteria and Methods to Assess Impacts of Non-Burning Management Alternatives

Impact	Criteria	Information Sources	Methods	Expected Results
Agronomic:				
	Soil compression	Prior trials; Agronomic experts	Apply results from prior trials to prospective sites	Problem for some crops; long term decline in productivity and/or additional work
	Soil erosion			Problem for some crops
	Increased water use			Little incremental water use
	Increased herbicide use			Likely problem as weeds proliferate without burning
	Increased pesticide use			Likely problem for some alternatives as pests shelter in unburned fields
	Land constraint			May be problem for smaller farms
	Time or equipment constraint			May be problem for smaller farms
Environmental:				
	Offsetting air emissions	Burning facilities emissions history	Compare emissions from burned fields with emissions from facilities	Burning at a power plant or disposal facility is less polluting than field burning
	Negative wildlife impacts	Prior trials	Anecdotal evidence of changes in habitat	Little change in effect from burning
	Water quality degradation	Prior trials	Qualitative assessment of likely changes	Little change anticipated
Health and Safety:				
	Increased equipment use	Crop budgets; Agricultural Injury database	Budgets will indicate extra equipment passes; apply injury rates per hour and compare with injuries from burning	Small increased risk of injury, largely from increased highway driving
	Increased chemical use			
Energy:				
	No contribution to energy production	Alternative description	Use engineering information to estimate energy produced by using residue as fuel	Some opportunity to increase energy output if prices are high enough
	Increased energy use	Life cycle energy assessment	Use agricultural engineering information to estimate changes in energy use.	Small changes in energy use.
Economics:				
	Not cost-effective	Crop budgets; engineers' emissions estimates	Estimate costs of farming practice changes per unit of emissions reduced	Reducing agricultural burning is comparatively cost effective in many situations
	Moderate farm stress	Crop budgets; ARMS survey data	Estimate impact of changes in farm costs on farm financial ratios	Minor impacts on some farms
	Substantial farm stress	Crop budgets; ARMS survey data	Estimate impact of changes in farm costs on farm financial ratios	Very few farms seriously affected
	Negative regional impacts	RIMS multipliers; aggregated costs	Estimate employment and other changes from multiplier changes	Small regional impacts
Social and Equity Issues:				
	Raises tribal/cultural /historical issues	Survey	Qualitative assessment	Unknown
	Raises small business issues	Survey	Anecdotal evidence	Some problems possible
	Impacts low resource farms	Survey; Crop budgets; ARMS data	Anecdotal evidence and estimated impacts from farm costs	Some small farms may be affected
Political Issues:				
	Raises agricultural objections	Survey	Anecdotal evidence	Some objections are likely
	Raises environmental objections	Survey	Anecdotal evidence	Some objections are possible

After the impacts/criteria have been evaluated, the assessor can then estimate the feasibility of a given alternative according to the ranking scheme shown on Table 3-4. The assessor needs to assign a numerical value from 0 to 3 to indicate the existence and/or significance of the negative outcome of the impact likely to occur (i.e., "0" means no problem exists or is likely to occur if the alternative is implemented; "3" means a major problem exists or is likely to occur if the alternative is implemented). While this is a somewhat subjective assessment, it can be valuable in determining the relative severity of a potential impacts. The same person should assign all feasibility factors for a given crop/alternative process. This simple process can address alternatives where there is only a limited amount of information. By assessing adoption of similar alternatives in similar situations, the rough scale of the alternative's impacts can be evaluated. When more information becomes available, a more sophisticated measurement scheme can be employed. This methodology is used in Section 4.0 to evaluate two case studies for implementation of non-burning alternatives.

Table 3-4. Ranking of Non-Burning Management Alternatives[1]

	Leave Residues in Place		Cut or Collect Residues and Haul											Scientific Improvements			Alternative Land Use		
Potential Impacts and Criteria	Mulch Residue	Soil Incorporation: Wet or Dry	Soil Incorporation: Fallow Field	Waste Facility	Permitted Burn Facility	Power Generation Facility	Ethanol Production Facility	Redistribution Facility	Manufacturing or Use Facility	Fiber Board Facility	Particle Board Facility	Use as Compost or Mulch	Use as Animal Feed	Use For Erosion Control	Less Fuel Residual	Disease / Pest Resistance	Other Tolerances	Plant Crops That Are Not Burned	Land Conversion to Non-Agriculture	Conservation Tillage
Agronomic:																				
Soil compression	1	3	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	0	0	1
Soil erosion	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1
Increased water use	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1
Increased herbicide use	2	2	2	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2
Increased pesticide use	2	2	2	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2
Land constraint	1																		0	0
Time or equipment constraint	1																		0	2
Environmental:																				
Countervailing air emissions	0																		3	1
Negative wildlife impacts	1																		3	1
Water quality degradation	1																		2	1
Health and Safety:																				
Increased equipment use	1																			1
Increased chemical use	1																			1
Energy Impacts:																				
No contribution to energy production	2																		3	1
Increased energy use	2																		3	1
Economics:																				
Not cost-effective	2																			
Farm financial stress	2																			
Negative regional impacts	1																		3	
Social and Equity:																				
Raises tribal/cultural/historical issues																			3	0
Raises small business issues	1	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0
Impacts low resource farms	2	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Political:																				
Agricultural objections	2	2	2	3	3	0	0	0	0	0	0	0	0	0	1	1	0	3	3	3
Environmental objections	2	1	1	3	3	1	1	2	1	1	1	0	0	0	2	3	2	1	3	0
Average Score	1.4	1.8	1.6	1.9	1.9	1.1	1.1	1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.2	1.1	0.9	1.6	2.1	1.1

Steps for Ranking Non-Burning Management Alternatives[1]:

1. Assign feasibility factors to indicate a negative outcome as follows:

   0 = No problem exists;
   1 = Problem may exist;
   2 = Problem does exist;
   3 = Major problem exists; and
   Blank = Not relevant or viable

2. Calculate the average score for each alternative using the feasibility factors for the relevant impacts.

3. The lowest scores indicate the most feasible alternatives.

[1] See Section 4.0, Tables 4-1 and 4-2 for examples of using feasibility factors.

4.0 SELECTING NON-BURNING ALTERNATIVES: CASE STUDIES

This section presents two case studies that assess impacts of non-burning alternatives. These case studies illustrate the use of criteria to determine the feasibility of adoption of the non-burning alternatives. The three-tier data collection effort first described in Section 2.0, was implemented throughout the study, and provided data for the case study analyses. The data that have been collected are described in detail in Section 5.0 of this report.

Open-field burning has been the traditional method to dispose of rice straw and control disease. Alternatives to burning present different sets of challenges to rice producers and their communities. A case study of rice straw alternatives demonstrates the methods of assessment that lead to criteria for adoption. Burning has also been a traditional treatment for grass seed fields. A second case study considers impacts of reduced burning on grass seed producers.

4.1 Rice Straw Case Study

More than 400,000 acres are devoted to rice cultivation in California. When rice fields are harvested, a standing crop of rice straw remains. The least costly means to dispose of the straw is to burn the open field. Burning can create smoke in nearby communities, and sometimes interfere with driving and air travel. Efforts have been underway since the 1970s to reduce the extent of rice straw burning and ensure that it occurs only when meteorological conditions are favorable. Since 1992, rice burning in the Sacramento Valley has been curtailed from 90 percent of planted acreage to less than 30 percent. Beginning in 2001, the annual goal is to burn the lesser of 25 percent of planted acres or 125,000 acres exclusively for disease control purposes. In fact, the industry estimates that under this program, less than 20 percent of its acreage will be burned (Buttner, 2002).

The legislated goal of reduced acreage burned has driven an effort to develop alternatives to burning. Rice straw is a re-newable biomass resource that can be used in many different processes and products. Among the uses being developed are ethanol production, particleboard, paper, composite materials, erosion control products, cattle feed, animal bedding, and straw bale construction. Agricultural and construction industries use rice straw as a mulching material and bale barrier to reduce sediment runoff from bare soil and promote new growth. California has sought to promote alternative uses through grants and other mechanisms to initiate markets for rice straw. These efforts continue to show promise even though they have not yet been entirely accepted (CIWB, 1998).

4.1.1 Agronomic Impacts

After rice is harvested, rice straw is burned to prevent overwintering of disease organisms, dispose of the straw, and prepare the field for planting. There are, basically, two alternatives to burning rice straw. The first is to incorporate it into the soil in the field. The other is to remove it and utilize it in some other fashion.

Continuous soil incorporation by chopping and discing or rolling the residue into the soil can promote stem rot infection and changes soil tilth. In the long run, these changes may lead to unsuccessful decomposition, decreased yields, and more difficult working conditions as the fields become slower to dry out (REI, 1997). Yield decline represents the largest financial risk to growers from soil incorporation (CARB, 1993). Chopping and discing takes considerably more labor and machine time than burning, but probably does not require the farm to purchase new equipment. Disease build-up may be offset with greater application rates for pesticides. However, the consequences to soil structure of increased traffic over the field cannot be easily mitigated. A combination of soil incorporation and occasional burns may be a viable alternative to annual burning. Winter flooding can also mitigate many of the disadvantages of soil incorporation and improve nutrient cycling and yields. However, it requires greater use of water and fuel which contribute to higher costs (CARB, 1993).

Removing rice straw from the field avoids some of the agronomic issues of soil incorporation but creates a large volume of material that must be used or disposed. Other than burning or composting in windrows, removal techniques require baling straw for transport. Purchasing a baler or hiring custom baling services is a significant cost of any removal alternative. Baling standards for many alternative uses are quite stringent which adds to the costs of removal (REI, 1997). Techniques requiring additional passes of machinery over the field raises the risks of soil compaction and possible delays from wet field conditions due to excess soil compaction. These may be addressed with more expensive technological options, such as tracks or flotation wheels on balers (REI, 1997).

Soil incorporation will continue to require burning or winter flooding of some rice land each year to maintain yields. Removal of rice straw for other uses may be a viable alternative if the producer can offset the added costs of removal with profits from sale of the product.

4.1.2 Environmental Impacts

The goal of promoting non-burning alternatives for agricultural activities is to reduce the environmental impact of burning on visibility and air quality. Alternatives, however, have environmental consequences of their own. Soil incorporation of rice straw reduces smoke and carbon dioxide emissions but increases methane production as organic matter decomposes in the wet soil. Methane is a powerful greenhouse gas with 20 times the heat trapping potential of carbon dioxide. Methane emissions increase 3 to 12 times when rice straw is added to the soil rather than burned (REI, 1997). Clearly, there is a local/global trade-off in environmental impacts from soil incorporation.

Other alternative uses of rice straw offer different trade-offs. Burning rice straw for power generation, for example, can reduce the production of particulate matter and methane because the burning conditions can be tightly controlled. However, the high silica content in rice straw tends to foul boiler tubes and disposal of ash also presents a new challenge. Non-burning alternatives require greater use of tractors and other equipment to chop and disk, or bale and remove, the rice straw. This added activity increases diesel and dust emissions. While the diesel emissions have a considerably smaller volume than the straw burning smoke, particulate emissions from diesel-fueled engines are listed by the California Air Resources Board (CARB) as a toxic air contaminant (CARB, 2001a). Also, increased vehicle traffic on paved and unpaved roads, and in fields, will increase particulate matter emissions. Relative risks from each source need to be considered as alternatives are assessed.

Alternative uses of rice straw that result in aerobic decomposition have fewer balancing emissions issues than soil incorporation. These include uses such as animal bedding, erosion control, and weed suppression. Rice straw is particularly well-suited as a mulch because it is slow to decay and carries few upland/non-aquatic weed seeds (REI, 1997). Uses that preserve the straw for an extended period or displace the use of other more valuable resources sequester excess carbon and so alleviate global warming without significant negative trade-offs. These include straw bale construction, building materials, and paper-making.

Wildlife adapts to the agricultural practices in their environment. California rice fields have been significant resources for migratory waterfowl (CARB, 2001a). If a non-burning alternative resulted in a change in the flooding regime, historical patterns of waterfowl migration could be affected. Ultimately, waterfowl populations could be reduced. Increased rice production in Arkansas and Texas is considered an important contributor to the over-population of mid-continent white geese and the subsequent destruction of their arctic breeding habitat (FWS, 1999). Such over-population issues have not arisen on the West Coast but indicate the interconnectedness of agriculture and wildlife.

Uses that consume large volumes of straw are also preferable environmentally. Composite materials made from rice straw are another potential use (REI, 1997). Such production, however, will consume only a small portion of the total rice straw harvest even when technological and financial hurdles are overcome. Proven uses which require large volumes of straw may be more successful in developing straw markets in the near term.

4.1.3 Health and Safety Impacts

Farm safety impacts do not appear to be a strong criterion for differentiating among rice straw burning alternatives. None of the alternatives appear to be unusually hazardous compared to other agricultural work.

4.1.4 Energy Impacts

Rice straw can provide a renewable source of biomass for power generation. However, it presents several challenges for electricity generation as described below:

- It has a low heat content. It requires a large volume of straw to generate as much energy as a cubic foot of natural gas. Collection is, therefore, costly. Large volume also creates handling problems in getting fuel into furnaces efficiently.

- Straw supplies are seasonal. Large amounts of straw need to be removed from fields in the fall and may not be available during the remainder of the year. As a consequence, large volumes of fuel will typically need to be stored for considerable periods to keep a power plant operating continuously. This problem can also be mitigated by using multiple biomass fuel sources which would be available in different seasons.

- Rice straw must be dried and chopped to be an efficient fuel. If energy must be expended to process the low energy fuel, more energy may be required to transport and process the fuel than it provides.

- Rice straw has an ash content of 14 to 20 percent, compared to wood that typically has an ash content of from less than 2 percent to 4 to 8 percent (typically used in power generators). Therefore, it leaves more ash to be disposed in landfills or similar facilities.

The California Air Resources Board concluded that the use of rice straw to generate electricity is precluded by technological constraints (CARB, 1993). Clearly, high energy prices or subsidies will be needed to solve the technological problems and overcome the logistical issues. Straw-burning district heating systems are common in Denmark where subsidies have been offered to curtail open-field burning (REI, 1997). Although, it is not possible within the scope of this project to speculate about possible incentive structures to establish a biomass energy industry, it is noted that rice straw has some unusual characteristics that make it particularly unattractive as boiler fuel.

4.1.5 Economic Impacts

The economic impact of adopting non-burning alternatives is an important consideration. One criterion for selecting the preferable options is cost effectiveness (i.e. the cost per acre per pound of particulate emissions reduced). The costs of adopting a non-burning agricultural alternative are measured by the difference in the cost of agricultural operations between a traditional burning operation, about $3 per acre, and alternative non-burning approaches, about $31 to $47 per acre (CARB, 2001a). The viability of any alternative also depends on the farm's ability to remain profitable given the new labor, capital, and land requirements of the new technology. Financial incentives can help overcome or offset the cost of implementing non-burning alternatives. (These are discussed in more detail in Section 7.3 of this report under Accountability Mechanism 16.)

Cost-Effectiveness – Enterprise Level Assessment

Engineers estimate that each ton of rice straw burned emits 6.3 to 9 pounds of PM_{10} (CARB, 2000). The emission factor used in this estimate was 6.9 pounds of PM_{10} per ton (Jenkins, 2002). A typical acre of rice yields approximately 3 tons of rice straw residue after harvest. Thus, each acre burned emits approximately 20.7 pounds of PM_{10} each year. Limiting burning to weather conditions that reduce the probability that smoke will reach cities can reduce the impact of smoke emissions on society. However, since the air quality goal is overall reduction in particulate emissions, cost effectiveness is determined in terms of reduced pounds of emissions rather than reduced human exposures.

Crop production budgets for current agricultural practices show all of the necessary tasks to raise the crop and their costs per acre by expenditure category for a well-run operation. Budgets do not represent the average but generally show an idealized production operation using the best practices suggested by the state cooperative extension service. The University of California (UC) Cooperative Extension Service (Williams, 2001) has produced a rice crop budget that contemplates a farm using a mix of burning and non-burning alternative practices.

An expanded budget that estimates the costs of four alternative straw management strategies was developed by the California Air Resources Board (CARB, 2001a). Rice growers actually use a variety of practices depending on field characteristics, past performance, and the prices of water and fuel. The CARB options range in cost from $31 to $47 per acre with the two most popular practices (Chop/Stubble Disc/Winter Flood and Chop/Chisel/Stubble Disc/Winter Flood) averaging about $43 per acre. The UC rice budget also indicates that the least costly non-burning alternatives are to chop and disc ($37 per acre) or chop, flood, and roll ($32 per acre). However, neither of these methods can maintain yields without resorting to occasional burning.

The UC rice budget suggests that 15 percent of rice land may need to be burned in a given year. Thus, the costs to abate burning rise by $1.40 per pound abated [($32-$3)/(20.7 lbs PM_{10})] until 85 percent of acreage is managed by the chop, flood and roll method. To avoid releasing the last 15 percent of PM_{10} emissions, a more sustainable winter flooding regime must be adopted at an increased cost of $2.13 per pound abated [($47-$3)/(20.7 lbs PM_{10})]. The cost of complete abatement reaches approximately $31.25 per acre. Figure 4-1 illustrates the relationship between cost of reduced burning and potential reductions in PM_{10} emissions on a per acre basis for rice straw.

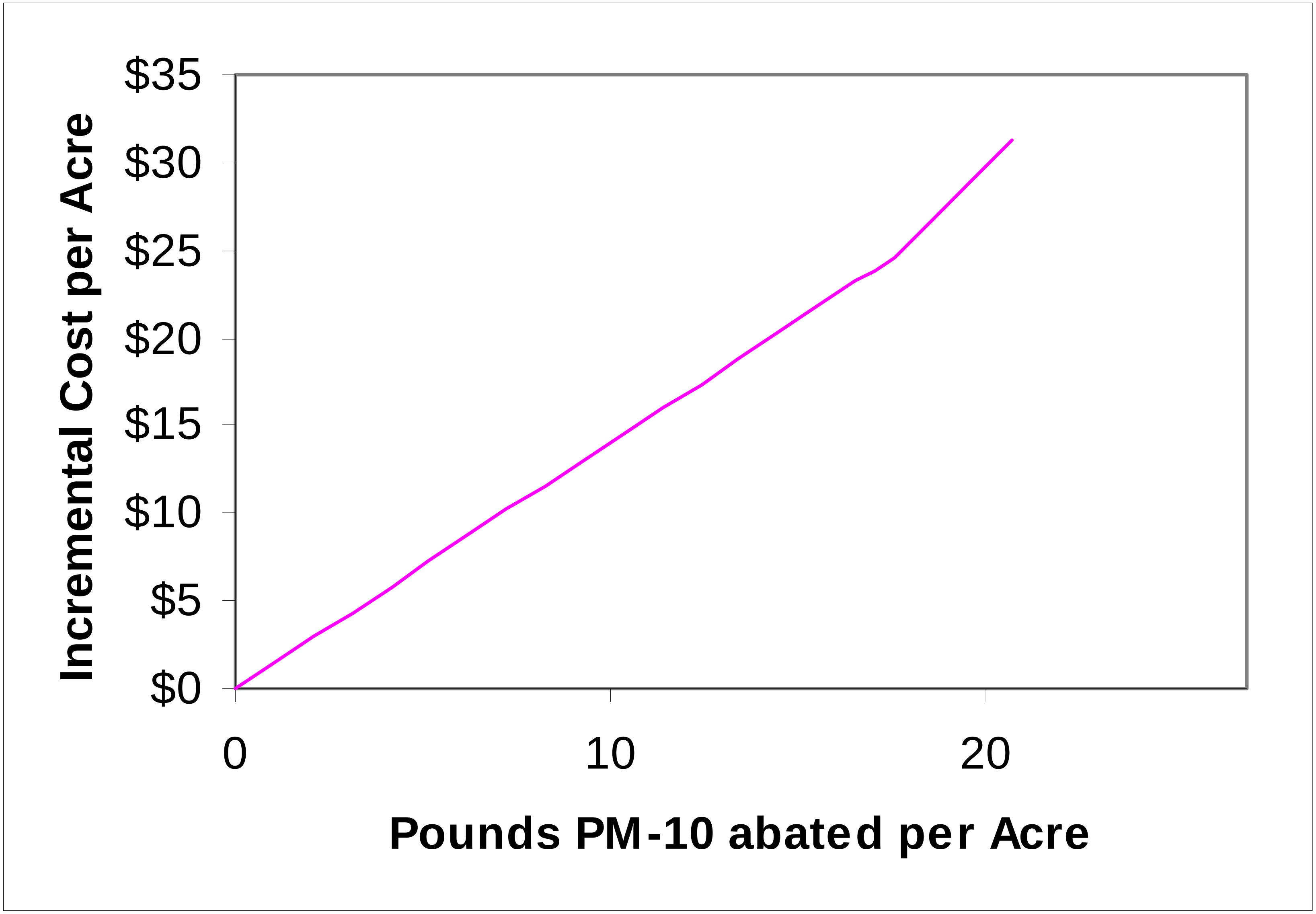
The UC rice budgets do not estimate the costs of baling rice straw, storing, and transporting it to alternative uses. These activities are more costly as they involve investment in a baler or hiring custom baling as well as more fuel and labor time in transit. The California Air Resources Board estimates field removal costs of $75 per acre based on field clearing costs of $60 per acre plus transportation costs of $15 per acre (CARB, 2001a). However, if a market for rice straw evolves, a compensating income could be obtained from baled straw. Furthermore, incentives offered by the state can influence the level of harvesting and use of rice straw. While use as compost or mulch, animal feed, or erosion control are the most likely alternative uses to consume large quantities of straw, there are many possible substitutes which will keep the price of straw for these uses relatively low. Hence, the costs of baling and hauling rice straw may not be recouped at competitive prices.

Affordability – Farm Level

Growers will not adopt a new technology or practice unless it makes economic sense for their farm as a whole. Rice acreage on farms that grow rice tends to be greater than the specific crop acreage of other commodity farms (Chambers and Childs, 2000). Rice farming is also more capital intensive than any field crop, other than cotton. This suggests a greater reliance on a single crop and the possibly a higher degree of borrowing by rice farmers than other producers. (Debt load information specific to California rice farming was not available.)

The UC rice enterprise budget shows producers' operating, overhead, and capital recovery costs are $188 greater than their revenue given current federal rice program payments and a price of $8.00 per hundredweight. Even a well-managed farm is operating at a long run loss. A more closely watched measure of profitability is revenues minus operating costs. Many growers will continue to operate at a paper loss as long as their cash flow is adequate to cover variable costs and the essential fixed costs (e.g., debt service). The UC rice budget indicates a net return above <u>operating</u> costs of $150 per acre. Additional costs to achieve complete abatement of PM_{10} of $35 per acre represents 21 percent of the farm's net return. The U.S. EPA,

Figure 4-1. Rice Straw - Cost of Implementing Non-Burning Alternatives



as an example, typically considers changes in net income of 3 to 5 percent as indicators of moderate stress (USEPA, 2001b). It is unlikely that farms can support such a high level of abatement costs in the long term without earning some return from rice straw sales. Thus, criteria should favor credible alternatives that encourage markets for rice straw.

Indirect Impacts – Regional Level

Changes in farm operations can have impacts in the regional economy. Collecting and transporting crop residue may require extra labor which may generate more income for farm workers. New equipment that might be needed or faster depreciation of old equipment may increase sales at agricultural implement dealers. Such effects generate ripple effects throughout the regional economy. The California Air Resources Board used a computable general equilibrium (CGE) model to trace the impact on prices and quantities of adopting different policy options for rice straw burning (CARB, 1993). Their baseline information indicated that agriculture provides about 10 percent of the Sacramento Valley's value added and employment. Rice production and processing accounts for about 13 percent of the region's agricultural value added and 7 percent of its agricultural employment. So, about one percent of the region's employment and value added come from the rice sector. The conclusion is that small changes in the output of this sector would have very small effects in the regional economy as a whole (CARB, 1993).

4.1.6 Social and Equity Issues

National trends over the last 10 years indicate that the number of large rice farms, measured both in terms of acreage and sales, has been growing faster than other field crop operations (Chambers and Childs, 2000). Very small farms (i.e., less than 100 acres) have also been disappearing rapidly. Large farms have greater yields per acre because they have better access to yield enhancing technologies such as precision leveling and permanent levees (Chambers and Childs, 2000). They may also be more profitable because they distribute fixed costs over a larger output. As a result, large farms may be able to absorb the added costs of non-burning alternatives more easily than small farms. Providing small producers access to straw markets and greater burning flexibility can mitigate the differential impact of adopting non-burning alternatives. Another equity issue is the stringent control and reduction in rice straw burning in the Sacramento Valley without equal control of other crop residue burning.

4.1.7 Political Issues

Promotion of non-burning alternatives by government, even on a voluntary basis, has the potential to antagonize agricultural interest groups. The California Rice Commission routinely advocates growers' concerns in the state. Environmental and recreation interests are also well organized. Surveyed stakeholders did not cite any specific groups with strong positions on agricultural burning but noted general concerns about implementation of the rice straw burning phase down in the Sacramento Valley.

4.1.8 Summary of Impacts

Table 4-1 summarizes the discussion above by indicating the severity of each potential impact for each alternative to burning rice straw on a scale from zero to three. Blank indicates "not relevant" or "no information." The factors in Table 4-1 are phrased in the negative so that a high number in the table always indicates a stronger degree of negative consequences for that alternative. An alternative with many 3's in its column is probably not a viable option. A total or average of these scores indicates an overall weight of problematic impacts. However, this also implies an equal weighting among the impacts listed, which is unlikely among different interest groups.

The cut and haul residue to a waste facility or permitted burn facility alternatives contain several 3's because they incur the additional costs of baling and hauling without any hope of compensation for the grower. These alternatives are economically and politically untenable. The conversion of land to a non-agricultural use in detail received many 3's because conversion to a developed use is likely to require greater water and energy use as well as generating other forms of air emissions.

4.2 Grass Seed Case Study

Grass for seed is widely grown in Washington, Oregon, and Idaho. Legislation that allows burning only under favorable weather conditions has reduced the number of smoky days experienced in Spokane and other cities (WDOE, 1998a). While burning is a convenient

Table 4-1. Rice Straw - Impacts of Non-Burning Alternatives[1]

Potential Impacts and Criteria	Leave Residues in Place			Cut or Collect Residues and Haul											Scientific Improvements			Alternative Land Use		
	Mulch Residue	Soil Incorporation: Wet or Dry	Soil Incorporation: Fallow Field	Waste Facility	Permitted Burn Facility	Power Generation Facility	Ethanol Production Facility	Redistribution Facility	Manufacturing or Use Facility	Fiberboard Facility	Particleboard Facility	Use as Compost or Mulch	Use as Animal Feed	Use For Erosion Control	Less Fuel Residual	Disease/Pest Resistance	Other Tolerances	Plant Crops that are not Burned	Land Conversion to Non-Agriculture	Conservation Tillage
Agronomic:																				
Soil compression	1	3	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	0	0	1
Soil erosion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	1	3	0
Increased water use	1	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	1
Increased herbicide use	2	2	2	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2
Increased pesticide use	2	2	2	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2
Land constraint	1	0	0	2	2	2	2	2	2	2	2	2	2	2	1	0	0	0	0	0
Time or equipment constraint	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	0	0	0	0	2
Environmental:																				
Countervailing air emissions	0	2	1	2	1	1	1	1	1	2	2	0	1	1	0	0	0	2	3	1
Negative wildlife impacts	1	2	2	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	3	1
Water quality degradation	1	2	1	3	3	2	2	2	2	2	2	0	1	0	1	1	0	2	2	1
Health and Safety:																				
Increased equipment use	1	1	1	2	2	2	2	2	2	2	2	2	1	2						1
Increased chemical use	2	2	2	0	0	0	0	0	0	0	0	1	0	1	1	1	0	2	3	3
Energy Impacts:																				
No contribution to energy production	2	2	2	2	2	0	0	2	2	1	1	2	2	2	2	2	2	2	3	1
Increased energy use	1	1	1	2	2	2	2	2	2	2	2	2	2	2	1	0	0	2	3	1
Economics:																				
Not cost-effective	2	2	2	3	3	1	1	1	1	1	1	2	2	2				2		
Farm financial stress	2	2	2	3	3	1	1	1	1	1	1	2	2	2				2		
Negative regional impacts	1	1	1	2	2	1	1	1	1	1	1	1	1	1				1	3	
Social and Equity:																				
Raises tribal/cultural/historical issues																			3	0
Raises small business issues	1	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	0
Impacts low resource farms	2	2	2	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Political:																				
Agricultural objections	2	2	2	3	3	0	0	0	0	0	0	0	0	0	1	1	0	3	3	3
Environmental objections	2	1	1	3	3	1	1	2	1	1	1	0	0	0	2	3	2	1	3	0
Average Score	1.3	1.8	1.6	1.9	1.9	1.1	1.1	1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.2	1.1	0.9	1.6	2.1	1.1

[1] Feasibility factors are phrased to indicate a negative outcome. Higher ratings indicate worse consequences for that impact and alternative.

Blank = not relevant or viable 0 = no problem exists 1 = problem may exist 2 = problem does exist 3 = a major problem exists disposal method for rice straw, it is an ecological necessity for grasses that evolved in fire-prone environments. Burning stimulates crown and tiller development which enhances seed head production. Cessation of all open field burning results in production losses of 23 to 31 percent even with the best mechanical residue management practices (WDOE, 1998a). Thus, evaluations of burning cessation in grass seed production often entail assumptions about farms converting to alternative crops, most often wheat.

4.2.1 Agronomic Impacts

After the seed is harvested, the remaining stubble is burned to prevent overwintering of disease organisms and condition the field for future growth. Alternatively, the straw must be cut, baled, and stacked and a crewcut vacuum used to remove the secondary residue. Soil incorporation is not an option as the grass is established as a long-lived stand and is not tilled each year. Repeated passes with equipment increase the risks of soil compaction, root damage, and possible delays from poor field conditions. Unlike rice straw, creating markets for grass straw will not mitigate all of the disadvantages of the non-burning alternative. Yields cannot be maintained by mechanical means so the consequences of farms shifting from grass to other crops must be considered. For example, growth of Meadowfoam has been explored as a rotation crop for annual ryegrass in Oregon's Willamette Valley. Meadowfoam seed produces oil that has had fluctuating market demand in the cosmetics industry.

4.2.2 Environmental Impacts

Non-burning alternatives require greater use of tractors and other equipment to cut, bale, and remove the straw. This added activity increases diesel and dust emissions. While the diesel emissions have a considerably smaller volume than the straw burning smoke, particulate emissions from diesel-fueled engines are listed by CARB as a toxic air contaminant (CARB, 2001a). The most likely alternative crop, wheat, exposes soil to wind and water erosion for much longer periods than grass production. Substantial volumes of particulate matter may be raised during wheat operations.

4.2.3 Health and Safety Impacts

Grass is often the crop of choice on relatively sloping sites because of its ability to hold the soil and limited need for cultivation. Non-burning alternatives require more mechanical operations and so increase the risk of tipping accidents injuring workers operating machinery on steep slopes. Washington state regulations permit burning on steep slopes and so avoid this risk (WDOE, 1998b).

4.2.4 Energy Impacts

Straw can provide a renewable source of biomass for power generation. Like rice straw, it has a low heat content, seasonal supplies, and processing requirements. However, the ash content of grass straw is more comparable to other biomass fuels, so it is preferable to rice straw.

4.2.5 Economic Impacts

The economic impact of employing non-burning alternatives on grass stubble is discussed below.

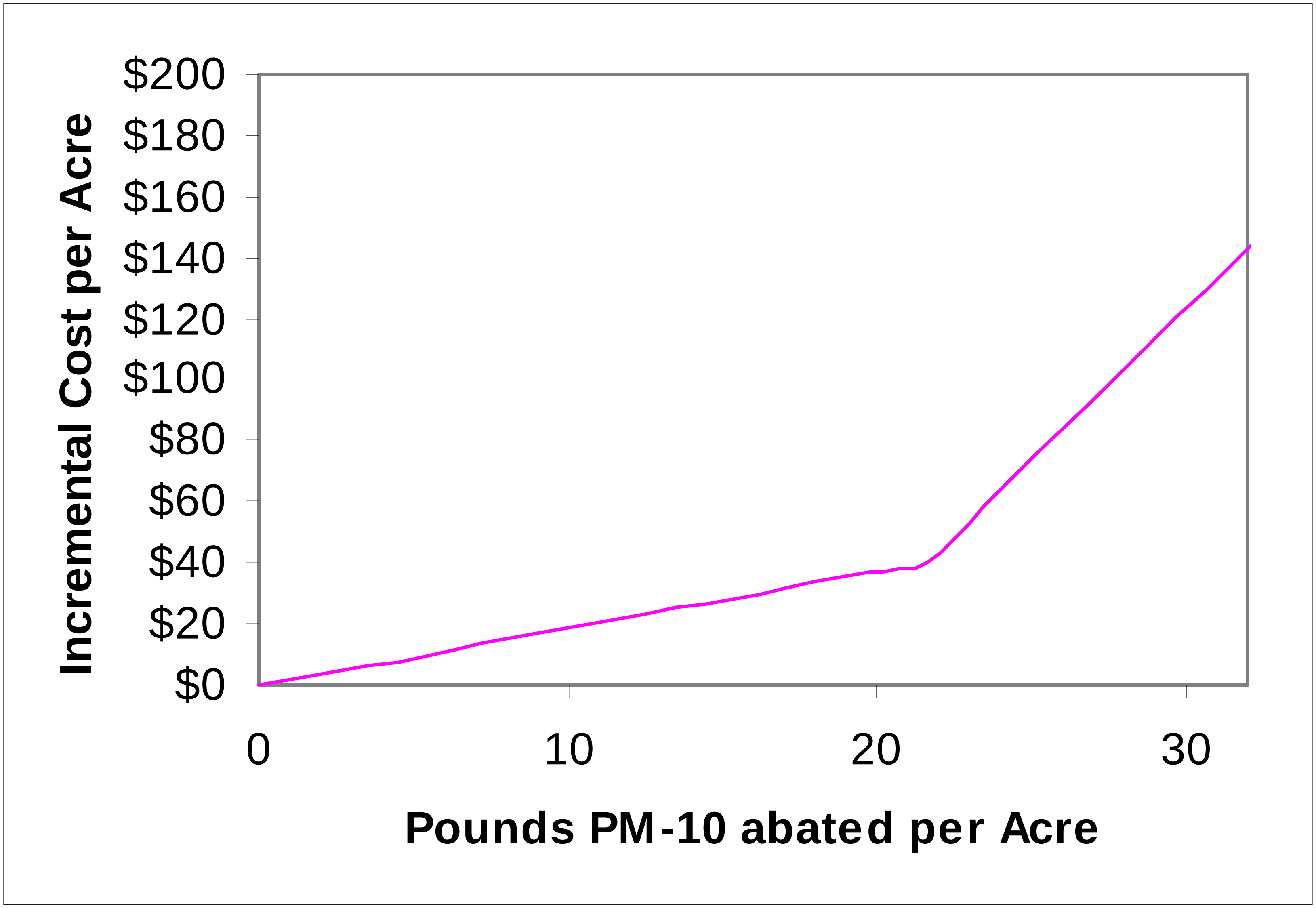
Cost-Effectiveness – Enterprise Level Assessment

Engineers estimate that each ton of grass straw burned emits 16 to 102 pounds of PM_{10} (CARB, 2000). The emission factor used in this estimate was 18.0 pounds of PM_{10} per ton (Jenkins, 2002). A typical acre of grass yields approximately 2 tons of straw acre after harvest. Thus, each acre burned emits 36 pounds of PM_{10} each year.

Washington Department of Ecology estimates the cost of mechanical straw management strategies as $70 per acre (WDOE, 1998a). The costs to the farmer to abate burning rise by $1.86 per pound abated [($70-$3)/(36 lb PM_{10})]. This impact is illustrated by the cost curve shown in Figure 4-2.

If farmers burn every third year rather than every year, burning can be reduced by two-thirds while yields are maintained near traditional levels. Thus, a diminution in yield effect becomes significant if more than two-thirds of the emissions are curtailed. The loss of output is part of the cost of abatement so costs rise sharply in Figure 4-2 if more than two-thirds of emissions are curtailed. Yield reductions of one-quarter to one-third have been observed which would reduce revenues per acre by $90 to $120 dollars, more than doubling the $70 direct costs of straw management itself.

Figure 4-2. Grass Seed - Costs of Implementing Non-Burning Alternatives



Affordability – Farm Level

Researchers have developed an enterprise budget for annual ryegrass that shows producers net return per acre with open-field burning is $73 at a price of $0.20 per pound (Taylor, Michael, et al, 1990). Additional costs to achieve complete abatement of PM_{10} of $70 per acre (not including yield effects) represents 96 percent of the farm's net return.

Indirect Impacts – Regional Level

Changes in farm operations can have impacts in the regional economy. Mechanical residue management employs more labor than open-field burning and so smoke abatement increases farm employment slightly (WDOE, 1998a).

4.2.6 Social and Equity Issues

A survey of stakeholders did not reveal any special considerations about social or equity issues among grass seed non-burning alternatives.

4.2.7 Political Issues

Promotion of non-burning alternatives by government, even on a voluntary basis, has the potential to antagonize agricultural interest groups. Survey respondents did not cite any specific groups with strong positions on agricultural burning but noted general concerns about implementation of new burning regulations in Washington. Any new regulation would have the potential to ignite legal controversies. Litigation over regulatory issues can become very costly to state governments.

4.2.8 Summary of Impacts

Table 4-2 summarizes the discussion above by indicating the severity of each impact in relation to each alternative to burning grass straw on a scale from zero to three. None of the "Leave Residues in Place" alternatives are viable for grass seed production because of agronomic issues so they are assigned all blanks. The waste and permitted burn facility alternatives cannot be sustained without subsidies because of the high cost to bale and transport straw without creating a saleable product.

Table 4-2. Grass Seed – Impacts of Non-Burning Alternatives[1]

Potential Impacts and Criteria	Leave Residues in Place			Cut or Collect Residues and Haul											Scientific Improvements			Alternative Land Use		
	Mulch Residue	Soil Incorporation: Wet or Dry	Soil Incorporation: Fallow Field	Waste Facility	Permitted Burn Facility	Power Generation Facility	Ethanol Production Facility	Redistribution Facility	Manufacturing or Use Facility	Fiberboard Facility	Particleboard Facility	Use as Compost or Mulch	Use as Animal Feed	Use For Erosion Control	Less Fuel Residual	Diseasepest Resistance	Other Tolerances	Plant Crops that are not Burned	Land Conversion to Non-Agriculture	Conservation Tillage
Agronomic:																				
Soil compression				2	2	2	2	2	2	2	2	2	2	2	1	1	1	0	0	1
Soil erosion	0			0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0
Increased water use				0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	1
Increased herbicide use				0	0	0	0	0	0	0	0	0	0	0	1	1	1	3	2	2
Increased pesticide use				0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2
Land constraint				2	2	2	2	2	2	2	2	2	2	2	1	0	0	0	0	0
Time or equipment constraint				2	2	2	2	2	2	2	2	2	2	2	1	0	0	0	0	2
Environmental:																				
Countervailing air emissions				2	1	1	1	1	1	2	2	0	1	1	0	0	0	3	3	1
Negative wildlife impacts				0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	3	1
Water quality degradation				3	3	2	2	2	2	2	2	0	1	0	1	1	0	3	2	1
Health and Safety:																				
Increased equipment use				2	2	2	2	2	2	2	2	2	2	2					0	1
Increased chemical use	2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3
Energy Impacts:																				
No contribution to energy production				2	2	0	0	2	2	1	1	2	2	2	2	2	2	2	3	1
Increased energy use	1			2	2	2	2	2	2	2	2	2	2	2	1	0	0	3	3	1
Economics:																				
Not cost-effective				3	3	1	1	1	1	1	1	2	2	2				2		
Farm financial stress				3	3	1	1	1	1	1	1	2	2	2				3		
Negative regional impacts				2	2	1	1	1	1	1	1	1	1	1				1	3	
Social and Equity:																				
Raises tribal/cultural/historical issues																			3	
Raises small business issues				3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Impacts low resource farms				3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1
Political:																				
Agricultural objections				3	3	0	0	0	0	0	0	0	0	0	1	1	0	3	3	3
Environmental objections				3	3	1	1	2	1	1	1	0	0	0	2	3	2	2	3	0
Average Score				1.9	1.9	1.1	1.1	1.2	1.2	1.2	1.2	1.1	1.2	1.1	1.2	1.1	0.9	1.9	2.0	1.2

[1] Feasibility factors are phrased to indicate a negative outcome. Higher ratings indicate worse consequences for that impact and alternative.

Blank = not relevant or viable   0 = no problem exists   1 = problem may exist   2 = problem does exist   3 = a major problem exists

5.0 ACCOUNTABILITY MECHANISMS

This section describes the strategies used to research, identify, and characterize accountability mechanisms of greatest importance in supporting the development and use of non-burning alternatives within the 15 Western states. Accountability mechanisms are procedures used for tracking if, and to what extent, non-burning alternatives are used by local, state, tribal, or federal entities.

Where possible, accountability mechanisms which are currently in place and are actively in use at the state, county, and local levels, as well as in the tribal community setting, are identified in this report. In addition, a discussion of how each accountability mechanism is important in supporting or promoting the development and use of non-burning alternatives is provided. Accountability mechanisms important to the implementation and use of non-burning alternatives by individual burners are also discussed in greater detail in Section 7.0.

5.1 Research Strategy and Sources of Information

The identification and characterization of accountability mechanisms of importance in the development, consideration, and use of non-burning alternatives was a complex process. It required a thorough assessment, understanding, and interpretation of current agricultural burning practices in the West. It also required a thorough assessment of the regulatory and programmatic structures in place for addressing agricultural or open burning activities in each state (and where applicable for each county or local air authority). An understanding of the variety of practical, technical, political, and economic forces affecting stakeholders involved in or currently conducting agricultural burns was also critical for the successful identification and characterization of accountability mechanisms in this effort.

To collect the desired information and to address the expectedly wide distribution of information sources, the same three-tiered approach discussed in Section 2.0 was employed. This approach included contacting and/or researching the availability of information from three different levels of information sources. It was expected that these sources would provide varying information perspectives and levels of programmatic detail. The majority of the information pertaining to this task came from the first level of information sources.

The first level of information sources investigated included state environmental agencies, boards and departments as well as state, county and local air pollution control authorities. Information important to this effort was collected from the respective administrative and statutory rules and regulations, formal published reports and documents, and articles or summary information posted on official state level or county level websites. For all 15 Western states, the presence, or in some cases the absence, of accountability mechanisms important in the identification, development, consideration and use of non-burning alternatives, was clearly documented by these information sources.

To ensure efficiency and effectiveness in the collection of data for this task, a process for reliably identifying, collecting, and documenting information obtained was developed. As part of this process, an informal survey was designed for in-house use only. Contacts at the various state, county, local or tribal environmental authorities were identified for all 15 states. Information was collected by phone or e-mail. Responses to a series of questions designed to identify and characterize accountability mechanisms were used to document information collected for this task. The contact persons have been identified and referenced in Appendix A.

As appropriate, contact was made with secondary sources identified by the first level sources. A focused review of prior agricultural burning survey reports, documents and other information produced by larger and more comprehensive multi-agency environmental and or governmental organizations was also conducted. These organizations included the WGA, WRAP, and its various task forces such as the FEJF. (GCVTC, 1996; WESTAR, 1999; WRAP, 2001a; WRAP 2001b).

5.2 Accountability Mechanisms Identified

Seventeen accountability mechanisms were identified that are important to the use of non-burning alternatives to agricultural burning in the West. The accountability mechanisms identified include the following:

1. Agricultural Burning is Exempt from all Regulations or Rules.
2. Agricultural Burning is Effectively Exempt from Regulations or Rules.

3. Agricultural Burning is Included in Regulations or Rules.

4. Specific Agricultural Burning Regulations or Rules Exist.

5. General Open Burning Regulations or Rules Exist.

6. Other Burning Sources are More Important.

7. Formal Agricultural Burning Approval Process Exists.

8. Agricultural Burning Permit is Required.

9. Agricultural Burning Permit Fees are Charged.

10. Smoke Management is Required.

11. Agricultural Burning Activity Enforcement Process Exists.

12. Requirement to Estimate Fuels, Acreage and Emissions on a Pre-Burn Permit Exists.

13. Requirement to Confirm Fuels, Acreage and Emissions on a Post-Burn Report Exists.

14. Agricultural Burning Activity Data is Reviewed and Included in Inventories.

15. Requirements to Consider the Use of Alternatives Exist.

16. Financial Incentive(s) are Available for Using Alternatives.

17. List of Alternatives is Available.

The results of this effort clearly suggest that the presence, or in some cases the absence, of identified accountability mechanisms may effectively determine whether non-burning alternatives will be used in the 15 Western states. The 17 mechanisms identified above fall into five main categories of accountability. These categories, (a) through (e), are shown in Table 5-1. The 17 accountability mechanisms are discussed in detail below.

5.2.1 Accountability Mechanisms 1 through 3

The most important mechanisms in the initial determination of whether non-burning alternatives will be employed are found in category (a) in Table 5-1. Accountability mechanisms in this category are initiated at the state or regional level. These mechanisms either absolutely (Mechanism 1) or in practice effectively (Mechanism 2) exempt agricultural burning from regulation. Conversely, they actively include agricultural sources for potential regulation

Table 5-1. General Categories of Accountability Mechanisms Identified in the 15 Western States

General Category and Description	Accountability Mechanism
(a) Accountability Initiated at the State or Regional Level	1. Agricultural Burning is Exempt from all Regulations or Rules 2. Agricultural Burning is Effectively Exempt from Regulations or Rules 3. Agricultural Burning is Included in Regulations or Rules
(b) Accountability at a State or Local Level that Supports the Active Regulation of Agricultural Burning Activities	4. Specific Agricultural Burning Regulations or Rules Exist 5. General Open Burning Regulations or Rules Exist 6. Other Burning Sources are More Important
(c) Accountability at a Programmatic Level that Supports a Formal Approval and/or Permitting Process	7. Formal Agricultural Burning Approval Process Exists 8. Agricultural Burning Permit is Required 9. Agricultural Burning Permit Fees are Charged 10. Smoke Management is Required 11. Agricultural Burning Activity Enforcement Process Exists
(d) Mechanisms that Encourage Accountability at the Local Level that Support the Tracking of Emissions and Program Effectiveness	12. Requirement to Estimate Fuels, Acreage and Emissions on a Pre-Burn Permit 13. Requirement to Confirm Fuels, Acreage and Emissions on a Post-Burn Report 14. Agricultural Burning Activity Data is Reviewed and Included in Inventories
(e) Mechanisms that Facilitate and Encourage the Use of Non-Burning Alternatives	15. Requirements to Consider the Use of Alternatives Exist 16. Financial Incentive(s) are Available for Using Alternatives 17. List of Alternatives is Available

(Mechanism 3). Mechanism 3 effectively establishes whether agricultural burning is defined and/or included in any state or local regulation or rule.

State environmental regulatory agencies throughout the 15 Western states either include agricultural burning in statute or they exempt agricultural burning completely from their regulations and rules. They may do this for a variety of reasons. Absolute exemption may occur because agricultural burning may not be a significant source of air pollution in the region, state or air basin. Agricultural burning may not be a source of air pollution because climate, topography, crops planted, or current agricultural practices may not support the need to burn. Also, agriculture activities may not exist or occur in a given state or air basin such that burning of residues or stubble is needed.

In contrast, agricultural burning may be an important and/or significant source of pollution in the state, tribal community, or an air basin in general. It may also be an important, significant source at certain times of the year and not others. However, in spite of this, some states still exempt agricultural burning sources from regulation. In these cases, political, social, economic, regulatory resource, or regulatory climate factors may make it impractical for states to include agricultural burning in their regulations as an air pollution source that can be controlled.

In other cases, state agencies or local air authorities may essentially, in practice, exempt agricultural burning even if it is identified in regulations as a source of air pollution. This occurs for a variety of reasons but for the most part it results from either a programmatic focus on other areas or sources of air pollution of greater concern, or from political, social, economic, regulatory resource, or regulatory climate factors that de-emphasize regulation of agricultural burning sources. Regardless of the reasons why this may occur, if agricultural burning is absolutely exempted or effectively exempted in practice from regulation at the state or regional level, there is little practical incentive, (private or governmental) to develop or implement alternatives to agricultural burning. When agricultural burning is identified in statute as a source of air pollution, the chances of identifying, developing, and employing non-burning alternatives increase substantially.

5.2.2 Accountability Mechanisms 4 through 6

Category (b) mechanisms provide accountability at the state or local level that supports the active regulation of agricultural burning activities. Category (b) mechanisms include mechanisms 4 through 6. If agricultural burning activities are included in state environmental or health statutes, there is a greater likelihood that non-burning alternatives will be identified, developed, and used. If agricultural burning is not otherwise exempted from regulation, the degree to which it will or may be regulated is closely tied to the regulatory strategy embraced by the environmental agency or air quality authority. The extent to which agricultural burning is practically regulated is also dependent on the form and subsequent effectiveness of the regulations used to address agricultural burning as a source of air pollution. The degree to which agricultural burning regulations serve as motivating factors in the identification, development, and use of non-burning alternatives can often be predicted based on the following factors:

- Whether there is a formal rule or regulation in place to address agricultural burning;
- The type or types of regulations or rules in place which address agricultural burning; and
- The relative degree to which agricultural burning is important as a source of air pollution compared to other sources in the state, regional or air basin.

Accountability mechanisms 4 and 5 support the active regulation of agricultural burning at the state and local levels. Mechanism 4 provides for clearly defined regulations or rules specifically designed to address agricultural burning activities. Mechanism 5 provides for the inclusion of agricultural sources in a more general open burn regulation or rule. Both mechanisms increase the likelihood that non-burning alternatives will be identified, developed and used. However, the more specific the regulation, typically the more detailed and ideally effective a regulation or rule may be in addressing a particular source or class of pollutant sources.

Mechanism 6 is also important in the identification, development and use of non-burning alternatives since it has the potential to deter, under some circumstances, the active addressing of agricultural burning sources. In Mechanism 6 other burning activities such as range management, land clearing or forest management may be more important sources of air pollution from a programmatic implementation standpoint. This may develop because of technical, political, or economic factors, or a combination of the same. In these cases, even though rules or regulations to address agricultural burning are in place at the state level, other vegetative burning sources receive higher implementation priority. In some cases, this may contribute to the effective exemption of agricultural burning activities although it may encourage the development of non-burning alternatives for other vegetative burning sources.

5.2.3 Accountability Mechanisms 7 through 11

Accountability mechanisms that support regulation of agricultural burning fall into category (c): Accountability at a Programmatic Level that Supports a Formal Approval and/or Permitting Process. Mechanisms in this category support more systematic approaches to the review and approval of proposed burn activities, overall program implementation and consistent enforcement of programs which include regulations or rules that address agricultural burning. Accountability mechanism 7 provides for a formal burn activity approval process. Accountability mechanisms 8 and 9 address pre-burn permit requirements and associated permit fees. Mechanism 10 provides for the accountability of smoke released from ongoing burn activities. Mechanism 11 supports compliance with existing regulations or rules as well as provides a forum for education on smoke program benefits through a formal enforcement process. All of these mechanisms provide information and in some cases economic motivation that supports the identification, development, and use of non-burning alternatives.

5.2.4 Accountability Mechanisms 12 through 14

Mechanisms that provide information for applying non-burning alternatives to current agricultural burning practices fall into category (d). These include Mechanisms 12 through 14 which encourage accountability at the local level by supporting the tracking of emissions and program effectiveness. Mechanisms 12 through 14 support the formal identification, tracking, and inventorying of burn activity parameters important in the implementation and review of an agricultural burning program effectiveness and extent of implementation. Some of the most important parameters addressed by these mechanisms include the identification of fuel types burned, the number of acres burned, and the resulting emissions from all identified agricultural burning sources. Mechanism 12 requires potential burners to estimate parameters such as fuel type, fuel loading, acreage impacted, and in some cases, potential emissions released from any proposed burn activity. This information is usually provided on a pre-burn permit application or even the permit itself. Mechanism 13 increases the assurance of quality data collection by requiring a post-burn report that confirms the parameters initially estimated on the pre-burn permit or permit application.

Mechanism 14 increases the likelihood that non-burning alternatives will be identified and used since it provides a mechanism for formal burn permit data review and the inclusion of important data in statewide inventories and implementation plans. As significant agricultural burning emissions are identified and documented at the state and regional levels, comparison to other more traditionally well-documented sources of air pollution becomes possible. In areas where agricultural activities are economically significant, motivation to continue agricultural production and related activities typically remains high despite the release of potentially significant air emissions. This type of atmosphere can provide motivation and support for, as well as stimulate interest in, the identification, development, and use of effective non-burning alternatives. This is especially true if agricultural source contributions can be documented and the stakeholders can be assured their efforts to use non-burning alternatives will be worthwhile. A more comprehensive discussion of these mechanisms and how they might be used in the effective implementation of non-burning alternatives can be found in Section 7.0.

5.2.5 Accountability Mechanisms 15 through 17

The fifth and final category is category (e). Mechanisms that facilitate and encourage the use of non-burning alternatives are found in this category. While it might seem in some cases that these mechanisms should be the only ones considered, it is unlikely that these mechanisms alone will produce the desired results in any but the most advanced agricultural burning management programs settings. Mechanisms 1 through 14 are essential for the support and validation of Mechanisms 15, 16, and 17. Mechanisms 15, 16, and 17 provide accountability at the state or local level that facilitates the active identification of, and encourages the consistent use of, effective non-burning alternatives in conjunction with, or as a substitute to, more traditional existing agricultural burning practices. Mechanism 15 provides incentive to actively consider non-burning alternatives by making it a requirement of pre-burn approval. This usually occurs during the pre-burn permitting process. If no pre-burn permitting process exists, in all but the most unique of circumstances, it is impractical and unrealistic to expect non-burning alternatives will be considered to any significant extent.

Mechanism 16 provides financial assistance in one form or another to burners who implement non-burning alternatives. This serves to help overcome one of the most often voiced oppositions to the use of non-burning alternatives which is that of cost "ineffectiveness". Mechanism 17 has the potential to provide useful, practical incentives to the increased use of non-burning alternatives by providing a list of alternatives that are available and/or in use successfully in the area. This mechanism would eliminate another readily voiced opposition to the use of non-burning alternatives, which is that non-burning alternatives do not exist or cannot be used effectively. A more comprehensive discussion of these mechanisms and how they might be used in the effective implementation of non-burning alternatives can be found in Section 7.0 of this report.

5.3 Review and Discussion of the Accountability Mechanisms in Place in the 15 Western States

A review and discussion of the accountability mechanisms identified during this effort and found to be in place in the 15 western states is included here to more fully explain the survey results presented in Table 5-2. (Relevant comments are provided in a comment key in Table 5-2a.) The authors of this report are making the assumption that if accountability mechanisms 3-17 are in place then there is a greater likelihood that non-burning alternatives to agricultural burning will be identified and implemented in areas where agricultural burning significantly contributes to air quality issues. This assumption appears to be supported by the results of the survey effort for those states with more aggressive mandates to address agricultural burning as a significant source of air pollution. However, this does not preclude the possibility that non-burning alternatives may be identified and implemented for other reasons or by other means or methods.

The authors recognize that the development of air pollution emission source reduction programs is a complex process involving countless stakeholders and many years of

Table 5-2. Accountability Mechanisms Important to the Use of Non-Burning Alternatives

State-County(ies) or Area	1	2	Accountability Mechanisms that Support Identification and Use of Non-Burning Alternatives															References	Comments
			3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		
	Agricultural Burning is Exempt from all Regulations or Rules	Agricultural Burning is Effectively Exempt from Regulations or Rules	Agricultural Burning is Included in Regulations or Rules	Specific Agricultural Burning Regulation or Rule	General Open Burning Regulation or Rule	Other Burning Sources More Important	Formal Agricultural Burn Approval Process	Agricultural Burning Permit is Required	Agricultural Burning Permit Fees are Charged	Smoke Management is Required	Agricultural Burn Activity Enforcement Process Exists	Requirement to Estimate Fuels, Acreage, & Emissions: Pre-Burn Permit	Requirement to Confirm Fuels, Acreage, & Emissions: Post Burn Report	Agricultural Burn Activity Data is Reviewed & Included in an Inventory	Requirements to Consider Use of Alternatives	Financial Incentive(s) are Available for Using Alternatives	List of Alternatives is Available		
AK		✓	✓		✓		✓[2,3]	✓					✓		✓			WRAP, 2001a	1, 27
AZ		✓	✓		✓						✓	✓		✓					2, 28
AZ-Pima			✓[1]		✓[1]		✓[1]	✓[1]	✓[1]		✓[1]								3
AZ-Pinal			✓[1]		✓[1]		✓[1]	✓[1]	✓[1]										4
AZ-Yuma			✓[2]		✓[2]		✓[2]	✓[2]	✓[1]		✓[1]	✓[2]							5
AZ-Maricopa		✓			✓[1]														6
CA			✓		✓[1]			✓[1]	✓[1]	✓[1]	✓[1]			✓	✓	✓		WRAP, 2001a	7, 43
CA-Lake			✓[1]		✓[1]		✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	44
CA-Sacramento Valley Counties			✓[1]	✓[1]			✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	45
CA-San Joaquin Valley Counties			✓[1]		✓[1]		✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	46
CA-South Coast Counties			✓[1]		✓[1]		✓[1]	✓[1]	✓[1]	✓[1]	✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	8, 47
CO	✓					✓													9
HI			✓		✓			✓	✓		✓	✓			✓				10
ID			✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓			WESTAR, 1999	11, 30
MT		✓	✓		✓	✓		✓	✓		✓								12, 31

Table 5-2. Continued

State-County(ies) or Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	References	Comments
			Accountability Mechanisms that Support Identification and Use of Non-Burning Alternatives																
	Agricultural Burning is Exempt from all Regulations or Rules	Agricultural Burning is Effectively Exempt from Regulations or Rules	Agricultural Burning is Included in Regulations or Rules	Specific Agricultural Burning Regulation or Rule	General Open Burning Regulation or Rule	Other Burning Sources More Important	Formal Agricultural Burn Approval Process	Agricultural Burning Permit is Required	Agricultural Burning Permit Fees are Charged	Smoke Management is Required	Agricultural Burn Activity Enforcement Process Exists	Requirement to Estimate Fuels, Acreage, & Emissions: Pre-Burn Permit	Requirement to Confirm Fuels, Acreage, & Emissions: Post Burn Report	Agricultural Burn Activity Data is Reviewed & Included in an Inventory	Requirements to Consider Use of Alternatives	Financial Incentive(s) are Available for Using Alternatives	List of Alternatives is Available		
ND		✓	✓		✓		✓[1]				✓								13, 32
NM		✓	✓		✓										✓				14, 42
NV	✓													✓				WRAP, 2001a	15, 33
NV-Pershing	✓											✓						WRAP, 2001a	
OR			✓		✓			✓	✓	✓	✓	✓			✓	✓			16, 34, 35
OR-Jefferson			✓[1]		✓[1]			✓[2]	✓[1]	✓[1]	✓[1]	✓[1]				✓[1]		WRAP, 2001a	36
OR-Umatilla			✓[1]		✓[1]			✓[1]	✓[1]	✓[1]	✓[1]	✓[1]				✓[1]		WRAP, 2001a	36
OR-Union			✓[1]		✓[1]			✓[1]	✓[1]	✓[1]	✓[1]	✓[1]				✓[1]		WRAP, 2001a	36
OR-Willamette			✓[1]		✓[1]			✓[1]	✓[1]	✓[1]	✓[1]	✓[1]				✓[1]		WRAP, 2001a	36
SD	✓																		17, 37
UT	✓																	WESTAR, 1999	18, 38
WA			✓		✓			✓	✓		✓		✓	✓	✓		✓	WRAP, 2001a; WESTAR, 1999	19
WA -Benton			✓[1]	✓[1]				✓[1]	✓[1]		✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	20, 40
WA-Columbia			✓[1]	✓[1]				✓[1]	✓[1]		✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	21, 40
WA-NW region			✓[1]	✓[1]				✓[1]	✓[1]		✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	22, 40
WA-SW region			✓[1]	✓[1]				✓[1]	✓[1]		✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	23, 40
WA-Walla Walla			✓[1]	✓[1]				✓[1]	✓[1]		✓[1]	✓[1]		✓[1]	✓[1]			WRAP, 2001a	24, 40

Table 5-2. Continued

State-County(ies) or Area	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	References	Comments
			Accountability Mechanisms that Support Identification and Use of Non-Burning Alternatives																
	Agricultural Burning is Exempt from all Regulations or Rules	Agricultural Burning is Effectively Exempt from Regulations or Rules	Agricultural Burning is Included in Regulations or Rules	Specific Agricultural Burning Regulation or Rule	General Open Burning Regulation or Rule	Other Burning Sources More Important	Formal Agricultural Burn Approval Process	Agricultural Burning Permit is Required	Agricultural Burning Permit Fees are Charged	Smoke Management is Required	Agricultural Burn Activity Enforcement Process Exists	Requirement to Estimate Fuels, Acreage, & Emissions: Pre-Burn Permit	Requirement to Confirm Fuels, Acreage, & Emissions: Post Burn Report	Agricultural Burn Activity Data is Reviewed & Included in an Inventory	Requirements to Consider Use of Alternatives	Financial Incentive(s) are Available for Using Alternatives	List of Alternatives is Available		
WY		✓			✓	✓													25, 41
Tribal	✓	✓^{3}; ✓^{4}; ✓^{5}				✓^{1}; ✓^{2}; ✓^{3}; ✓^{4}; ✓^{5}	✓^{1}; ✓^{2}; ✓^{3}; ✓^{4}; ✓^{5}											WRAP, 2001b	26

Notes:

✓ = State Level
✓^{1} = County or Local Authority
✓^{2} = Rural Fire District
✓^{3} = Natural Resources Authority
✓^{4} = Tribal Authority
✓^{5} = Federal Land Management Authority

AK = Alaska
AZ = Arizona
CA = California
CO = Colorado
HI = Hawaii
ID = Idaho
MT = Montana
ND = North Dakota

NM = New Mexico
NV = Nevada
OR = Oregon
SD = South Dakota
UT = Utah
WA = Washington
WY = Wyoming

Table 5-2a. Comments Key for Table 5-2

No.	Comments
1	Ann Lawton, AK State Dept. Env. Quality, ERG/ETC Informal Survey 2001 (see Appendix A): No agricultural crops burned. Limited burning conducted to date is for land clearing; may be more in future. Limited to fall and spring because of climate, tourism, and fire danger. Burning occurs in Delta Junction area only. Rest of AK no agricultural burning at all. Permits are required for burns greater than 40 acres in size only. Most of the smoke issues occur with non-permitted burns.
2	Varma Sunil, AZ State Dept. Env. Quality, ERG/ETC Informal Survey 2001: Typically agricultural burning is not addressed in statewide open burning smoke management program. Most burning occurs in Yuma county. 8,000 acre/yr limit via State Implementation Plan. Non-agricultural open burning is allowed in Yuma and Maricopa Counties.
3	Bill Maxwell, Pima County Dept Env. Quality, ERG/ETC Informal Survey 2001: Most burning is tumbleweeds, year round via open burn permit. Based on burn/no-burn days program. No smoke management plan is required and emissions are not tracked.
4	Donald Gabrielson, Pinal County Dept. Env. Quality, ERG/ETC Informal Survey 2001: Principal agricultural burning is for irrigation ditch bank clearing. Occurs in Spring. Most other permitted burning is for residential use burn barrels. Some rural agricultural burning. If okayed for agricultural, annual permit to burn anything up to 320 contiguous acres.
5	Varma Sunil, AZ State Dept. of Env. Quality and Kurt Foster, Yuma County Fire Dept, ERG/ETC Informal Survey 2001: Most burning is limited by the State Implementation Plan up to 8,000 acre/yr. It typically includes citrus and other orchard fuels burning for orchard retirement and removal. Often use a curtain air destructor.
6	Rick Hado, Maricopa County, ERG/ETC Informal Survey 2001: No burning for agricultural residues occurs in county. Majority of burning is for ditch banks, tumbleweeds, fenceline clearing and land clearing. Do often use high temperature propane burners for ditch banks and best management practices.
7	WRAP, 2001a: Agricultural burning is allowed under state law. It is typically permitted at the county air authority level. Many crops are burned, especially rice, wheat and other grains. Orchard prunings are also burned by permit. The newly adopted statewide Title 17 Smoke Management Guidelines for Agricultural and Prescribed burning in CA provides authority, direction and guidance to the local air authorities (air quality management and/or control districts) for the regulation and management of burning. Smoke management plans are required of each local air authority. There is considerable variability in the implementation of local rules and regs and little systematic statewide review of programs or emissions estimates.
8	WRAP, 2001a: Almost any crop can be burned any time of the year.
9	Coleen Campbell, CO State Dept. of Public Health and Phyllis Woodford, CO State Dept. of Public Health, ERG/ETC Informal Survey 2001: Burning occurs only of range land and irrigation ditches. Regulations exempt agricultural residues but do encourage good burning practices. Some spring wheat, corn and sunflower burning may occur in Western counties/Grand Junction area. Approval to burn via courtesy burn/no-burn calls.
10	Lisa Young, HI State Dept. of Health and Janet Ashman, HI Agricultural Research Center; ERG/ETC Informal Survey 2001: Two year crops, roughly half of the acres planted in any year would be burned the following year for both sugar cane and pineapples. Estimate 40,000 to 50,000 acres of sugarcane are in production. Roughly 30,000 acres sugarcane is burned in any given year. Acreage burned for pineapples is unknown. Sugarcane industry is having economic difficulties due to competition with sugarbeet production in other states. Sugarcane burning will likely decrease the future.
11	Diane Riley, ID State Dept. Env. Quality, ERG/ETC Survey 2001; Dan Redline, Coeur d'Alene Regional Office, ERG/ETC Informal Survey 2001; Curt Thornberg, ID Dept. of Agriculture, ERG/ETC Informal Survey 2001, Robert Wilkosz, ID Dept. Env. Quality, WESTAR (1999): Data not available for most of the state. Some data on grass and cereal grains is available for the Kootenai and Benewah counties. Voluntary smoke management plans are used in Kootenai and Benewah counties. Grass seed and cereal crops are burned in the fall (Aug-Sept). Alfalfa, mint and other perennial forage crops are burned in both the spring and fall. Ditch banks are burned in the spring. Individual burners make the burn/no-burn decisions. Open burning rule specifically allows burning of orchard clippings and burning for weed control.

Table 5-2a. Continued

No.	Comments
12	Bob Habeck, MT State Dept Environmental Quality, ERG/ETC Informal Survey 2001: Data on acreage burned are not tracked. State has permit authority Sept-Feb otherwise burner gets to decide when to burn and not burn. Program is geared toward wildlands and forest management, not agricultural. Rarely allowed to burn in summer months because of fire danger. Burning that does occur addresses ditches and sagebrush land conversion.
13	Chuck McDonald, ND State Health Dept., ERG/ETC Informal Survey 2001: Wheat is burned in fall and only in northeastern areas of Red River Valley. Yields are high, similar to rice in CA. Do not track emissions at all. Agriculture is exempt. Open burning is prohibited but variances are issued for prescribed burning of forest lands. One particle/fiberboard plant is highly successful in the state.
14	Brad Musick, NM State Dept of Environment, ERG/ETC Informal Survey 2001: Orchard prunings are the main issue. No emissions data is kept. Wheat is burned in eastern portion of the State. Pecans are the main crop. Prunings, hulls etc. are burned in the Dona Ana (Rio Grande) areas of state. Tumbleweeds and irrigation ditches are burned routinely as a way of life in some areas to supply pecan orchards with water.
15	Colleen Cripps, NV State Dept. Env. Quality, ERG/ETC Informal Survey 2001 and WRAP, 2001a: Agricultural burning is essentially not regulated. Some self regulation occurs in parts of the state with greater community concerns. This includes the Lovelock Valley.
16	Brian Finneran, OR State Dept. Env. Quality, ERG/ETC Informal Survey 2001: Grains burned July-Sept. Basically track emissions through three separate geographically distinct field burning programs. All three programs publish annual emissions reports. Largest source of burning is the Willamette Valley. Complex state run program. Orchard burning is typically allowed statewide.
17	Chris Hansen, SD Dept of Environment and Natural Resources, ERG/ETC Informal Survey 2001; Tim Rogers, SD State Dept of Environment and Natural Resources, ERG/ETC Informal Survey 2001: agricultural burning is not regulated in the state. No Tracking, no records kept, and no permits required for agricultural burning in the state. Grasses burned in spring (March - May) and fall (Sept - Oct). Grain is burned in March and April. Open burning of rubbish, treated woods, wastes, etc. is prohibited.
18	Francis Bernards, UT State Dept. Env. Quality, ERG/ETC Informal Survey 2001; Steven Parkin, UT State Division of Air Quality, WESTAR (1999): State does not track acres burned. Large agri-farming occurs in nearly every county. No burning occurs during Ozone season, (June - Aug). Burn season is Sept-May.
19	Grant Pfeifer, WA State Dept of Ecology, Agricultural Burn Task Force, ERG/ETC Informal Survey 2001; Chad Akins, WA State Dept of Ecology, WESTAR, 1999: Burning occurs in Benton, Columbia, Island, Skagit and Whatcom counties. Wheat is burned in March, April and July-Nov. Fall burning occurs Aug-Nov. Spring burning occurs March-May. Crops burned include wheat, barley, grass seed, pasture and alfalfa seed. A post-burn “Report Card” is required. Emissions from these sources are tracked. Burning incidental to agricultural residue is allowed without a permit. This type of burning includes orchard prunings, fencelines, irrigation and drainage ditches. Emissions are not tracked from these sources. State of WA does support research to explore alternatives to burning.
20	WRAP 2001a: Most of the burning in the county is orchard removal.
21	WRAP 2001a: Spring burning in March through April; Fall burning in Mid-Sept through October
22	WRAP 2001a: Very small amount of acreage burned. 475 total acres in year 2000.
23	WRAP, 2001a: Little agricultural burning occurs in this county. Less than 50 acres in 2000, none were grain or grass seed crops. Burning is allowed year round because so little occurs in the county.
24	WRAP, 2001a: Most burning is done in spring. Fall burning is being phased out.
25	Darla Potter, WY Dept. Env. Quality, ERG/ETC Informal Survey 2001: Emissions are not tracked at all. Burn permits are required for forestry and rangeland. Recently grass seed companies from OR and WA have been relocating to WY which may increase burn emissions from these sources.

Table 5-2a. Continued

No.	Comments
26	WRAP, 2001b: There are 240 Indian reservations in the Western Regional Air Partnership (WRAP) region representing more than 54 million acres of land. Historically each tribal entity manages their own lands independently. No centralized agricultural burning activity data presently exisits. Historically burning occurs on approximately 50% of the reservations within the WRAP region of the 15 Western states. Types of burning include wildland, rangeland and agricultural. Often burns are part of an overall annual burn or land management plan but some are completely independent. Most tribal entities do not have a formal smoke management program although some do. Coordination with other off-site land management entities and air quality authorities is highly variable among the tribes.
27	State of Alaska, Department of Environmental Conservation, Open Burning Policy and Guidelines document. http://www.state.ak.us/dec/dawq.
28	State of Arizona, Department of Environmental Quality, Arizona Guidelines for Open Burning and Permit Application Form, Title 49. http://www.adeq.state.az.us/environ/air.
29	State of Hawaii, Administrative Rules, 11-60.1-51: Open Burning, and Application for Agricultural Burning Permit, http://www.state.hi.us/doh/rules/emd/11-60.PDF.
30	State of Idaho, Statute Title 22, Agriculture and Horticulture, Chapter 48, Smoke Management and Crop Residue Disposal, http://www.state.id.us/idstat
31	State of Montana, Department of Environmental Quality, Rules Title 17, Chapter 8, Air Quality, Open Burning. http://www.deq.state.mt.us/dir/legal
32	State of North Dakota Air Pollution Control Rules, Chapter 33-15-04, Open Burning Restrictions, http://www.health.stat.nd.us/ndhd/environ
33	State of Nevada, Division of Environmental Protection, Smoke Management Program, NAC 445B.381 Open Burning, http://www.state.nv.us/ndep/bao/smoke1.htm.
34	State of Oregon, Department of Agriculture, “Field Burning Rules”, http://arcweb.sos.state.or.us/rules
35	State of Oregon, Department of Agriculture Natural Resources Division, http://www.oda.state.or.us/Natural_Resources/smoke.htm.
36	State of Oregon, Administrative Rules, Department of Environmental Quality, “Pollution Control Tax Credits”, http://arcweb.sos.state.or.us/rules/OARS_300/OAR_340/340_tofc.html
37	State of South Dakota, Department of Environment and Natural Resources, “Air Quality Guidelines for Open Burning”, http://www.state.sd.us/denr/DES/airquality/regulations
38	State of Utah, Administrative Code, Title R307, “Environmental Quality, Air Quality”, Section 307-202-1, http://www.rules.state.ut.us/publicat/code
39	State of Utah, Statute, Title 19, “Environmental Quality code” Chapter 2, “Air Conservation Act”, http://www.le.state.ut.us
40	State of Washington, Department of Air Quality, Best Management Practices and Administrative Code, “Agricultural Burning”, RCW 70.94.656 Open Burning, http://www.ecy.wa.gov
41	State of Wyoming, Air Quality Standards and Regulations, Chapter 10, Section 2, “Open Burning Restrictions”, http://deq.state.yw.us.
42	State of New Mexico, Environmental Protection Air Quality, “Open Burning”, Title 20, Chapter 2, Part 60.
43	State of California, Title 17 “Smoke Management Guidelines for Agricultural Burning and Prescribed Burning”, California Code of Regulations, Section 80100, et. Seq. California Air Resources Board, http://www.arb.ca.gov
44	State of California, Lake County Air Quality Management District, Rules and Regulations: Chapter VIII, Agricultural Burning, http://www.arb.ca.gov/DRDB/lak/CURHTML/LKRulebook7-13-01-PDF
45	State of California, Sacramento Metropolitan Air Quality Management District, Rule 407: Open Burning, http://www.arb.ca.gov/DRDB/SAC/CURHTML/R407.htm and Rule 501: Agricultural Burning, http://www.arb.ca.gov/DRDB/SAC/CURHTML/R501.htm
46	State of California, San Joaquin Valley Unified Air Pollution Control District, Rule 4103: Open Burning, http://www.arb.ca.gov/DRDB/SJU/CURHTML/R4103.PDF
47	State of California, South Coast Air Quality Management District, Rule 444: Open Fires, http://www.arb.ca.gov/DRDB/SC/CURHTML/R444.htm

time and effort. The authors also recognize that the identification and development of non-burning alternatives is something that will likely evolve over time. The results of the survey effort here clearly represent only “a snap shot in time” for all the programs reviewed. The results of this effort are not intended and should not be interpreted as to be predictive of what states or tribal entities may or may not intend to do in the future. Nor should the results of the survey effort reported here be interpreted as necessarily a reflection on state or tribal entities or their staffs commitment or desire to address agricultural burning as a source of air pollution through the identification and implementation of non-burning alternatives. An assessment of state and tribal entity future plans and/or desire or intent to address agricultural burning and the identification and implementation of non-burning alternatives was not included in this effort.

The results of this survey effort simply reflect which of the previously identified accountability mechanism appear to be in place for each state, local area or tribal entities in general. It is important for the reader to keep in mind that this section is intended to be positive and constructive. This section is intended to serve as a useful tool for those state or tribal entities desiring to address the use of non-burning alternatives more effectively. One way to approach this challenge is to compare how different states or tribal entities are addressing accountability mechanism in their programs. Where specific states are used as examples the intent is to provide useful comparisons of different program content. With this in mind the following review and discussion is presented below.

The presence or, in some cases, the absence of Mechanisms 1-17 appears to reflect whether non-burning alternatives will be used in the 15 Western states. In general, for states with aggressive mandates to reduce agricultural burning, such as Washington, Oregon and California, a large number of the accountability mechanisms identified in Table 5-2 were found to be in place. These states have mechanisms in place that fall into all five categories of accountability. These states also currently have the largest number and greatest variety of non-burning alternatives in use.

In those states with less aggressive smoke reduction programs or no formal requirements to address agricultural burning, essentially no accountability mechanisms were found to be in place. This was the case for Colorado, Nevada, South Dakota, and Utah. As a consequence, little or no direct information on non-burning alternatives was available for these states. However, this finding in and of itself may not be significant. For states where agricultural burning may not be a significant source of air pollution, it makes sense that their programs would focus on other more relevant sources.

For those states that in practice effectively exempt agricultural burning from regulation, few if any accountability mechanisms were found to be in place. Those that were found to be in place were often in place to address other sources of open burning such as forest and range land management activities. This was the case for Alaska, Arizona, New Mexico, Montana, North Dakota, and Wyoming. No agricultural burning is indicated as occurring in Alaska (see Volume I, Section 3.0).

For those states that have little or no agricultural crop production, such as Alaska, Montana, and Wyoming, air quality programs may of practical necessity be focused on other sources such as forest or rangeland management practices. (Crop production in these states is documented in Volume I, Section 2.0.) Burn programs in general may also be in place to address fire safety issues. However, in other states where a number of accountability mechanisms appear to be in place, political, social, economic and practical programmatic resource factors may play a significant role in the overall de-emphasis on addressing agricultural burning as a source of air pollution in the state or region. This may be the case in North Dakota, Arizona, and New Mexico.

In other states such as Idaho and Hawaii, a number of accountability mechanisms are in place. In fact there are mechanisms in place for these states in all five categories of accountability. However, the number of non-burning alternatives identified and in use for these states remain insignificant. Patterns such as this suggest that additional research may be needed to better identify and characterize the nature of the apparent inconsistency. It may be that significant political, social, economic or practical programmatic resource factors are playing a role here.

In tribal communities there appear to be agricultural burning review and approval mechanisms in place. However, these appear to be less formal in nature with little emphasis on agricultural burning per se and essentially no coordination with neighboring non-tribal land managers. The implementation of these mechanisms also appear to be more widely distributed across local, county, tribal, state, and federal authorities than any of the 15 states in general. This is likely a reflection of the wide variety of types of burning that occurs on the more than 54 million acres of tribal lands (WRAP, 2001b). It is also likely a reflection of the historically independent and self-reliant nature of more than 240 tribal communities found in the 15 Western states. However, this could simply be a reflection of the fact that very little air pollution from agricultural burning sources may result from tribal activities and that air quality programs may of practical necessity be focused on other sources such as forest or range land management practices. Burn programs in general may also be in place to address fire safety issues on tribal properties. As states and other entities gather more information on the extent of agricultural burning activities on tribal lands, the identification and use of non-burning alternatives and the presence of absence of accountability mechanisms in place at tribal government levels should be possible.

Overall, the incentive and motivation to identify and use non-burning alternatives are lacking in many of the 15 Western states. This may be due to a lack of effective accountability mechanisms in place at the state and local program levels. In some states there are formal requirements to consider alternatives to infield agricultural burning of residues prior to carrying out field burning activities (Alaska, California, Hawaii, Idaho, New Mexico, Oregon, and Washington). Although in some cases economic incentives do exist, such as in Oregon and California, there are typically no formal requirements to actually implement non-burning alternative management practices in any states. Furthermore, routine information regarding the availability, applicability, and cost effectiveness of non-burning alternatives is typically not provided by the states in any comprehensive or coordinated fashion. If alternatives are routinely used, the degree to which non-burning alternatives are implemented is often not formally tracked, making it difficult to appropriately credit the proactive participants in the non-burning alternatives community. A more comprehensive discussion of the role these mechanisms might play in furthering the identification, development, consideration and use of non-burning alternatives in those of the 15 Western WRAP member states and tribal communities where agricultural burning appears to be a significant source of air pollution in the region, state or air basin can be found in Section 7.0 of this report.

In some cases statutory changes may be required in order to provide for adequate availability and implementation of the desired accountability mechanisms. In other cases lead agencies may consider the development and implementation of voluntary accountability and/or non-burning alternatives implementation programs. However, it is very important to note that while voluntary programs may facilitate program development and implementation, in cases where this would result in increased economic costs and changes in practical business operations or management, voluntary programs alone are not typically effective in meeting overall air quality program objectives. Voluntary programs under these circumstances often do not provide adequate incentives to bring about significant changes in current practices.

Lastly, a critically important aspect of the burn program and accountability mechanism review is the inconsistent definition of agricultural burning. How agricultural burning is defined varies extensively throughout the regulations and rules reviewed for the Western states. In some cases, agricultural burning defines only row or field crops. In some cases, orchard and vineyard prunings are included as agricultural residues while in others they are not. There is no consistency within the state regulations and rules with respect to how irrigation ditch, fence line, or weed or land clearing for range land improvement or other agricultural purposes are addressed. This complicates the interpretation of the findings of the accountability mechanisms provided here. This issue is discussed further in Section 7.0 of this report.

6.0 NON-STATUTORY ADMINISTRATIVE BARRIERS

This section describes the strategies used to research, identify, and characterize non-statutory administrative barriers. In practice, non-statutory administrative barriers have the potential to limit new program development and implementation to a greater extent than do statutory barriers. Non-statutory administrative barriers are those situations, circumstances, activities, or factors that serve to minimize, deter, or prevent the active use of non-burning alternatives. These barriers are not defined in statute, rules, or regulations. These typically result from, or are defined by, administrative practices associated with the implementation of agricultural or open burning programs in the West. They can also develop as a result of political, social, economic, cultural, and religious pressures that hinder or impede the development and use of non-burning alternatives.

The non-statutory administrative barriers currently in place at the state level for each of the 15 Western states (and where possible, at the county local, or tribal level) are identified and discussed in this section. A discussion of how each non-statutory administrative barrier may be addressed to increase the support, development, and use of non-burning alternatives in each case identified is included in Section 7.0 of this report.

6.1 Research Strategy and Sources of Information

For this task, the same comprehensive three-tiered approach to identifying and researching the various potential sources of information discussed in detail in prior chapters of this report was used. The three-tiered approach included contacting and/or researching the availability of information from three different levels of information sources.

The first level of information sources investigated included state environmental agencies, boards and departments, county and local air pollution control authorities; their respective administrative and statutory rules and regulations; formal published reports and documents; and articles or summary information posted on official state level or county level websites. As expected, the presence, or in some cases absence, of non-statutory administrative barriers relevant to non-burning alternatives were known to staff at the state and county or local level environmental agencies and air authorities having responsibility for implementing agricultural or open burning programs.

The second level of information sources researched were the agricultural extension services agencies for all 15 Western states. The third level of sources included private sector stakeholders identified during the first and second level research efforts. The most relevant and comprehensive information regarding the identification and characterization of non-statutory administrative barriers has come from informal survey information collected from state and local air quality program staff, agricultural extension research staff and individual stakeholders who currently use or desire to use to some degree, non-burning alternatives. Additional information has also been collected from published reports and literature.

6.2 Non-Statutory Administrative Barriers Identified

There are many non-statutory administrative barriers (i.e. situations, circumstances, activities and elements) which may minimize, deter and/or prevent the active use of non-burning alternatives in the West. Non-statutory administrative barriers include the following categories:

a. *Economic challenges* including labor costs; increased liability; disposal, storage, packaging or transport costs; availability and/or willingness of investors to provide capital for new technologies or non-traditional methods; market return; crop yield, quality, and production rates;

b. *Geographic limits* due to climate or topography;

c. *Political, cultural or religious practices*;

d. *Practical issues* such as supply and demand of essential materials (e.g., seed or seedlings, storage facilities, machinery), reporting mechanisms, timing and effectiveness of the non-burning alternative, and short- or long-term effects on the farm unit or agricultural operation;

e. *Public acceptance* of a practice or program result, which may be closely tied to aesthetics; and

f. *Aesthetics* (e.g., visual, olfactory, and auditory, but also possibly nuisance factors such as plant debris or dust infiltration or deposition in or near homes and businesses).

Eighteen non-statutory administrative barriers, which fall into four of the categories as defined above, were identified. These currently exist in specific situations in the 15 Western states and are summarized in Table 6-1. No non-statutory administrative barriers were identified for aesthetic or for public acceptance reasons, numbers (5) and (6) above.

6.3 Project Case Study

Case studies can be very useful tools in identifying what is working in a program and what may need enhancing or improving. Case studies can provide this information in a succinct format designed specifically for an audience comprised of environmental program coordinators and/or state level executive decision-makers. One case study, entitled "Alaska Agricultural Project, Delta Junction" in located in Appendix B. This case study illustrates how the Alaska Department of Environmental Conservation (ADEC) successfully worked with the agricultural community to address the issue of timing as a smoke management tool pertaining to burning of wastes from land clearing in preparation for agricultural use.

Table 6-1. Non-Statutory Administrative Barriers Identified in the 15 Western States

General Category and Description	Non-Statutory Administrative Barriers
a. Economic Challenges	• Transport costs to remove agricultural residues from the field, orchard or vineyard must be incurred. • Labor and machine costs to bail and stack or otherwise collect field residues for offsite use. • Capital for investing in new technologies is limited. • Availability of investors and willingness to invest in new methodologies is limited. • Decreased market return, crop yield, crop quality, and production rates can occur with increased damage from pests or disease. • Availability of economic incentives for burners to try new non-burning alternatives is limited. • Program implementation of existing economic incentive programs is fractured and untimely. • Water costs in the arid West and Southwest increase costs substantially for field residue soil incorporation non-burning alternatives. • Costs to remove straw can be up to 10 to 15 times greater than the costs to burn. • High cost of plowing for soil incorporation. • No or limited markets for marketing products made with residues. • Low market price of products made with residues do not offset costs. • Increased costs are associated with the need for more skilled labor to carry out specialized crop rotations and soil incorporation activities.
b. Geographic Limits	• The steep terrain in some mountainous states make it impractical to implement some non-burning alternatives. • Climate barriers that affect crop yields.
c. Political, Cultural and/or Religious Practices	• Cultural practices in at least one state center around agricultural burning activities. Changes in burning practices may significantly impact local community cultural events. • In at least one circumstance, historical promises play a role in the social and cultural acceptance of the use of non-burning alternative. During the great Dust Bowl, state officials lured farmers away from other states by promises of land and an agricultural way of life. Any changes to that way of life are difficult to address programmatically.
d. Practical Issues	• Soil compaction and decreased drainage resulting from collection and bailing of straw. • Methane poisoning of soils with soil incorporation and increased release of a greenhouse gas. • Increased water usage for soil incorporation. • Increased use of diesel harvesting and transport equipment which could increase air pollution levels. • Decreased crop yields unless burning is allowed on at least a rotating basis. • Increased soil erosion associated with increased fallow periods. • Disturbance of soil micro-organisms and soil fauna with soil incorporation practices. • Genetically improved plant varieties for various tolerances do not provide as high of yields for some uses. • Increased incidence of pest and weed infestations with many types of non-burning alternatives.
e. Public Acceptance	None identified.
f. Aesthetics	None identified.

7.0 IMPLEMENTATION PLAN

This section provides a summary of general strategies for increasing the development and use of non-burning alternatives in the 15 Western states. This section also provides a summary of the overall results of this project to date and identifies some conclusions that may be drawn based on the information, results and conclusions found in prior sections of this report. The main conclusions provided here pertain to the identification and use of non-burning alternatives, the identification and implementation of program accountability mechanisms, and the identification of non-statutory administrative barriers.

7.1 Review of Project Background and Study Objectives

The Western Regional Air Partnership and its Fire Emissions Joint Forum sponsored this project to provide more complete information about the identification and use of non-burning alternatives to the common practice of infield burning of agricultural residues in the West. The geographical scope of the project includes the 15 Western states of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, North Dakota, New Mexico, Nevada, Oregon, South Dakota, Utah, Washington, and Wyoming. State, as well as tribal, jurisdictional issues were addressed.

The project objectives include the following:

1. Identification of current crops and the extent to which residue is disposed of through burning for the 15 Western states (Sections 2.0 and 3.0 of Volume I);

2. Display of the crop and agricultural burning data in a geographic database using a geographical information system (Appendices B and D of Volume I);

3. Identification of potential alternatives to agricultural burning and characterization of their agronomic, environmental, health and safety, social, economic, and political impacts (Section 2.0 of Volume II) ;

4. Development of criteria for selecting “reasonable” non-burning alternatives, cost-abatement curves (i.e., cost of alternative by crop) and examples of how to apply the criteria and cost-abatement curves to evaluate alternatives (Sections 3.0 and 4.0 of Volume II);

5. Identification of existing and potential accountability mechanisms for tracking if, and which, non-burning alternatives are used by local, state, tribal, or federal entities (Section 5.0 of Volume II);

6. Identification of existing and potential barriers to the use of alternatives, including non-statutory barriers (e.g., public acceptance, cultural practices, etc.), and recommendations on how these can be overcome (Section 6.0 of Volume II); and

7. Development of a plan for implementing a non-burning program based on the analysis, findings, and recommendations developed under this project (Section 7.0 of Volume II).

The methodologies used to carry out this effort and to address the main objectives noted above have been described in each of the previous sections. The overall results of this effort and general conclusions that may be drawn as they pertain to the potential identification and use of non-burning alternatives in the 15 Western states and tribal communities are presented here.

7.2 Summary of Study Results

In addition to review of formal reports and articles, air quality agency, environmental agency, agricultural extension services, and/or state university research representatives from all 15 states as well as representatives from a variety of local regions within several states were contacted (See Appendix A: List of Informal Survey Participants and Contact Information). The information gained by contacting these representatives is presented here as well as throughout this report.

Straw or residue management treatments can impact many aspects of agricultural production and land management. Straw management practices, including the use of prescribed fire, can impact levels of soil nutrients such as nitrogen (RCAAFC, 1998). Agronomists often recommend returning unburned crop residues to the soil to help maintain soil organic matter levels and to maintain or improve soil aggregation which inhibits erosion (NDSUCE, 1974). Often it is highly desirable to keep crop stubble standing and residues in place on the soil surface to protect from soil erosion, especially after seeding when the soil is most vulnerable (SAF, 1999). In some cases the need to burn, as a field residue, orchard, or vineyard management technique, has been established to address disease incidence, pest infestation, or crop production

(UCCE, 2001). For example, burning grass pastures can result in short-term increases in nitrogen mineralization which results in short bursts of nutrient availability. It can also be used to control weeds and sagebrush can be nearly eradicated from rangelands when burned in the late fall when it is dry (MSUES, 1998).

However, in the majority of cases throughout the West, agricultural burning has not been based on scientific reasoning but rather on many practical aspects of farm management such as economics, crop production, expediency, tradition and ease of use (USDA, 1997c). Today these practical aspects also include, in some cases, the absence of effective and economically viable non-burning alternatives. In other cases, effective and economically viable non-burning alternatives may exist, but the affected agricultural community may not have knowledge of their existence or, for a variety of practical reasons may not be willing or able to put them into practice in their daily operations.

Burning of crop residues was found to occur for all of the major crop groups (i.e., grains and hay, grasses and seeds, orchard, and fruits and vegetables). Also, other crops are burned as well including sugarcane. In total, residues from more than 35 different crops are burned in the states of Arizona, California, Colorado, Hawaii, Idaho, Montana, North Dakota, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington and Wyoming. Other agricultural related fuels such as ditches and ditch banks, and CRP lands are reported as burned in Idaho and Washington, respectively. (Appendix C of this report includes a copy of Table 3-5 from Volume I. This table shows the quantity of residues burned by state for various years. Care should be taken not to compare quantities between states where the data represent different years.)

More than 20 different non-burning alternatives organized into at least 4 different major category types were identified in this effort (see Table 2-1 of this report). Qualitatively one or more of these non-burning alternatives were found to be in use today or in the past in at least 7 of the 15 states addressed by this effort. The quantitative extent to which non-burning alternatives are in use in these states is highly variable and largely undocumented. It is possible that these or other non-burning alternatives may in be use by the agricultural community in other states or regions of the Western states; however, the documentation of this does not appear to exist at this time. Records which document the extent to which non-burning alternatives are being used in lieu of open field burning were not found to be kept by any state or local agency contacted during this research effort. This finding is further explained by the results of the accountability mechanism assessment provided in Section 5.0 of this report. This is a considerable obstacle in the identification and use of non-burning alternatives that has the potential to significantly impact program implementation efforts.

Some states are now taking action to correct this gap in essential data collection. These states include California (with its recent changes to Title 17 of the California Code of Regulations) Washington (with its post-burn report card efforts), Alaska, and Nevada. However, data collected to date remains in handwritten form. It has not been routinely input into electronic form, quality checked, or included in emissions inventories (Pfeifer, 2001: informal survey response from Grant Pfeifer, Washington Department of Ecology, Agricultural Burn Task Force). Any data slated for collection in the future by California and other states was by definition unavailable for this research effort. It is reasonable to expect that these data will remain unavailable until states have fully implemented changes to their existing agricultural burning programs; the data has been collected, and then made available for review. Responses from a variety of other air quality and environmental agency representatives indicate that other states are looking forward to collecting better data on agricultural burning practices in general, as well as documenting the use and effectiveness of non-burning alternatives. For many states significant changes in statutory authority (or in seemingly all cases, increases in essential programmatic resources) are required before agencies and organizations or their representatives can move forward in these program areas.

7.3 Discussion of Results Pertaining to the Identification and Use of Non-Burning Alternatives

The majority of information collected and reviewed suggests that states, local agencies, tribal communities and fire control experts agree that the development and use of non-burning alternatives is desirable for a number of reasons throughout the 15 Western states and tribal communities. However, the identification, development and use of non-burning alternatives throughout the Western states appear to be in the fundamental research stages. A number of non-burning alternatives have been considered for a variety of crops in several states

(CARB, 1993; CARB, 1997a; CARB, 1997b; CARB, 1998; CARB, 2001b; CIWB, 1998; CIWB, 1999a; CIWB, 1999b; CIWB, 2000a; CIWB, 2000b; CIWB, 2001a; CIWB, 2001b; CIWB, 2001c; CIWB, 2001d; MSUES, 1998; NDSUCE, 1974; NDSU, 1998; OSU USDA-ARS, 1994; OSU USDA-ARS, 1995; OSUES USDA-ARS, 1989; SAF, 1999; SCAC, 1995; UCCE, 2001; USDA, 1997c).

However, there is considerable debate within the scientific community regarding the potential impacts, benefits and/or dis-benefits of burning versus not burning. There is considerable debate in the scientific community regarding the effectiveness and potential agronomic impacts of the various non-burning residue treatments. There is also extensive debate among researchers, air quality entities and affected agricultural parties regarding what is “reasonable” or “feasible” when it comes to the use of non-burning alternatives. In many cases, the need to conduct some form of burning, even if only under special circumstances, has been supported by a number of agriculture experts.

As a consequence, the identification and large scale practical use of non-burning alternatives was not found to exist in any state addressed in this effort. Although a few potentially effective non-burning alternatives have been identified and are in use for some crops grown in the West, the practical use has been limited to a very few crops, such as grass seed, wheat, or rice. The practical use has also been limited to a few states or regions of the West. These include Washington, Oregon and California. It is expected that this can be explained largely by the programmatic limitations and overall practical development and implementation issues identified in the assessment of accountability mechanisms outlined in Section 5.0 of this report.

During the survey effort it was found that none of the 15 states surveyed currently have or can provide a list of non-burning alternatives for any crops grown and otherwise known to be burned in their states or agricultural burning regions. This is an important finding of this effort. Representatives contacted during this effort routinely pointed to published research reports and agency summary documents which discussed the issues surrounding the identification and potential use of alternatives that were considered. However, none were able to provide succinct summaries or lists identifying and supporting the practical use of known alternatives in settings appropriate for their state or region. This is not likely a reflection of the lack of agency staff commitment to the non-burning program efforts; it is more likely a reflection of incomplete statewide or regional program development and inadequate, or in some cases nonexistent, interagency coordination. It is also more likely a reflection of incomplete or inadequate stakeholder outreach, education, and overall involvement in the process to identify and develop successful alternatives to burning in the state or local areas under their jurisdiction.

Accountability mechanisms play an important role in the identification, development, consideration and use of non-burning alternatives to agricultural burning in the West. The results of this effort suggest that the presence, or in some cases the absence, of identified accountability mechanisms appear to effectively determine whether non-burning alternatives will be used in the 15 Western states. The 17 mechanisms identified in this report fall into five main categories of accountability (see Table 5-1). It was expected, and therefore not surprising, that different states had varying numbers and types of accountability mechanisms in place to address agricultural burning as a source of air pollution and visibility impairment. For states where agricultural burning has not been identified as a significant source of air pollution it seems reasonable that a limited number of mechanisms, if any, would be put in place and that accountability mechanisms to address other more significant sources might be emphasized instead. However, in those states and regions where agricultural burning does significantly impact air quality, including visibility, it would be ideal to see the development and implementation of a number of accountability mechanisms to address the issue of agricultural burning.

Mechanisms 1 through 14 are essential for the support and validation of Mechanisms 15, 16 and 17 (see Table 5-2 of this report). The degree to which these accountability mechanisms are in place and in use by the various states is highly variable. There are a number of important mechanisms in place for several of the states or regions which have identified agricultural burning as a significant source of air pollution. These mechanisms actively support the management of agricultural burning activities. However, several of the most important mechanisms necessary for the identification and actual use of non-burning alternatives, such as mechanisms 15, 16 and 17, do not appear to be in place in the majority of the 15 Western states and tribal communities studied, even in those states or regions where agricultural burning appears to have the potential to significantly impact air quality. These mechanisms actively address the identification of effective non-burning alternatives, establish requirements to consider the use of alternatives to burning prior to burn approval, and offer practical assistance in offsetting costs to implement the typically more expensive non-burning alternatives.

Mechanisms 15, 16 and 17 provide accountability at the state or local level that facilitates the active identification of, and encourages the consistent use of, effective non-burning alternatives in conjunction with or as a substitute to traditional existing agricultural burning practices. Mechanism 15 provides incentive to actively consider non-burning alternatives by making it a requirement of pre-burn approval. This usually occurs during the pre-burn permitting process. If no pre-burn permitting process exists, in all but the most unique of circumstances, it is impractical and unrealistic to expect non-burning alternatives will be considered to any significant extent. The relationship between the requirement to secure approval prior to burning and the requirement to consider or practically implement some form of non-burning alternative to at least a portion of the slated burn acreage is key to encouraging the consideration and use on non-burning alternatives in the West.

Mechanism 16 provides financial assistance in one form or another to burners who implement non-burning alternatives. This serves to help overcome one of the most often voiced oppositions to the use of non-burning alternatives which is that of cost "ineffectiveness". Cost "ineffectiveness" is the most often cited reason for not using or implementing non-burning alternatives. Practical use or effectiveness is another reason (see Table 6-1 of this report). The latter may be overcome in time by more scientific research and close coordination with the agricultural community. The former remains a significant barrier for most state, regional, or local level entities who are trying to implement non-burning alternatives programs. In some cases subsidies, tax credits, permit fee reductions, or rebates may be an effective way to address this barrier. However, it is not always feasible for public entities to accommodate these financial incentives. Although it may not always be feasible to provide financial assistance to offset direct costs, it might be feasible for state air quality or environmental agencies to identify, if not actually recruit, other state or local experts in the areas of manufacturing, product development, marketing, and distribution to assist in the economic development of some types of non-burning alternatives. In at least one case during this research effort, it was found that members of the agricultural community were willing and able to develop and manufacture highly desirable products from rice straw stubble; however, they have been unable (to date) to overcome state level administrative obstacles in storing, distributing and selling their product (informal survey response, Jerry Maltby, Broken Box Ranch; see Appendix A).

Mechanism 17 has the potential to provide useful, practical incentives for the increased use of non-burning alternatives by providing a list of viable, practical, economically feasible alternatives that are available, currently in use, or have been used in the past. This mechanism alone, if put into practice in each of the 15 Western states and tribal communities, has the potential to eliminate another readily voiced opposition to the use of non-burning alternatives which is that non-burning alternatives do not exist or cannot be used effectively.

If effective non-burning alternatives do exist, but the agricultural community is unaware of their existence or is otherwise unconvinced of their effectiveness, it is impractical and somewhat unrealistic to expect that non-burning alternatives will be considered to any significant extent in any state or region of the West. If viable non-burning alternatives do exist and can be used effectively in a particular state or region of the state, then it seems reasonable that air quality and environmental agencies (with the support and input of the affected agricultural community, other stakeholders, university and extension services researchers) should be able to provide a consolidated well documented list, as needed, to anyone interested in identifying and using non-burning alternatives for a particular crop type in areas or regions of interest in the state. Historically, a number of the 15 states included in this effort have provided significant amounts of funding to support the research and development of non-burning alternatives. This is commendable and an excellent start to addressing this issue; however, these efforts to date do not appear to have contributed significantly to the practical use of non-burning alternatives in the majority of the Western states. Fortunately, this and other related non-statutory administrative barriers may be largely addressed by increased research efforts and improved stakeholder involvement, outreach, and communication efforts.

7.4 Developing Implementation Plans: Content

The results of this effort suggest a very clear starting point and overall path for increasing the identification and use of non-burning alternatives in the West. One important step is the development of effective non-burning alternatives program implementation plans. Programs that have the potential to be effectively implemented have several critical elements in common (Black, 2000). These include the following eight essential elements:

- Element #1: Program-Specific Strategic Plan;
- Element #2: Correctly Identified Target Audience and Stakeholders;
- Element #3: Clear Concise Messages and Program Purpose;
- Element #4: Effective Communication Tools and Strategies;
- Element #5: Effective Resource Allocation;
- Element #6: Reasonable Program Expectations;
- Element #7: Solid Sustained Executive Commitment; and
- Element #8: Consistent Program Implementation.

7.4.1 Strategic Plan

The most essential element of any successful environmental program implementation plan is the development of a program-specific strategic plan. A well developed strategic plan serves as a road map for the entire program effort. It is essential for identifying target audiences and for the development and delivery of, easily understood program messages. In addition to clearly identifying goals and outlining reasonable objectives, a well developed strategic plan will assist decision makers in defining the reasons for implementing a non-burning alternatives program.

A strategic plan may be very simple in nature with only one or two clearly defined goals and a few reasonable objectives; or it may be highly complex with numerous goals and extensive accompanying objectives. It may encompass the entire organizational state level program or it may address only those aspects related to agricultural burning in a given area. Whatever form and complexity the strategic plan ultimately takes, for a non-burning alternatives program to be successful the first step should be to deliberately develop a strategic program plan.

7.4.2 Correctly Identified Target Audience and Stakeholders

To be successful, non-burning alternatives implementation programs must correctly identify the target audience or stakeholders intended to be reached or ultimately impacted by the implementation effort. The stakeholders identified will be tightly tied to the purpose the air quality entities have for developing the programs. In some cases, it may be important for the non-burning alternatives implementation program to incorporate stakeholder expertise and comments in the identification and development of non-burning alternatives. In other cases the implementation program may be limited to enhancing and encouraging the use of previously identified alternatives.

In most cases, it is expected that plans will be developed to address both these needs in most states or tribal communities where agricultural burning has been identified as a significant source of air pollution. The target audiences or stakeholders identified will also determine what communication tools are necessary for the overall implementation program success. Whether these audiences include members of the regulated community or highly vocal opposition members of environmental groups, if the stakeholders are not clearly identified, the non-burning alternatives implementation program has essentially no chance of success. Fortunately, target audiences and stakeholders can be clearly identified if strategic planning activities are properly conducted.

7.4.3 Clear Concise Messages and Program Purpose

For any environmental program to succeed, it is essential that the program purpose be clearly identified at the beginning. Only after the reason(s) for addressing agricultural burning and for developing non-burning alternatives have been defined does it become possible to develop clear messages which can be communicated to the affected stakeholders and interested members of the public. The most successful non-burning programs developed will have implementation plan elements that effectively deliver clear messages to the target audiences and stakeholders that air quality and environmental entities would like to reach.

The collection and presentation of easily understood facts, data comparisons, emissions estimates, case studies, success stories, photographs, images and diagrams is essential to the success of this portion of the program development and implementation effort. Without documentation of current burning practices, emissions and air quality impacts, as well as proof of the practical effective infield use of non-burning alternatives, it is difficult to establish program purpose and credibility even with the most well designed and professionally implemented communications program. This appears to be an area where incomplete or uncollected data pertaining to agricultural burning activities and the identification and use of effective non-burning alternatives in the 15 Western states and tribal communities may play a significant role in the development of non-burning alternatives implementation plans. This finding also helps to prioritize which program development elements should be addressed initially for most states as they go on to develop non-burning alternatives implementation programs.

7.4.4 Effective Communication Tools and Strategies

The most successful non-burning alternatives implementation programs will be specifically designed to take advantage of the latest and most effective communication tools available today. These tools will of necessity be tailored to address the communication skills and needs of interested stakeholders as well as the communication skills and resources available to the state, regional, local or tribal agencies. In this age of electronic media, stakeholders have greater access to more information in shorter timeframes than ever before in the history of civilization. Technology has made it possible for motivated members of the public and the regulated community to follow, almost on a real time basis, environmental issues that may impact their lives. Motivated stakeholders have become more informed about environmental issues. As a consequence, they have become in many ways more demanding of service in their search for knowledge. Their expectation of timeliness in the delivery of information has risen exponentially. This changes the way public sector entities must reach out to and communicate with the targeted stakeholders in their non-burning alternatives program implementation efforts.

However, this does not mean that to be successful, public sector entities need to procure state-of-the-art communication technologies. It does mean that they should use what they have effectively and secure the resources in the future to grow as they can. Public sector entities do need to employ effectively those tools that they have at their disposal as well as assess whether the tools they are using will be effective in reaching interested stakeholders. Whatever communication tools and strategies are employed, it is essential that it be easy for stakeholders to obtain information and to participate in the implementation program efforts. If agencies do not have in-house expertise to at least identify the available non-burning alternatives program communication resources, and define effective strategies for addressing stakeholder communication needs, they may want to consider procuring outside professional assistance. Environmental programs that do not have effective communication tools and strategies in place typically have little chance of successful implementation (USEPA, 2000a).

7.4.5 Effective Resource Allocation

Low, even “no budget”, non-burning alternatives program efforts can be tremendously successful if they are carefully planned, consistently implemented, and conscientiously include affected and interested stakeholders (see Section 6.0 and Appendix B of this report). It is worth noting that a “rule of thumb” often applied to environmental program implementation efforts is “the less money and resources spent on a program, the more time it will take to successfully implement any given program”. Programmatic resources that are available should be spent in those areas most likely to provide programmatic value. These areas can be effectively identified in a well conducted strategic program planning effort.

7.4.6 Reasonable Program Expectations

The most successful non-burning alternatives implementation program efforts will clearly identify and subsequently set reasonable program expectations. These expectations, if identified correctly, should address a variety of program elements including implementation timelines as well as program outcomes, deliverables, and progress measurement methodologies. If air quality and environmental entities do not set reasonable program expectations and communicate those expectations to interested stakeholders, the chances are very great that the stakeholders will develop their own expectations. These expectations may not match those of the air quality experts. These mismatches in expectations often create unnecessary miscommunications and misunderstandings which often result in conflict. This can ultimately create barriers to the successful implementation of otherwise important programmatic efforts. Program challenges such as these can largely be avoided if reasonable program expectations are established at the beginning of the implementation plan effort. The development of reasonable program expectation often comes out of a well conducted strategic program planning effort.

7.4.7 Solid Sustained Executive Commitment

A solid sustained executive commitment to support an implementation program is essential to the success of any public program. A positive attitude triggers enthusiasm for any effort (Chapman, 1995). This enthusiasm can often be felt even if it is not always seen on a daily basis. However, as competing political, social and economic forces draw agency executive resources and focus toward other often more imminent and seemingly urgent issues, executive commitment to existing programs often wanes. This waning, although not always immediately evident, usually always results in decreased program resources, staffing, and commitment to the original program goals. This decreased commitment more often than not becomes readily apparent to affected stakeholders. From the affected stakeholders' perspective, if air quality and environmental entities expect them commit to modify current agricultural practices and in some cases cultural activities, the commitment on the part of the public agency to support and sustain the implementation of the program will likely be expected.

7.4.8 Consistent Program Implementation

It takes time to effectively implement any public environmental program, especially environmental programs to address air quality concerns which are inherently intangible and can be difficult to grasp. Because of this, it is essential that non-burning alternatives program implementation efforts be designed around reasonable program expectations. To be successful in implementing non-burning alternatives programs, the way people think and feel about agricultural practices, about burning and air quality in general, may need to change. Changing the way people approach business activities, or think about complex environmental issues takes time and consistent program implementation.

The timeframes needed to effectively implement any program will vary based on the target stakeholder audiences identified and the overall non-burning alternatives program purpose. In many cases, implementation programs will be designed to address several purposes and to reach different target audiences or affected stakeholder groups. In these cases, multiple time lines may need to be developed. Program expectations should also be adjusted accordingly. Fortunately, reasonable program expectations and realistic time frames can be readily developed once the program purpose has been defined and the target stakeholder audiences have been identified through a well thought-out strategic planning effort.

7.5 Developing Implementation Plans: Recommended Strategy

The results of this effort suggest a very clear starting point and methodology for developing implementation plans to increase the identification and use of non-burning alternatives in the West. Based on the results and conclusions found in the prior sections of this report, the following strategy for developing successful non-burning alternatives program implementation plans is recommended for any state, region or tribal entity desiring to increase the identification and use of non-burning alternatives:

1. Air quality or environmental program entities should conduct a focused review to identify the nature and extent to which agricultural burning contributes to air quality problems in the state, or local, or tribal area. A starting point for this review could be the evaluation of agricultural burning activity presented in the companion Volume I document to this report. A key element of this review that should be included is a careful consideration of the definition of "agricultural burning". This is important so that accurate comparisons can be made between other states, local or tribal programs. The review should also take into account the potential impacts that agricultural burning may have on interstate regional air quality.

2. If agricultural burning does not contribute significantly to local or statewide air quality problems which fall under the jurisdiction of the state, local or tribal entity, it is still recommended that the focused program assessment also take into account, to the greatest extent possible, the potential impacts agricultural burning may have on interstate regional air quality.

3. If agricultural burning is not found to be a significant source of air pollution for a given state, local region, tribal entity, or interstate region, it may not be necessary to continue with non-burning alternatives program development. This may be the case for some states that appear to lack accountability mechanisms as noted in Section 5.0 of Volume II.

4. If agricultural burning is found to make a significant contribution to air quality problems on either a local, state, tribal community or regional level, then the air quality or environmental agencies in authority in the affected areas and the areas contributing to the problems should work together to define solutions and develop non-burning alternatives programs. This will help to ensure success on a regional level.

5. If agricultural burning is found to be a significant source of air pollution for a given state, local region, tribal entity or interstate region, or if a given entity desires to more effectively implement non-burning alternatives, then

an overall air quality review should be conducted to determine how to integrate agricultural burning as a source. One goal of this review would be to determine which of the accountability mechanisms identified in Section 5.0 of this report are in place and how they are being used. Table 5-2 can be used to determine the specific accountability mechanisms and tailor the agricultural burning program. In some cases statutory changes may be required in order to provide for adequate availability and implementation of the desired accountability mechanisms. In other cases lead agencies may consider the development and implementation of voluntary accountability and/or non-burning alternatives implementation programs. However, it is very important to note that while voluntary programs may facilitate the development and implementation of portions of programs in some settings, in other cases they may not be effective. For example, in where program development and implementation are associated with increased economic costs and changes in practical business operations or management, voluntary programs alone are not typically effective in meeting overall air quality program objectives. Voluntary programs under these circumstances often do not provide adequate incentives to bring about significant changes in current practices.

6. For those states, local regions, and tribal entities desiring to more effectively address the use of non-burning alternatives in general, it is recommended that a list of effective and economically viable non-burning alternatives be developed (ideally including non-burning alternatives for use by crop, by season, and by region or area). Table 2-1 (listing of non-burning alternatives by crop) can be used to identify specific alternatives. The criteria, methodology, and case studies described in Sections 3.0 and 4.0 of this report can be used to determine feasibility.

7. It is further recommended that a list, or in some cases multiple lists, of feasible non-burning alternatives be maintained and updated periodically by the participating lead public or private entity. The list(s) should be made available using a variety of common effective communication strategies, methods, and technologies.

8. If non-burning alternatives have not been previously identified or have not been characterized for practical use an area, it is recommended that air quality and environmental entities work closely with university and agricultural extension scientists, affected agricultural community stakeholders, and interested members of the public to identify and characterize non-burning alternatives for specific use in their state or region.

9. WRAP member states should form a technical working group or task force to systematically review the identification and current use of non-burning alternatives and to make recommendations, if desired, on how and where

the use of these non-burning alternatives may be improved or enhanced in other states, local regions, and tribal communities.

10. WRAP member states should work together to begin to address ancillary non-emission related program implementation issues, such as assisting the affected agricultural community and local business developers with post-residue removal product development, manufacturing, distribution, and marketing. Although this often falls outside the traditional charter of most state air quality and environmental programs, it does not fall outside the realm of services offered by other state agencies, boards and environmental departments. Some states have taken steps to assist in the research and development stages but their efforts have not extended to distribution and marketing.

11. It is highly recommended that the results of this and any of the above mentioned program efforts be carried out in close coordination with a well defined stakeholder outreach, education and communication program.

7.6 Agency Roles and Responsibilities

The agency roles and responsibilities associated with agricultural burn program implementation were found to vary greatly throughout the 15 Western states and tribal communities addressed in this effort. It was found that the accountability for agricultural burning program development, coordination and implementation, although typically originating at the state level, was in many cases delegated directly to local or regional entities (see Tables 5-2 and 5-2a of this report). In some states, where the primary concerns regarding agricultural burning impacts were fire hazard and public safety, the authority to approve burning was delegated to local fire agencies or even private contract fire control businesses. In no cases was it found that local implementing agencies were required to quantitatively report back to the state or region level on the status of the agricultural burning program implementation.

There was found to be essentially little or no coordination between tribal and non-tribal burn entities (WRAP, 2001b). The authority to approve burns on tribal lands was found to be exceptionally variable and spanned the entire range of agency authority from rural fire district authority to federal land management agency.

The agency roles and responsibilities associated with the identification, development and implementation of non-burning alternatives are not clearly identified for any of the 15 Western states. In one case, the primary contact for the identification and use of non-burning alternatives was the state Waste Management Program (informal survey response, Tim Rogers, South Dakota Department of Environment and Natural Resources; see Appendix A). In another case, it was found that while a state level air quality agency and legislative authority had generously developed and made available a monetary subsidy to support and encourage the alternative use of rice straw, the program implementation was delegated to another agency (the Department of Food and Agriculture). It appears that since the rice straw subsidy program was not one of their own programs, the staffing and implementation priority were not given. The end result of this agency role and responsibility inconsistency was the existence of a potentially helpful economic subsidy provided by the state, the availability of several qualified applicants currently using rice straw for other purposes, and more than a 2 year (and counting) wait for application acceptance and subsidy funding (Public testimony provided by Jerry Maltby, Broken Box Ranch Feedlot and Compost, California Air Resources Board public meeting to discuss the impacts of legislative mandate to phase-down rice straw burning in the Sacramento area, June 28, 2001; see Appendix A).

As non-burning alternatives programs are reviewed or developed in many states, it is recommended that the air quality or environmental agency responsible for initiating the identification and development of non-burning alternatives also be responsible for monitoring and implementing the non-burning alternatives program at the local level. While it makes sense to work closely with the affected agricultural community through existing pathways, such as the agricultural extension offices, natural resources conservation offices, local fire agencies or the local and state departments of agriculture, unless these agencies and departments are fully invested in statewide or even local or regional air quality program efforts, it may be difficult to get the program implementation results desired. Nonetheless, these existing pathways can be hugely valuable in the successful implementation of non-burning alternatives programs if they are effectively incorporated, and relationships are clearly defined, in the air quality or environmental entity's strategic planning process.

Regional approaches to defining agency roles and responsibilities, where possible are highly desirable as well. In another case, because Washington and Oregon have more stringent air quality regulations, in the last 3-5 years grass seed companies have been relocating to Wyoming where air quality regulations are less stringent (informal survey, Darla Potter, Wyoming Dept of Environmental Quality, 2001; see Appendix A). Clearly, the air quality and environmental agency roles and responsibilities, whether defined by statute or delegated by the same statutory authority, play an important role in the development and implementation of non-burning alternatives in the West.

7.7 Strategies to Address Stakeholder Involvement

Stakeholder acceptance of any effort to address environmental challenges will always be tightly bound to the success of the lead environmental entity's public outreach and communication efforts to address the subject. It will also be tightly bound to their efforts to include stakeholders in developing and implementing solutions to the identified challenges. This is true for any state, region, local area or tribal community. To be successful in these efforts, lead environmental agencies should provide the following critical program information to interested parties and stakeholders:

- Clearly identified problem(s) or challenge(s);
- Carefully quantified significance or effect of the problem(s) or challenge(s);
- Clearly identified solution(s) to the problems or challenges or, at a minimum, a clearly defined method for identifying or obtaining critical information necessary to develop solutions; and
- Clearly identified plan for addressing the problems or challenges identified.

Not surprisingly, a well designed, closely coordinated and consistently implemented stakeholder involvement, outreach and communication effort incorporating this critical program information is also essential to the success of any non-burning alternatives program. Not only will stakeholder involvement be essential for promoting the use of non-burning alternatives, it will likely be key in developing future alternatives to the current practice of infield or onsite burning of residues. In this age of electronic media and the Internet, people have become much more knowledgeable and increasingly more demanding of timely service in their search for that knowledge. Unless the commitment to identify and implement the use of non-burning alternatives is understood and its value embraced and shared by the public as well as the regulated agricultural communities, the implementation of non-burning alternatives will likely remain marginal in many of the 15 states and tribal communities addressed in this effort.

Stakeholder involvement, education and communication efforts can be handled on a one-on-one basis as an organization's staff come in contact with stakeholders and other members of the public or they can be addressed with a formalized, organization supported and endorsed outreach effort. Although it is still based in part on one-on-one contacts, the latter is much more effective and is preferred.

To be more successful in these efforts, air quality agencies and environmental managers must develop non-burning alternatives implementation programs that contain solid well supported public outreach and communication efforts that also increase stakeholder involvement. The strategies and tools needed to address stakeholder outreach in the 15 western states and Tribal communities included in this effort were not assessed directly. This was not within the scope of this current effort. However, based on the results of the accountability mechanisms assessment provided in Section 5.0 of this report, stakeholder involvement is expected to vary greatly.

Those states with more aggressive mandates to address agricultural burning, in general, may already have in place fairly adequate stakeholder outreach programs. States that are just developing programs to address agricultural burning are less likely to have well developed programs to address stakeholder involvement. Taking into consideration the results of the accountability mechanisms assessment found in Section 5.0 of this report, if they do desire to address the use of non-burning alternatives more effectively, it is likely that all 15 Western states and tribal entities identified in this effort could benefit greatly from well designed, focused, and consistently implemented non-burning alternatives stakeholder involvement, outreach and education programs. A careful assessment of current stakeholder involvement efforts is recommended for each state, local, regional or tribal entity interested in addressing agricultural burning through the use of non-burning alternatives.

No matter what the ultimate goal of a non-burning alternatives implementation program is, historical burning practices will always remain more familiar, more immediately tangible and likely more cost effective. This is because existing agricultural operations are already set up to conduct business in the traditional fashion. In some cases, whole cultures and communities have grown up around specialized agricultural operations.

This is the case in New Mexico where centuries-old farming practices rely on the communal management of water delivered by an elaborate system of irrigation ditches. These irrigation ditch systems, or "acequia," are maintained by the entire community. Acequias formed the basis for settlement of New Mexico's Indo-Hispanic communities between two and four hundred years ago (NMAA, 2002). Today, a statewide organization of communities representing the 1000 or so autonomous organizations that maintain their own acequia and share water by custom and tradition has been formed and it is called the New Mexico Acequia Association. There are often community celebrations and cultural activities centered around the maintenance of the acequias. The maintenance of acequias in many parts of New Mexico also involves the annual burning of weeds that grow in these irrigation ditches (informal survey response, Brad Musick, New Mexico Environmental Department Air Quality Bureau; see Appendix A). Changing agricultural practices in these communities and possibly many others throughout the West is very challenging since it may require in some cases the modification or ultimate abandonment of some cultural practices. In some cases, this practically equates to changing the way people have lived their lives and conducted business in their communities for generations.

As urban communities encroach on these more rural agriculturally based communities, public pressure to decrease or eliminate burning may play a role. Although the fuel source and agricultural practices may differ in New Mexico, this is much the same situation as seen in most all of the growing Western states. It is expected that political and social pressures supporting the need to find and make use of viable non-burning alternatives will come into play to a greater extent in the future. It is also expected that these will have an impact on how stakeholder involvement is carried out in each of the 15 Western states and tribal communities identified in this effort. Program implementation success will be greatly tied to an agency's ability to communicate to the public and affected industries it serves, why the program is valuable and provide valid information as to why it is expected that the program will be successful. The public is intelligent and informed and more than capable of understanding the need to address air quality concerns. However, neither the public nor the regulated agricultural communities will accept what they can not understand or what they do not value (USEPA, 2000b). It is up to the air quality and environmental management entities to effectively communicate the need to identify and utilize alternatives to burning in the West.

Lastly, it is important to note that program implementation planning and timing is very important in the development and implementation of programs to encourage the use of non-burning alternatives. When in place, statutorily mandated 30 and 60 public noticing requirements often dictate the assignment of communication program and implementation timelines for regulatory activities. However, these statutory requirements often have little or nothing to do with the actual timeframes needed to develop and implement effective public communication programs. Instead, although expectedly unintended, they are often instrumental in defining unreasonable communication and program implementation expectations.

While statutory deadlines must be met, reasonable program expectations should also be set if a public communication program and stakeholder involvement effort is to be successful in addressing the identification and use of non-burning alternatives. The key to addressing the issue of program implementation and timing is to involve stakeholders in the beginning of any process. The key is also to allow adequate time for the communication and stakeholder involvement effort to work. It is reasonable to expect that effective stakeholder involvement and communication efforts may take on the order of 1 to 3 years or more to implement.

For most states surveyed as part of this research effort, few if any of the four essential information areas necessary for developing and implementing effective stakeholder outreach and involvement efforts as noted above, have been adequately addressed. This is an area where additional work is recommended for those states and tribal communities that desire to address the use of non-burning alternatives. Fortunately most states desiring to address agricultural burning appear to be aware of these issues and are taking steps to begin addressing these program development and implementation challenges. However, in light of the time frames discussed here and the program information data gaps discussed here and elsewhere, it seems clear that good strategic planning and program development will be essential for any state, local, regional or tribal entity desiring to address the use of non-burning alternatives more effectively.

7.8 Suggestions for Further Research and Information Development

A number of directions for further research and information development necessary for Western states and tribal communities to begin addressing the identification and use of non-burning alternatives more effectively have been identified through this study. These fall into the following main categories:

1. Better characterization of agricultural burning activities in the 15 Western states and tribal communities addressed in this effort, including the development of a consistent definition for "agricultural burning";
2. More consistent and thorough collection and evaluation of agricultural burning activity data by regulatory agencies and stakeholders;
3. More thorough assessment of the impacts agricultural burning has on air quality and visibility in the participating states, local areas, tribal communities and WRAP member state regions;
4. On-going identification, characterization and accounting of effective non-burning alternatives and their use;
5. Effective inclusion of stakeholders in the identification and implementation of non-burning alternatives; and
6. Development of well designed, consistently implemented stakeholder outreach, education and communication programs that not only address state or local issues but bridge gaps in interstate and regional communication and provide consistent, readily understood messages.

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APPENDIX A

LIST OF INFORMAL SURVEY PARTICIPANTS AND CONTACT INFORMATION

List of Informal Survey Participants and Contact Information

State	Contact	Affiliation	Purpose	Phone	Fax	Email
AK	Ann Lawton	Dept. Env. Conservation	Air Program	907.269.3066	--	ann_lawton@envircon.state.ak.us
	Gerry Guay	Dept. Env. Conservation	General	907.269.3070	--	--
	Dr. Anthony Nakazawa	Univ. AK Fairbanks, Coop. Ext.	Alternatives	907.474.7246	907.474.6971	fnatn@uaf.edu
	Phil Kaspari	Univ. AK Fairbanks, Coop. Ext.	Alternatives	907.895.4215	--	fnpnk@uaf.edu
AZ	Varma Sunil	Dept. Env. Quality	Air Program	602.207.2322	--	varma.sunil@ev.state.az.us
	Shannon Reif	Dept. Env. Quality	Air Program	602.207.2369	--	--
	Dena Kanopka	Dept. Env. Quality	Air Program	602.207.2378	--	--
	Bill Maxwell	Pima County Dept Env. Quality	Implemetation	520.740.3340	--	bmaxwell@deq.co.pima.az.us
	Donald Gabrielson	Pinal County Dept Env. Quality	Air Program	520.868.6929	520.868.6967	don.gabrielson@co.pinal.az.us
	Curt Foster	Yuma County Fire Dept	Burn Info	520.782.4757	--	--
	Rick Hado	Maricopa Cnty Dpt Env. Quality	Burn Info	602.506.6700	--	--
	Dr. James Christenson	Univ. AZ College of Agriculture	Alternatives	520.621.7209	520.621.1314	jimc@ag.arizona.edu
	Kevin Rogers	Cotton/Alfalfa Farmer	Alternatives	602.757.5779	--	--
CA	Arndt Lorensen	Cal/EPA Air Resources Board	Air Program	916.322.6040	--	alorenze@arb.ca.gov
	Patrick Gaffney	Cal/EPA Air Resources Board	Emissions		--	pgaffney@arb.ca.gov
	Karen Magliano	Cal/EPA Air Resources Board	Air Program	916.322.7137	--	kmaglian@arb.ca.gov
	Tina Suarez-Murias	Cal/EPA Air Resources Board	Air Program	916.323.1495	--	tsuarezm@arb.ca.gov
	Dr. W.R.Gomes	Univ. California Coop. Ext.	Alternatives	510.987.0060	510.451.2317	wr.gomes@ucop.edu
	Jerry Maltby	Broken Box Ranch, Private	Alternatives	530.473.3006	530.473.5481	bbr@mako.com
CO	Coleen Campbell	Dept. Public Health	General	303.692.3224	303.782.5493	coleen.campbell@state.co.us
	Pat McLaughlin	Dept. Public Health	General	303.692.3256	--	--
	Phyllis Woodforld	Dept. Public Health	Burn Info	303.692.3221	303.782.0278	phyllis.woodford@state.co.us
	Dirk Wold	Dept. Public Health	Burn Info	303.692.3150	303.782.0278	dirk.wold@state.co,us
	Milan A.Rewerts	CO State Univ. Coop. Ext.	Alternatives	970.491.6281	970.491.6208	mrewerts@vines.colostate.edu
	Dr. Mary Gray	CO State Univ. Coop. Ext.	Alternatives	970.491.6281	970.491.6208	mgray@vines.colostate.edu
HI	Lisa Young	Dept. of Health	General	808.586.4200	--	--
	Janet Ashman	Ag Research Center	Burn Info	808.486.5307	--	jashman@HARC-HSPA.com
	Susan Kihara	Dept. of Health	General	808.586.4200	--	--
	Dr. H.Michael Harrington	Univ. HI Coop. Ext.	Alternatives	970.491.6280	970.491.7396	wdal@lamar.colostate.edu
	Dr. Andrew Hashimoto	Univ. HI Coop. Ext.	Alternatives	808.956.8234	808.956.9105	dean@avax.ctahr.hawaii.edu
	Dr. Ron Mau	Univ. HI Coop. Ext.	Alternatives	--	--	maur@ctahr.hawaii.edu

Continued

List of Informal Survey Participants and Contact Information

State	Contact	Affiliation	Purpose	Phone	Fax	Email
ID	Diane Riley	ID Dept. Env. Quality	Air Program	208.373.0214	--	driley@deq.state.id.us
	Dan Redline	Courdelaine Regional Office	Burn Info	208.769.1422	--	dredline@deq.state.id.us
	Curt Thornberg	Dept. Ag.	Alternatives	208.322.8633	--	cthornbu@agri.state.id.us
	Mike Dubois	Dept. Env. Quality	Emissions Info	208.373.0136	--	--
	Dr. Leroy Luft/ Roger Veseth	Univ. ID Coop. Ext.	Alternatives	208.885.6639	208.885.6654	extdir@uiuc.edu
MT	Bob Habeck	Dep. Env. Quality	Air Program	406.444.7305	--	bhabeck@state.mt.us
	Dave Levinson	Dep. Env. Quality	Burn Info	406.329.4952	--	--
	Dan Walsh	Dep. Env. Quality	Air Program	406.444.0285	--	dwalsh@state.mt.us
	Dr. David Bryant	MO State Univ. Coop. Ext.	Alternatives	406.994.6647	406.994.1756	dbryant@montana.edu
ND	Chuck McDonald	State Health Dept.	General	701.328.5188	--	cmcdonal@state.nd.us
	Dr. Sharon Anderson/ Duane Bergland	ND State Univ. Coop. Ext.	Alternatives	701.231.8944	701.231.8378	ext-dir@ndsext.nodak.edu
NM	Brad Musick	Dept. Env. Air Qual.	Air Program	505.827.0335	--	brad_musick@nmenu.stste.nm.us
	Paula Garcia	Private Group	Cultural Pract.	--	--	--
	Dr. Jerry Schickedanz/ Denise McWilliams	NM State Univ. Coop. Ext.	Alternatives	505.646.3016	505.646.5975	adean@nmsu.edu
NV	Colleen Cripps	Div. Env. Protection	Air Program	707.687.4670	--	--
	Karen L. Hinton	Univ. NV Coop. Ext.	Alternatives	775.784.4848	775.784.4881	hinton@agnt1.ag.unr.edu
	John Burton	Univ. NV Coop. Ext.	Alternatives	775.784.7070	775.784.7079	burtonj@unce.unr.edu
OR	Brian Finneran	Dep. Env. Quality	Air Program	503.229.6278	--	--
	John Hamblin	OR Dept. Ag.	Burn Info	503.986.4702	--	--
	Patti Gentiluomo	OR Dept. Ag.	Alternatives	503.986.4793	--	--
	Suzy Pettey	Dept Ag	Burn Info	503.986.4794	--	--
	Dr. Lyla Houghlum	OR State Univ. Coop. Ext.	Alternatives	541.737.2713	541.737.4423	lyla.houglum@orst.edu
	Kathryn BarryStelljes	USDA Ag Research Service	Alternatives	510.559.6069	--	--
SD	Tim Rogers	Dept. Env. Nat. Res.	Burn Info	605.773.6706	--	tim.rogers@state.sd.us
	Chris Hansen	Dept. Env. Nat. Res.	Air Program	605.773.3151	--	--
	No Contact	Waste Mgmt Program	Alternatives	605.773.3153	--	--
	Larry Tideman	SD State Univ. Coop. Ext.	Alternatives	605.688.4792	605.688.6347	tidemann.larry@ces.sdstate.edu

List of Informal Survey Participants and Contact Information

Continued

State	Contact	Affiliation	Purpose	Phone	Fax	Email
Tribes	Sarah Kelly	Inst. Tribal Environ. Prof.	Tribal Info	928.523.6377	--	--
UT	Francis Bernards	Dept Env. Quality	General	801.536.4056	--	fbernard@deq.state.ut.us
	Dr. Robert Gilliland	UT State Univ. Coop. Ext.	Alternatives	435.797.2201	435.797.3268	bobg@ext.usu.edu
WA	Grant Pfeifer	Dept. Ecol. Ag Burn	Burn Info	509.456.3284	--	GPFE461@ECY.Wa.Gov
	Dr. Michael Tate	WA State Univ. Coop. Ext.	Alternatives	509.335.2933	509.335.2926	mtate@wsu.edu
	Mark Wagoner	Alfalfa Seed Farmer	Alternatives	509.394.2970	509.394.0479	wagoner@wwics.com
WY	Darla Potter	Dept. Env. Quality	Burn Info	307.777.7346	307.777.5616	dpotte@state.wy.us
	Dr. Glen Whipple	Univ. WY Coop Ext.	Alternatives	307.766.5124	307.766.3998	glen@uwyo.edu
	Grant Stumbough	Dept. Ag. Nat Resources	Alternatives	307.777.7321	307.777.6593	--

End

APPENDIX B

PROJECT CASE STUDY:
ALASKA AGRICULTURE PROJECT, DELTA JUNCTION

Alaska Agriculture Project, Delta Junction

Objective:

To present realistic information on the successes and challenges currently seen or encountered in developing and implementing non-burning alternatives in the West.

Geographic Location (i.e. State, County, Region, Tribe, etc.):

Delta Junction, Alaska (64° latitude, 146° longitude)

This community is rather remote, but still on a road system. It is a three-hour drive to Fairbanks (in good weather with good road conditions), which is its nearest large community.

Description:

The Alaska Agriculture Project was initially started in Palmer, Alaska, in approx.1940. The objective was to populate the Alaska territory so that it could become a state. Because the Palmer Project was a success, the Delta Project (approx. 1970s) was implemented and designed to improve the state's resource base. As land was cleared to provide open spaces for agriculture, large piles of woody debris were deposited along the edges of cropland (Figures 8-1 through 8-3).

Agriculture in Alaska is difficult at best, but it can provide produce (potatoes, kole crops), meat (cattle, swine, some elk, reindeer, buffalo), feed (dryland hay and grain primarily) and milk at a price that is cheaper than shipping it from Lower 48 markets. However, a sustained, reliable supply is not always achievable. Proceeds from crops only during the past ten years were variable, from $1.9 million to $5 million, largely depending on weather.

The Delta Projects are in danger of "going away" primarily because weather conditions are severe, which limits a sustained supply, which limits the market. Politics are also a limiting factor here, partially because a state-funded program must exist in order to sustain agriculture through low-market prices, small infrastructure, and other limitations to farming. Hope springs eternal, however, particularly among Alaskan farmers. They are a tough breed. They call themselves "The Frozen Chosen."

This case study has more to do with proper timing and coordination of agricultural burning than it does with non-burning alternatives. Timing is an important smoke management tool.

Figure B-1: Close up View of piles woody debris from land clearing (Delta Junction, Alaska).

Figure B-2: Close up view of piled woody debris and vehicle for scale, land clearing (Delta Junction, Alaska).

Figure B-3: Aerial “Birds Eye” view of long rows of piled woody debris from land clearing (Delta Junction, Alaska).

Figure B-4: Post burn view of prior woody debris pile from land clearing (Delta Junction, Alaska).

Case Study Successes or Positive Benefits

The success of this case study comes in the manner that the challenge was overcome. They still burn, but in a more coordinated and environmentally-safe fashion (Figure B-4).

Practical considerations outweighed political and social considerations in the end.

Environmental and statutory considerations were satisfied.

The Delta Projects were allowed to continue burning to remove debris (which is the cheapest and most practical alternative for this situation), and the community keeps its farming resource which is desperately needed due to the closure of nearby Fort Greely, one of its major sources of income.

Challenges or Limits

When the land was cleared in the 1970s, the idea was to either use the piles as windrows or burn them in place. The clearing method that was used intentionally incorporated dirt into the piles because the "proper" burning technique at the time involved a "kiln-effect" where the debris smoldered within the pile and the dirt and snow prevented smoke from escaping. This technique didn't work.

Because the piles were not clean, burning did not occur, or when it did it was a dismal failure. Not only did the piles smolder for many days, the debris often didn't completely burn, which left large debris without fine material to get it lit and keep it burning.

Alaska legislature recently passed a "Right to Farm" bill limiting civil suits against farmers for odors or smoke. This was done in direct response to the open burning practices done by the farmers prior to Alaska Dept. of Environmental Conservation (DEC) coordination. The bill does not limit DEC enforcement.

Prior to the Right to Farm bill and DEC coordination with farmers, smoke from open burning of land clearing debris was so bad, you literally could not see the road. It caused a school bus to run off the road. No one was injured, but it led to a series of events that caused friction between Alaska Division of Forestry, Division of Agriculture, DEC, the farmers, the local residents, and the Governor's office.

Recommendations to Overcome Challenges or Limits

Communication and flexibility among all stakeholders, including regulatory agency. Due to the controversial nature of the smoke problem, we established a "Task Force" which brought all interested parties to the table to work out a resolution. If nothing else, this method defused the situation and brought about a more thorough understanding of all parties' grievances. Angry words were said, but ultimately solutions were achieved.

Anecdotal incident: Prior to the formation of the Task Force, DEC had tried several techniques of enforcement. All of these techniques failed, primarily because DEC did not fully understand the cultural, logistical and societal elements of the problem.

At the Governor's request, DEC held a public meeting in Delta which was attended primarily by the farmers who thought DEC would inflict more unreasonable regulations on them. Needless to say, the tone of the meeting was tense at best.

I presented the DEC's case to the farmers at this meeting, and was well aware of the negative reaction I was receiving. Alaskans are notorious for their dislike of government intrusion, and this is particularly the case in remote Alaska. Arms folded, frowns, and grunts were the primary responses to my statements. When I asked how I could fix the problem, how we all could fix the problem, they asked me if I could stay another day to take "The Tour." I readily agreed.

The next day, seven of us piled into a Suburban and began driving. It should be noted that it was late October and bitter cold with a lot of snow on the ground. We drove for nearly an hour, asphalt road became gravel, gravel became dirt, yet we kept driving. I had no idea where I was. I was also new to Alaska and understood that remote areas can be deadly without proper respect for the environment. It appeared we were deep in the "Cold As I've Ever Been Middle of Nowhere."

At last we stopped, and the driver got out. I nervously asked (with humor), "Is this where I get out?" The driver said, "Oh no! You could still get back from here!"

*********** Case Study Participant Additional Comments*********

The Tour ended up being an excellent experience. For me, it was a tremendous opportunity to understand the full extent of the problem, to get to know the people, and some of the things they believe are more important than unreasonable state regulations. In return, they began to understand that there are better ways to burn. We achieved a workable compromise, which makes it a 100% success.

I also attended some Farm Symposiums (statewide conference) and gave a presentation at the Farm Forum (a yearly gathering in Delta). Now, I'm fairly well-known by the community, the local Cooperative, the Agricultural Extension staff, and the Division of Agriculture. They know that if there's a problem, we'll all figure out a way to fix it.

Magnitude of Potential Impact

The debris does not easily decompose primarily due to extreme weather. It's been there for 10 to 30 years and has only gotten spongy and regrown trees and weeds. It's now much more difficult to burn than it was 30 years ago. In addition, they usually need to be burned twice (burning piles, replying into round piles, burning again).

Alternatively, it is also an extreme wildfire hazard at times, partially due to high winds and dry conditions in the summer. The debris is also a target for arsonists, which makes it a double-hazard. Most residents in the area cannot afford fire insurance. In addition, when the piles ARE burned, wildfire escapement is a very real danger.

Alaska Division of Forestry recommended moving residents out of areas for short period of time while they conducted controlled burns to remove hazard. Proposal estimate at $2 million in 1995. Project denied due to high cost. Approximate cost to state for wildfire suppression and smoke past ten years = approx. $7 million.

One wildfire destroyed thousands of acres of farmland and nearly destroyed the entire town of Delta in mid-80s in which arson was a prime cause (arson was denied by the community and it was blamed on rouge lightening). Those farmers with completely cleared land are thriving and consist of the largest acreage and largest financial income at this time.

Most often heard: “It’s a serious liability for the farmer to do it, might burn down the area, including houses. It was the state’s idea to do it this way, let the state come up with the money to clean it up.”

Average percentage of farmers with debris piles on their land = 75%; average size = 40 ft. wide x 10 ft. high with majority being longer than 1,000 ft in length without breaks; average total length on land = 6 miles; 0-100 ft. from standing trees.

Statistics indicate that the debris piles comprise about 20% of the fields. The piles harbor pests and weeds, interfere with drainage and water access (snow accumulates on one side which limits water on the far side and water does not flow evenly), and interfere with efficient cultivation (requiring extra passes with equipment, blockages in turning equipment, etc.).

Protecting Alaska produce from diseases is important because currently Alaska is able to sell “organic” produce and seed stock due to the lack of common disease organisms. Very little pesticide, if any, is needed here.

In 1997, the Delta Project had approximately 18,300 acres in cropland (of potential 90,000 acres total for livestock and crop land), which was almost 60% of the state total for that year. Harvest of crops in the Delta Project was $2,830,000 which was 29% of the state total. Crops and livestock production for the Delta area was $4.7 million which accounted for 32% of the state totals.

Removing all piles, assuming they presently comprise 20% of crop land, might increase proceeds to greater than 20% due to: greater efficiency, higher acreage in production (important in small business/small infrastructure), larger amount of feed for livestock in area, greater water capacity/drainage, etc.

When viewed from the bigger perspective, it is in the best interest of all concerned to make sure the hazards and obstacles are removed as much as possible. This includes obstacles in the form of government regulations. This can be accomplished without compromising public health if done properly.

The ultimate solution required flexibility from DEC, a streamlined permitting process, and more oversight and guidance from the local Alaska Division of Forestry. Forestry conducts an inspection for each site. They are on heightened alert during burning, which generally occurs during the spring and fall. Fall is best because they wait for a low front to come in carrying snow three days after the piles have been ignited. The snow covers the embers which after three days are beginning to smolder. The wood under the snow continues to burn down for a month or more. Only one or two land owner is allowed to burn at a time, and they still incur all liability for burning. But the process is safer, smoke complaints have been reduced 99%, and the community appears quite happy with the compromise.

Contact Information

Name: Ann Lawton	**Phone:** 907-269-3066
Title: Open Burning, Environmental Specialist	**Fax:** 907-269-7508
Affiliation: Alaska Department of Environmental Conservation	**Email:** ann_lawton@envircon.state.ak.us
Address: 555 Cordova Street, Anchorage, AK 99501	**Website:**

APPENDIX C

RELEVANT VOLUME I TABLES

Table 3-5. Summary of Agricultural Residues Burned within the Western States for Various Years (1996-1999) (Tons)[1]

Fuel/Residue	AZ 2000/01	CA 1996/97/99	CO Avg	HI 1996	ID 1996	MT 1996	ND Avg	NM 1996/Avg	NV[2] 1998	OR 1996	SD Avg	UT 1996	WA 1999	WY 1996/97
Grains and Hay														
Barley		889			167,943					21,429	14,158	4,671	22,223	3,060
Corn, for Grain	1,680	36,380											3,310	
Corn, Unspecified										5,112				
Hay, Alfalfa		7,213											2,882	
Hay, All Other		361											327	
Oats		3,944								7,902			1,021	
Rice		764,293												
Rye		124												
Wheat, All	15,352	224,709			376,010	5,055	410,145	6,560		244,755		17,379	48,121	
Wheat, Spring			2,000										63,125	
Wheat, Winter All											84,140		223,869	
Grasses and Seeds														
Bermuda	9,400	49,224												
Grasses, Propaning										3,204				
Grasses, Stack Burning										38,205				
Seeds, Other		1,604											394	
Seeds, Alfalfa					6,701								1,959	9,600
Seeds, Grasses (Field Burning), Unspecified	3,014									569,616			542	2,000
Seeds, KBG					100,000								750	
Sudan		5,770												
Orchard														
Almond		310,836												
Apple	74	8,071											879	
Apricot		6,603												
Avocado		1,371												
Cherry		7,511											88	
Citrus	548	15,458												
Fig		12,097												
Grape		78,860											513	
Nectarine		6,951												
Olive		8,042												
Pruning, Unspecified	2	5,570											458	
Pruning, Other		2,454												

Table 3-5. Continued

Fuel/Residue	AZ 2000/01	CA 1996/97/99	CO Avg	HI 1996	ID 1996	MT 1996	ND Avg	NM 1996/Avg	NV[2] 1998	OR 1996	SD Avg	UT 1996	WA 1999	WY 1996/97
Removal, Unspecified		84,359										11,265	32,024	
Peach		22,940											52	
Pear		17,748											395	
Pecan	7	3,186												
Pistachio	17	24,136												
Plum, Prune, Pluot		25,152											7	
Walnut		113,223												
Other														
Asparagus		8,819											21	
Beans	300	4,430											245	
Other		3,561			352								555	
Peas		1											495	
Safflower		6,686												
Sugarcane		4		420,000										
Agricultural Related Fuels														
CRP													76,096	
Ditches, Ditch Banks	1,225	25,552			160,013							3,030		
Total[3]	**31,619**	**1,898,134**	**2,000**	**420,000**	**811,018**	**5,055**	**410,145**	**6,560**	**20,952**	**890,223**	**98,298**	**36,345**	**480,349**	**14,660**

[1] AK does not conduct agricultural burning as defined under this project; thus only 14 states are shown. Values on this table represent tons of agricultural residue burned as reported by each state or developed with gap-filling/averaging techniques. As such, values for states should not be compared to each other.

[2] NV reports 20,952 acres burned; since specific crops are not indicated, residue (tons) cannot be estimated (Sergent, 2002).

[3] Sum of individual crops may not be equal total due to rounding.

Seeds, Other = All seeds not including alfalfa and Kentucky bluegrass (KBG).
Pruning, Other = Bushberry, kiwi, date, persimmon, pomegranate, quince
Other, Other = Other fruits and vegetables, unspecified, sorghum, peanuts, mint, jojoba beans, canola, hops
Wheat, All = All wheat not including spring and winter, all

<u>Appendix A-10h. WRAP report “Enhanced Smoke Management Programs for Visibility”</u>

Western Regional Air Partnership Policy on Enhanced Smoke Management Programs for Visibility

Approved by the Western Regional Air Partnership
November 12, 2002

Prepared by:
the Enhanced Smoke Management Program Task Team
of the Fire Emissions Joint Forum

WRAP Policy on

Enhanced Smoke Management Programs for Visibility

Executive Summary

The Western Regional Air Partnership (WRAP) is charged with developing technical and policy tools to assist states (or the delegated regulatory authority) and tribes with implementing the Regional Haze Rule (Rule).

The WRAP Policy on Enhanced Smoke Management Programs for Visibility (WRAP ESMP Policy) has been developed over an eleven-month period through a stakeholder-based consensus process to assist the WRAP region states and tribes in addressing emissions from fire sources. In this Policy, the WRAP seeks to provide a consistent framework that states and tribes can use to efficiently develop their individual implementation plans. The WRAP recognizes states' and tribes' authority and responsibility to develop, adopt and implement their regional haze implementation plans, and recognizes the Rule as the principal document on which states and tribes should rely.

The Rule requires states to develop implementation plans (SIPs) for addressing regional haze in the Nation's 156 mandatory Class I areas.[1] Additionally, the Rule requires effective management of fire sources. The Rule provides two pathways for western states to follow as they implement the requirements of the Rule: 1) develop their regional haze implementation plans per the nationally applicable provisions of Section 308, or 2) Transport Region states may choose to incorporate the Grand Canyon Visibility Transport Commission (GCVTC) recommendations into their regional haze implementation plans under Section 309 of the Rule.

Enhanced smoke management programs are specifically required in Section 309 of the Rule. However, if a state, under Section 308, has determined that fire emissions are contributing to visibility impairment and that smoke needs to be addressed in its SIP, then an enhanced smoke management program is a viable tool to accomplish this goal. Therefore, the WRAP is advancing the WRAP ESMP Policy for states under both Section 308 and 309 to meet the requirements of the Rule.

Tribes are not subject to the same requirements of the Rule as states, but tribes wishing to assume the regional haze requirements outlined in the Rule may, according to the CAA, seek approval to be treated in the same manner as states, under the Tribal Authority Rule (TAR), 40 CFR 49. The intent of this Policy is to assist both states and tribes with the

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[1] The Rule is only applicable to mandatory Class I areas (see Appendix A & Appendix B for additional information on mandatory Class I areas). States/tribes in the WRAP region may utilize the WRAP ESMP Policy to protect visibility in non-mandatory Class I areas.

development of their regional haze implementation plans (SIPs/TIPs), and therefore, tribes are included in all references to states, except where specific requirements and/or deadlines of the Rule are cited.

The WRAP ESMP Policy defines the enhanced smoke management program as smoke management efforts that specifically address visibility. It is the position of the WRAP ESMP Policy that there are nine elements of an enhanced smoke management program that are necessary to meet the requirements of the Rule. According to the Rule, enhanced smoke management programs are to be included in implementation plans based on the criteria of efficiency, economics, law, emissions reduction opportunities, land management objectives, and reduction of visibility impacts.

Smoke management efforts/programs currently in place (sometimes referred to as "basic smoke management programs") may not specifically address visibility effects in mandatory Class I areas. The WRAP ESMP Policy explicitly addresses visibility effects from fire that contribute to visibility impairment in mandatory Class I areas. Fortunately, smoke management efforts/programs, regardless of the purpose (e.g., visibility protection, avoidance of National Ambient Air Quality Standards [NAAQS] violations, or prevention of nuisance smoke impacts), have many common elements. It is anticipated that the enhanced smoke management program elements outlined here will integrate well with current and future smoke management efforts/programs.

The WRAP ESMP Policy document is comprised of four major sections. Section 1 is the eight WRAP ESMP Policy statements. Section 2 provides overall background for the WRAP ESMP Policy, including a discussion of the regulatory environment, the current context of smoke management in the WRAP region, and details of the Rule that are germane to the WRAP ESMP Policy. Section 3 is an annotation of each of the eight policy statements, further explaining and defining them, and including a description of the nine enhanced smoke management program elements. Finally, Section 4, the Appendices, include (A) a glossary of terms, (B) a related documents listing, and (C) specific examples for states/tribes on the implementation of the nine enhanced smoke management program elements.

WRAP Policy

Enhanced Smoke Management Programs for Visibility

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Policy Statement B. Enhanced smoke management programs apply to all fire sources.

Policy Statement C. Enhanced smoke management programs are required for states under Section 309 of the Regional Haze Rule.[2]

Policy Statement D. Enhanced smoke management programs are a viable tool for all other states and tribes in the WRAP region to use in the development of their implementation plans.

Policy Statement E. Enhanced smoke management programs include nine elements that are necessary to meet the requirements of the Regional Haze Rule, as follow:

Element 1. Actions to Minimize Emissions from Fire
Any burning techniques that reduce the actual amount of emissions produced.

Element 2. Evaluation of Smoke Dispersion
Using meteorological conditions to assess the ability to minimize smoke impacts.

Element 3. Alternatives to Fire
Any method of removing or reducing fuels by mechanical, biological or chemical treatments.

Element 4. Public Notification of Burning
Any method that communicates burn information to the burn community, to air regulators and to the general public. Also includes public education and media relations.

Element 5. Air Quality Monitoring
Observations and/or equipment that enable an assessment of air quality impacts of smoke from fires.

Element 6. Surveillance and Enforcement
An oversight mechanism that assures adherence to smoke management efforts as defined by the regional haze implementation plan.

[2] Published in the Federal Register on July 1, 1999, 64 FR 35714.

Element 7. Program Evaluation
A mechanism to assess the adequacy of the enhanced smoke management program in meeting the requirements of the Rule.

Element 8. Burn Authorization
The management approach used to facilitate burn decision-making.

Element 9. Regional Coordination
Communication and information sharing across state/tribe jurisdictional lines.

Policy Statement F. Enhanced smoke management programs will be based on the criteria of efficiency, economics, law, emission reduction opportunities, land management objectives, and reduction of visibility impact,[3] which will determine the rigor applied to the nine elements.

Policy Statement G. Enhanced smoke management programs may be applied uniformly to source sectors throughout a state's or tribe's jurisdiction or they may be tailored to source sectors and/or geographic areas to address presumed or confirmed visibility impairment.

Policy Statement H. The development and application of enhanced smoke management programs, including the consideration of the criteria (F), will be done collaboratively with state, tribal, local and federal agencies, and private parties.

2. Background

2.1 Clean Air Act and Grand Canyon Visibility Transport Commission

In 1990, Congress amended the Clean Air Act (CAA), and as part of these amendments created the Grand Canyon Visibility Transport Commission (GCVTC).[4] The GCVTC was charged with assessing the current scientific information on visibility impacts and making recommendations for addressing regional haze in the western United States. The GCVTC signed and submitted more than 70 recommendations to the Environmental Protection Agency (EPA) in a report dated June 1996 that indicated that visibility impairment was caused by a wide variety of sources and pollutants, and that a comprehensive strategy was needed to remedy regional haze.

Fire sources were among those specifically acknowledged in the GCVTC Report as contributors to visibility impairment on an episodic basis:

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[3] 64 FR 35771, §51.309 (d) (6) (iv).

[4] The Grand Canyon Visibility Transport Commission (GCVTC) was composed of the governors of eight western states (AZ, CA, CO, NM, NV, OR, UT, WY), four tribes (Acoma Pueblo, Hopi, Hualapai, and Navajo), four Federal land management agencies (Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service), the Columbia River Inter-Tribal Fish Commission, and the Environmental Protection Agency.

> All types of fire (prescribed fire and agricultural burning) must be addressed equitably as part of a visibility protection strategy. [5]

The GCVTC Report acknowledged federal and state land managers' projection of significant increases in prescribed fire in order to reduce the effects of wildfire resulting from past decades of fire exclusion.[6] The GCVTC Report cited the need for minimizing the increase in emissions from all fire programs to the maximum extent feasible.[7] One of the Report's recommendations called for:

> …the development and implementation of criteria and requirements for the use of enhanced smoke management programs (including alternative management practices) and emission reduction strategies.[8]

2.2 Western Regional Air Partnership

The Western Regional Air Partnership (WRAP) was established in 1997 as the successor organization to the GCVTC. The WRAP is a voluntary organization comprised of western governors, tribal leaders and federal agencies,[9] and is charged "to identify regional or common air management issues, develop and implement strategies to address these issues, and formulate and advance western regional policy positions on air quality."[10] These policies and technical tools are developed through inclusive, stakeholder-based processes and approved by consensus of the WRAP.

WRAP participants include state air quality agencies, tribes, federal/state/private land managers, the EPA, environmental groups, industry, academia and other interested parties. There are over 400 tribes within the WRAP region. The large number of tribes limits the participation of all of them in WRAP activities, and accordingly, in the development of this Policy. Therefore, the tribal representatives involved in the development of this Policy may not represent all tribal concerns.

2.3 Regional Haze Rule

Following the issuance of the GCVTC Report, the EPA issued the Regional Haze Rule (Rule) in July 1999 to improve visibility in 156 national parks and wilderness areas across the country. The Rule outlines the requirements for states and tribes to address

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[5] GCVTC Report, p. 47.
[6] GCVTC Report, p. 23.
[7] GCVTC Report, Recommendation 7, p. 50.
[8] GCVTC Report, Recommendation 4, p. 49.
[9] The WRAP members include the governors of thirteen western states (AK, AZ, CA, CO, ID, MT, ND, NM, OR, SD, UT, WA, and WY). Tribal nations selected as WRAP members include Pueblo of Acoma, Campo Band of Kumeyaay Indians, Cortina Indian Rancheria, Hopi Tribe, Hualapai Nation of the Grand Canyon, Nez Perce Tribe, Northern Cheyenne Tribe, Salish and Kootenai Confederated Tribes, Pueblo of San Felipe, and Shoshone-Bannock Tribes of Fort Hall. Federal WRAP members are the Department of the Interior, the Department of Agriculture, and the Environmental Protection Agency.
[10] WRAP Charter, Purpose, p. 1.

regional haze in these mandatory Class I areas. EPA incorporated all of the GCVTC recommendations into Section 309 of the Rule, which may be used by some of the WRAP states/tribes. The remaining WRAP states must, and tribes may, utilize the nationally applicable Section 308 provisions of the Rule.

Tribes are not subject to the same requirements of the Rule as states, but tribes wishing to assume the regional haze requirements outlined in the Rule may, according to the CAA, seek approval to be treated in the same manner as states, under the Tribal Authority Rule (TAR), 40 CFR 49. In these cases, EPA still recognizes that "unlike States, tribes are not required by the TAR to adopt and implement CAA plans or programs, thus tribes are not subject to mandatory deadlines for submittal of implementation plans."[11] Although provision for flexibility in the submission of programs and implementation plans for tribes is made under TAR, EPA does "encourage tribes choosing to develop implementation plans to make every effort to submit by the deadlines to ensure that the plans [TIPs] are integrated with and coordinated with regional planning efforts."[12]

EPA recognizes the WRAP as the Regional Planning Organization that is developing the necessary policy and technical tools to implement the Rule in the WRAP region. A WRAP policy, once approved, represents the WRAP's consensus position on the best means for states and tribes to implement the portion of the Rule at issue. The WRAP recognizes states' and tribes' authority and responsibility to develop, adopt and implement their regional haze state and tribal implementation plans, and the seminal guidance to do this is the Rule.[13]

2.4 Existing Guidance on Smoke Management

The elements of an enhanced smoke management program as outlined in this Policy are based upon careful review and consideration of the Rule and the existing guidance on smoke management: the EPA's Interim Air Quality Policy on Wildland and Prescribed Fires (EPA Interim Policy)[14] and the Agricultural Air Quality Task Force's (AAQTF) Recommendation on Air Quality Policy on Agricultural Burning (AAQTF Recommendation on Air Quality Policy).[15] However, these documents do not specifically provide guidance for smoke management programs that address visibility effects. The WRAP ESMP Policy goes beyond the EPA Interim Policy and the AAQTF Recommendation on Air Quality Policy to address visibility effects and regional haze, as required by the Rule.

[11] 64 FR 35758.
[12] 64 FR 35759.
[13] WRAP Charter, p.1.
[14] U.S. EPA, Office of Air Quality Planning and Standards, Interim Air Quality Policy on Wildland and Prescribed Fires, April 23, 1998 (hereafter referred to as "EPA Interim Policy").
[15] Agricultural Air Quality Task Force, Air Quality Policy on Agricultural Burning, Recommendation to the U.S. Department of Agriculture, November 10, 1999 (hereafter referred to as "AAQTF Recommendation on Air Quality Policy").

3. Annotated Policy

3.1 Introduction

The WRAP ESMP Policy is the result of the WRAP region-wide multi-state/tribe stakeholder planning and coordination effort focused on addressing the development of enhanced smoke management programs that address visibility effects. The intent of the WRAP ESMP Policy is to assist states (or the delegated authority) and tribes to address visibility effects associated with fire in a way that is adequate for SIP/TIP implementation.

The WRAP ESMP Policy identifies for states/tribes in the WRAP region the elements of an enhanced smoke management program to address visibility effects from all types of fire that contribute to visibility impairment in mandatory Class I areas. Although the Rule is only applicable to mandatory Class I areas, state/tribes in the WRAP region may utilize the WRAP ESMP Policy to protect visibility in non-mandatory Class I areas.[16]

Most states/tribes in the WRAP region address fire source sectors differently, as does EPA in its guidance documents. Consequently, fire sources in the WRAP region are currently regulated at various and inconsistent levels, from rigorous regulation to regulation with exemption applied, to no regulation. This variability emphasizes the need for the development and application of an enhanced smoke management program framework that is predictable and flexible while meeting the requirements of the Rule.

The WRAP ESMP Policy has been developed to embody appropriate regulatory and policy requirements and to provide a predictable framework for enhanced smoke management programs that can be reasonably implemented by states and tribes. The WRAP believes that states, tribes, or EPA on behalf of the tribes maintain the ultimate responsibility for the implementation of the enhanced smoke management program.

The WRAP recognizes states/tribes authority and responsibility to develop, adopt and implement their regional haze state and tribal implementation plans. The WRAP further recognizes that the implementation plans will be revisited and revised, per the schedule specified in the Rule, giving opportunities to refine individual enhanced smoke management programs to reflect technical advances and policy updates.

3.2 Visibility Effects

> *Policy Statement A. Enhanced smoke management programs under this Policy are defined as those smoke management efforts that specifically address visibility effects, and therefore, may need to be augmented to address public health and welfare issues.*

Most current smoke management efforts and programs to date in the WRAP region have been developed to address public health and/or nuisance concerns, and do not have

[16] See Appendix B for the reference to a map of Class I areas.

procedures to address visibility effects that contribute to regional haze. The *enhanced* smoke management program adds visibility impairment/regional haze considerations to existing smoke management efforts.

States/tribes are currently addressing NAAQS and/or nuisance to the extent they deem appropriate through existing smoke management efforts. Some states/tribes have certified their smoke management programs under EPA's Interim Policy, both inside and outside the SIP/TIP process.[17] The EPA certified programs include those mandated by rule, state statute, and programs based on voluntary measures.[18] However, few, if any, states/tribes have smoke management programs that address all fire sources, (e.g., prescribed fire on wildlands, wildland fire use, wildfire and agricultural burning), in one unified program.

The WRAP ESMP Policy assumes that states/tribes will *maintain* their current smoke management efforts and/or smoke management programs for NAAQS and/or nuisance. The WRAP ESMP Policy can be used to establish new programs to address visibility concerns even if there are no other smoke management efforts currently in place. While the WRAP ESMP Policy provides a framework for visibility/regional haze, states/tribes may choose to do more in their smoke management programs to protect NAAQS, prevent nuisance and/or address visibility.

The WRAP ESMP Policy facilitates the integration of visibility protection with NAAQS and nuisance protection, in accordance with the Rule:

> The regional haze program is being promulgated in a manner that facilitates *integration* of emission management strategies for regional haze with the implementation of programs for new NAAQS for Ozone and PM.[19]

The elements included in the enhanced smoke management program as outlined by this Policy have been selected in an attempt to address direct visibility effects and regional haze in mandatory Class I areas. It is possible that states/tribes may encounter conflicts between managing smoke for visibility considerations and smoke management efforts for NAAQS and/or nuisance. It is therefore recommended that states/tribes coordinate their efforts to protect visibility with existing or future efforts to address NAAQS and/or nuisance smoke.

3.3 All Fire Sources

Policy Statement B: Enhanced smoke management programs will apply to all fire sources.

The WRAP ESMP Policy applies to all fire, and maintains the previously established definitions:

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[17] A state/tribe certifies "to EPA that they have adopted and are implementing a smoke management program that includes the basic components identified in this policy." EPA Interim Policy, p. 7.

[18] WRAP states implementing smoke management programs using voluntary measures include NM and ID.

[19] 64 FR 35719, emphasis added.

> This Policy applies to both wildland and agricultural lands regardless of ownership (i.e., Federal, state, tribal, public, private), cause of ignition (e.g., lightning, arson, accidental human, land management practices) or purpose of the fire (e.g., vegetative residue disposal, hazard reduction, maintain ecosystem health). It is the intent that this Policy be applied equitably across all land types and sources. [20]

All fire source sectors are included in the WRAP ESMP Policy because it is recognized by EPA that "fire of all kinds (wildfire, prescribed fire, etc.) contributes to regional haze."[21] This Policy needs to be applied to all sources addressed by the WRAP Fire Categorization Policy. In accordance with Section 118(a) of the CAA requires that all entities, federal and non-federal, be subject to the same requirements, authorities and processes,[22] the WRAP ESMP Policy will be applied equitably to all fire sources.

The WRAP ESMP Policy specifically does not apply to Native American cultural non-vegetative burning for traditional, religious, or ceremonial purposes (e.g., cremation, sweat lodge fires).[23] Nor does it apply to open burning activities on residential, commercial, or industrial property (e.g., backyard burning, garbage incineration, residential wood combustion, construction debris).[24] However, states/tribes may choose to consider the impacts of these fire sources when developing their regional haze implementation plans.

The WRAP ESMP Policy applies to smoke impacts in mandatory Class I areas from fire anywhere in the WRAP region. Each state has an obligation to account for those emissions it produces that have impacts in its own mandatory Class I areas. Accountability also extends to states and tribes that have smoke impacts outside their jurisdictions.

3.4 Section 309

> *Policy Statement C: Enhanced smoke management programs are required for states under Section 309 of the Regional Haze Rule.*

The EPA incorporated all of the GCVTC recommendations into Section 309 of the Rule, which specifically calls for "[e]nhanced smoke management programs for fire that consider visibility effects, not only health [NAAQS] and nuisance objectives…."[25] Under Section 309, states must incorporate an enhanced smoke management program into their SIPs, which will give them the demonstration of reasonable further progress through 2018.[26] The ability of a state/tribe to implement the enhanced smoke management

[20] WRAP Policy for Categorizing Fire Emissions, November 15, 2001 (hereafter referred to as "WRAP Fire Categorization Policy"), p 7.
[21] 64 FR 35735.
[22] Clean Air Act §118(a).
[23] WRAP Fire Categorization Policy, p. 24.
[24] Ibid, however "industrial property" would not include land such as industrial forestland.
[25] 64 FR 35771, §51.309 (d) (6) (iv).
[26] 64 FR 35769, §51.309 (a).

program may require legislative changes to existing rules or removal of exemptions from regulation for specific fire sources.

The tracking of emissions from all fire (i.e., wildland and agricultural land) is a requirement of the Rule for states under Section 309, including the development of an emissions inventory for VOCs, NOx, elemental and organic carbon, and fine particulate matter.[27] States/tribes under Section 309 will need to address projected fire emissions in order to facilitate regional haze planning and operational smoke management.[28] The tracking of emissions could allow for these projections to be developed. Emissions tracking will also provide information critical to implementing several of the necessary elements of an enhanced smoke management program. The Rule under Section 309 further calls for the establishment of annual emission goals for fire that will minimize emissions increases from fire to the maximum extent feasible.[29] The WRAP is currently developing policy on both emissions tracking and on the establishment of annual emissions goals that will work in concert with the WRAP ESMP Policy.

3.5 Section 308

> *Policy Statement D. Enhanced smoke management programs are a viable tool for all other states and tribes in the WRAP region to use in the development of their implementation plans.*

The Rule requires states/tribes to address visibility impairment in mandatory Class I areas due to emissions from all sources including fire activities. The Preamble to the Rule emphasizes smoke management programs as effective tools to accomplish this:

> Where smoke impacts from fire are identified as an important contributor to regional haze, smoke management programs should be a key component of regional and State regional haze planning efforts and long-term strategies.[30]

Under Section 308, a state must consider smoke management techniques for agricultural and forestry lands in its long-term strategy for regional haze. Section 308 of the Rule states:

> The State must identify all anthropogenic sources of visibility impairment considered by the State in developing its long-term strategy [for regional haze]. The State should consider major and minor stationary sources, mobile sources, and area sources.[31]

and:

> (v) The State must consider, at a minimum, the following factors in developing its long-term strategy [for regional haze]:

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[27] 64 FR 35771, §51.309 (d) (6) (ii)
[28] 64 FR 35771, §51.309 (d) (6) (i).
[29] 64 FR 35771, §51.309 (d) (6) (v).
[30] 64 FR 35736.
[31] 64 FR 35767, §51.308 (d) (3) (iv).

> (E) Smoke management techniques for agricultural and forestry management purposes including plans as currently exist within the States for these purposes.[32]

If a state's visibility impairment analysis[33] shows that fire sources contribute to visibility impairment in a mandatory Class I area and the state determines that fire sources need to be addressed in its SIP, then the enhanced smoke management program will be a viable tool to do so. A statewide inventory of emissions of pollutants that contribute to visibility impairment in mandatory Class I areas is a requirement of the Rule for states choosing to implement the Rule under Section 308. Further, these states will also be required to account for future projected emissions.[34]

3.6 Elements of an Enhanced Smoke Management Program

> *Policy Statement E: Enhanced smoke management programs include nine elements that are necessary to meet the requirements of the Regional Haze Rule.*

The elements included in the enhanced smoke management program as outlined by this Policy have been selected in an attempt to address direct visibility effects and regional haze in mandatory Class I areas to improve visibility on the worst days and maintain visibility on best days.[35] The first seven enhanced smoke management program elements come directly from Section 309 of the Rule that states that SIPs "*must* include smoke management programs that include all necessary components including, *but not limited to*, actions to minimize emissions, evaluation of smoke dispersion, alternatives to fire, public notification, air quality monitoring, surveillance and enforcement, and program evaluation."[36] These same smoke management components are also found in the EPA Interim Policy and the AAQTF Recommendation on Air Quality Policy.[37]

The EPA Interim Policy and the AAQTF Recommendation on Air Quality Policy also advocate a burn authorization component (i.e., Element #8).[38] Without a central burn authority considering the cumulative smoke impacts, it will be difficult on a daily basis for individual land managers/owners to assess their relative contribution to regional haze.

Regional coordination (i.e., Element #9) is central to burn authorization, and will facilitate coordinated decision-making. It is a necessary mechanism to address transport issues and cumulative effects, especially when considering impacts of a source that may be large, or many sources that cumulatively are large, but a long distance from a Class I

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[32] 64 FR 35767, §51.308 (d) (3) (v) (E).

[33] As outlined in the Rule under Section 308, this process includes calculating the baseline of all sources; comparing the baseline visibility conditions with natural conditions; assessing the contribution to this of the different sources (of which smoke is one); then considering in the development of long term strategies: smoke management techniques, including current smoke management programs that exist; and if not adequate, considering enforceable emissions limitations and compliance schedules and other measures as necessary. 64 FR 35765 §51.308.

[34] 64 FR 35767, §51.308 (d) (4) (v) and 35769, §51.308 (g) (4).

[35] 64 FR 35764, §51.301.

[36] 64 FR 35771, §51.309 (d) (6) (i), emphasis added.

[37] EPA Interim Policy, p. 17-23, and AAQTF Recommendation on Air Quality Policy, p. 2.

[38] EPA Interim Policy, p. 18, and AAQTF Recommendation on Air Quality Policy, p.12.

area (i.e., greater than 100 km). Regional coordination is emphasized in the Rule as key to reaching the national visibility goal. In the preamble, the Rule states:

> Therefore, States will need to develop strategies in coordination with one another, taking into account the effect of emissions from one jurisdiction to air quality in another.[39]

And in the preamble to Section 308, the Rule states:

> In developing each reasonable progress goal, the State must consult with those States which may reasonably be anticipated to cause or contribute to visibility impairment in the mandatory Class I Federal area.[40]

The WRAP ESMP Policy elements include measures to control and/or reduce emissions from fire (Elements 1, 3, and 8); tools to assess and manage the potential impacts from fire (Elements 2 and 5); and operational components of a successful smoke management program (Elements 4, 6, 7, and 9). In addition to the elements descriptions that follow, suggestions for implementation of the nine enhanced smoke management program elements are included in Appendix C of this document.

3.6.1. Element 1. Actions to Minimize Emissions from Fire

A wide range of opportunities to minimize emissions exists depending upon the fire source and management objectives. Four potential actions that may be used are: emission reduction techniques, establishing burn manager qualification programs,[41] developing incentive programs, and establishing emissions goals.

3.6.2. Element 2. Evaluation of Smoke Dispersion

A variety of tools and methods exist by which a land manager/owner could reduce smoke impacts over periods ranging from several hours to several days. States/tribes may focus on the use of specific weather information, fuels information, modeling or a burner qualification and certification program to assist in the evaluation of dispersion conditions.

3.6.3. Element 3. Alternatives to Fire

Alternatives to fire (as distinguished from alternative methods of burning) include any method of removing or reducing fuels by mechanical, biological or chemical treatments. States/tribes may assist land managers/owners to develop and implement alternatives to fire. Land managers/owners may be required to assess the feasibility of using alternatives to fire where there are many competing sources or large amounts of burning occurring that could lead to visibility impairment in mandatory Class I areas. Regulatory authorities may want to consider incentives to encourage the use of alternatives to burning where appropriate. The WRAP through its FEJF has commissioned two reports on alternatives to burning that will aid states and tribes in addressing this element of the ESMP.

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[39] 64 FR 35728.
[40] 64 FR 35766, §51.308 (d) (1) (B) (iv).
[41] States/tribes could consider adopting existing burn qualification programs sanctioned by land management agencies.

3.6.4. Element 4. Public Notification of Burning

Public notification is a significant part of the CAA, and is inherent in the Rule. Public notification under an enhanced smoke management program should be at least what is required by EPA for a certifiable smoke management program,[42] and may include extra activities, depending on location. Generally, regardless of what kind of smoke management program is in place, significant effort should be made to educate and notify the public about burning, its impacts, as well as its benefits.

3.6.5. Element 5. Air Quality Monitoring

Monitoring of smoke impacts may be a very sophisticated effort using EPA reference method sampling equipment or it may be as simple as creating a hand-written log of smoke behavior as assessed visually. Minimal procedures would be most likely in areas of little burn activity or when farther away from Class I areas.

3.6.6. Element 6. Surveillance and Enforcement

Good communication between regulators and land managers/owners can significantly reduce the need for surveillance and enforcement. An atmosphere of trust and cooperation between regulators and land managers/owners can help facilitate emissions reductions and compliance with air quality regulations. Performance and compliance standards may be established under various methods of operations.

3.6.7. Element 7. Program Evaluation

Enhanced smoke management programs need to be reviewed on a periodic basis for their effectiveness by the regulatory authority and affected stakeholders. Formal periodic progress reports could coincide with time intervals used to evaluate reasonable progress. The Rule requires progress reports every five years.[43] However, shorter review and evaluation time periods would better determine if enhanced smoke management programs are effective.

3.6.8. Element 8. Burn Authorization

Burn authorization requirements are expected to vary depending upon the amount of burning that is occurring, the fire source types that are conducting the burning, and the degree of impairment that exists or may be expected to occur as a result of the burning. The proximity of mandatory Class I and non-attainment areas may also have a bearing on the complexity of the burn authorization procedure that should be implemented.

3.6.9. Element 9. Regional Coordination

Coordination of burning activity is critical to avoiding cumulative smoke impacts within and across source types in mandatory Class I areas. Coordination may range from a passive mode of information sharing between land managers/owners and/or the public to a more complex, active coordination in which burn decisions are altered based on jurisdictional authority and other activities that are occurring or have recently occurred. Methods for this inter-jurisdictional and regional coordination will need to be developed.

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[42] EPA Interim Policy, p.17-23.

[43] 64 FR 35768, § 1.308 (g) and 35772, §51.309 (d) (10).

The development process should be a collaborative one involving state, tribal, local and federal agencies, and private parties.

3.7 Criteria

> *Policy Statement F: Enhanced smoke management programs will be based on the criteria of efficiency, economics, law, emission reduction opportunities, land management objectives, and reduction of visibility impact,[44] which will determine the rigor applied to the nine elements.*

According to the Rule, enhanced smoke management programs are to be included in implementation plans based on the criteria of efficiency, economics, law, emissions reduction opportunities, land management objectives, and reduction of visibility impacts. These criteria will influence the extent to which individual elements of the enhanced smoke management program are applied or the level of effort that is possible. For example, legal barriers may need to be removed and/or infrastructure may need to be developed to implement the enhanced smoke management program. The level of effort each state/tribe will apply to the nine elements of the enhanced smoke management program needs to be based on a *pre-determined* process or metric established by the regulatory authority that considers the public as well as stakeholders.

Additional examples of how states/tribes might consider the enhanced smoke management program criteria are listed below.

<u>Efficiency</u>: What are the resources, infrastructure, networking, workforce and information necessary to reduce visibility impairment in mandatory Class I areas? Is it feasible to share these items with another group in order to reduce redundancy or build on existing expertise?

<u>Economics</u>: What are the costs and incentives of the items listed under Efficiency? Are there ways to economically quantify improvements to regional haze in a local area? What is the economic trade-off of moving fuels off-site to be converted to another use or burned elsewhere? What are the economic costs to a landowner to look for emission reduction alternatives? What are the economic gains from improved habitats, functioning watersheds, species diversity and healthy ecosystems? What are the economic losses to a community associated with impairment, (e.g., property values, tourism, etc.)?

<u>Law</u>: Are there federal, state, tribal ordinances, local rules or statutes that prohibit mechanical treatments or prohibit the regulation of burning? Are there conflicts with management or law pertaining to the Threatened and Endangered Species Act and/or the Wilderness Act?

<u>Emission Reduction Opportunities</u>: Where are the opportunities to consider reducing emissions through mechanical, biological, or chemical means? Where are the places where reducing emissions will be best done through smoke management techniques

[44] 64 FR 35771, §51.309 (d) (6) (iv).

rather than moving fuels off-site or manipulating fuels through chemicals or biological decomposition or a combination of mechanical treatments and maintenance burning?

Land Management Objectives: Are there places where manipulating fuels is not an option because of land management objectives, e.g., tribal cultural values, wildlife habitat, crop requirements, residue removal constraints, or inaccessible terrain? Are there places where manipulating fuels is more conducive to the land management objective, e.g., areas targeted for commodity production, watershed protections or tribal cultural activities sites? Are there places that restoration of ecosystem function may have a high priority?

Reduction of Visibility Impacts: Using the current information and science available to a state/tribe, how will an enhanced smoke management program decrease impacts to visibility?

3.8 Application

> *Policy Statement G: Enhanced smoke management programs may be applied uniformly to source sectors throughout a state's jurisdiction or they may be tailored to source sectors and/or geographic areas to address presumed or confirmed visibility impairment.*

Since emissions from fire sources contribute differently to visibility impairment in Class I areas and/or may be from different geographical areas, tailoring of an enhanced smoke management program to a fire source sector and/or a geographic area may be appropriate. This section presents options for states/tribes to consider in tailoring such a program. The first two options are built upon a presumption that certain sources or situations contribute to visibility impairment. The third option relies upon confirmation of impairment attributed to a source sector. The options described below may be implemented independently or in any combination, as deemed appropriate by the state/tribe.

The options explored here are not exhaustive or definitive in structure or design. However, any selected option must still consider the nine elements as well as the criteria as specified in the Rule. Application of these or any other options can be considered at the source sector level, but should also be sensitive to the potential for cumulative impacts of all fire source sectors. Additionally, state/tribal authorities will want to be mindful of equitable treatment of sources in the implementation of their enhanced smoke management programs.

3.8.1 Source Sector Option

Under this option, there is a presumption that certain source sectors are reasonably expected to contribute to visibility impairment based on historical data and/or projected future burning. Where this presumption exists, states/tribes could choose to apply the nine enhanced smoke management program elements to those source sectors with a greater level of effort.

3.8.2 Situational Option

This option describes certain situations that, if true, would indicate to the state/tribe the need for a greater level of effort of implementation of the enhanced smoke management program elements. The scenarios below can be used by states/tribes in the development of area and/or source sector-specific enhanced smoke management programs. Each scenario describes a combination of emission levels, NAAQS status (e.g., non-attainment area status) and proximity to Class I areas that may indicate the level of enhanced smoke management program needed.

The following is an example of how this situational option could be applied, and is modeled after the Prevention of Significant Deterioration (PSD) permitting requirements[45] for major stationary sources (see table in footnote below).[46] In this example, the emissions are the annual totals that would be produced by a fire source sector. The attainment status accounts for existing non-attainment area (NAA) issues that a state/tribe may need to address.[47] The proximity parameter addresses how close a fire source sector is to a Class I area. This example is predicated on all three factors applying simultaneously.

a) Emissions levels: Greater than 50 tons/yr of PM_{10} (total/year) within state/tribe for all anthropogenic fire sources
Attainment status: No PM_{10} or Ozone NAAs
Proximity: Within and near (i.e., <50 km) a Class I area

b) Emissions levels: Greater than 250 tons/yr of PM_{10} (total/year) within state/tribe for all anthropogenic fire sources
Attainment status: No PM_{10} or Ozone NAAs
Proximity: Within 100 km of Class I area

c) Emissions levels: Greater than 100 tons/yr PM_{10} (total/year) within state/tribe for all anthropogenic fire sources

[45] 40 CFR § 52.21.

[46] This table provides estimates of acres burned to give an idea of approximate fire size using the available emission factors for the source type indicated. These numbers are not an exact representation of acreages, emission factor, and fuel loading of all fires for each type. Note: Agriculture and Rangeland numbers are the same.

Tons (PM_{10})	Acres Burned (Annual Total)		
	Wildland (Forest: 20 tons/acre consumed)	Agriculture (4 tons/acre consumed)	Rangeland (2 tons/acre consumed)
250	833	12,500	12,500
100	333	5,000	5,000
70	233	3,500	3,500
50	167	2,500	2,500

[47] When $PM_{2.5}$ NAAs are identified, then $PM_{2.5}$ could also be used in assessing the level of enhanced smoke management program needed.

Attainment status:	Moderate PM_{10} or Ozone NAA or Maintenance Area
Proximity:	Within 100 km of Class I area
d) Emissions levels:	Greater than 70 tons/yr PM_{10} (total/year) within state/tribe for all anthropogenic fire sources
Attainment status:	Serious PM_{10} or Ozone NAA
Proximity:	Within 100 km of Class I area
e) Emissions levels:	Greater than 250 tons/yr of PM_{10} (total/year) within state/tribe for all anthropogenic fire sources
Attainment status:	Any level of Attainment/NAA
Proximity:	Distances farther than 100 km

3.8.3 Impact Based Option

A state/tribe can determine the level of effort of an enhanced smoke management program based on the relative contribution (i.e., impact) of each of its fire source sectors and cumulatively all fire source sectors' impacts to visibility impairment in Class I areas.

One possible approach that could be used is related to deciview, the metric commonly associated with visibility analyses and also used within the PSD permitting process. Under this scenario, states/tribes would determine the frequency, magnitude (in deciview), and duration of a source sector's contribution to visibility impairment (on the 20 percent "worst" visibility days in a calendar year). To prevent degradation of the 20 percent "best" visibility days in a calendar year, the state/tribe may want to increase the rigor of its enhanced smoke management program if emissions from fire sources correspond with declining visibility.

In order to determine these components, a visibility impairment assessment could be conducted using Interagency Monitoring of Protected Visual Environments (IMPROVE) data, emissions data derived from fire activity data, contemporary visibility modeling techniques, or other available information. Note that currently, final analysis of IMPROVE data sometimes lags as much as a year from when data were collected. This situation may also be true of visibility impairment assessments. Therefore, there may be lag time between when impacts were measured and how soon enhanced smoke management programs could be implemented or revised.

Based on the results of the visibility assessment, the states/tribes could determine what level of effort of enhanced smoke management program corresponds to the degree of impact.

3.9 Collaborative Development

Policy Statement H: The development and application of enhanced smoke management programs, including the consideration of the criteria (F), will be done collaboratively with state, tribal, local and federal agencies and private parties.

The GCVTC Report cites the importance of a collaborative process in a number of places with regard to fire.[48] EPA's Interim Policy also supports collaborative efforts and specifies roles for the stakeholders in the process. The underlying tenet of the WRAP process further conveys the importance of approaching visibility and the Rule with stakeholder input and use of collaborative processes.

Utilizing land managers and affected publics as well as the responsible air regulatory entity can result in an enhanced smoke management program that will meet the expectations of EPA for SIP submittal under Section 309, and may reduce localized controversy. There are certain steps in the enhanced smoke management program development process that will need cooperative efforts, such as the establishment of the criteria to be used by the regulatory entity to determine the level of effort needed for the enhanced smoke management program. The criteria for determining the level of effort is a significant issue as there is a paucity of data on emissions and visibility impairment from fire sources. This level of effort assessment is also tied to developing funding mechanisms for the enhanced smoke management program, which the GCVTC urged be developed cooperatively.

The SIP/TIP development process will be initiated by the respective regulatory entity, which is the responsible party for initiating the collaborative efforts. The earlier in the SIP development process that a collaborative effort could be initiated would likely result in a more valuable result. It is envisioned that, through a collaborative effort, a schedule and process for implementing the enhanced smoke management program will be created that is acceptable to both EPA and affected stakeholders. Using a collaborative process will facilitate the needed equity among fire source sectors as well.

[48] GCVTC Report, p. 49-50.

APPENDICES

Appendix A
Glossary

This glossary is intended to facilitate readers' consistent review of this Policy. This glossary is not intended to be a complete list of all terms and acronyms. An asterisk (*) indicates a definition from Section 1.1 of the WRAP Fire Emissions Joint Forum (FEJF) Workplan, February 25, 1999. A number sign (#) indicates a definition from the WRAP Policy for Categorizing Fire Emissions, November 15, 2001.

Agricultural Fire/Burning* - Any fire ignited by management actions to meet specific objectives (i.e., managed to achieve resource benefits) on agricultural land.

Agricultural Land* - Agricultural land includes croplands, pasture, and other lands on which crops or livestock are produced (PL 104-127, Section 1240A). Rangeland will be included with wildland for the purposes of the FEJF work.

Alternatives to Burning - Land management practices that treat fuel without using fire.

Anthropogenic - Produced by human activities.

Anthropogenic Emissions Source Classification ("anthropogenic")# - A categorization that designates which fire emissions contribute to visibility impairment in a Federal Class I area. "Anthropogenic" emissions must be controlled to achieve progress toward the 2064 natural conditions goal [i.e., natural visibility goal] for each Federal Class I area in the WRAP region. This classification includes natural and human-caused ignitions.

Area Source - A source category of air pollution that generally extends over a large area. Prescribed burning, field burning, home heating, and open burning are examples of area sources.

Attainment Area - An area considered to have air quality as good as or better than the national, state/tribe or local ambient air quality standards. Note that an area may be in attainment for one or more pollutants but be a non-attainment area for one or more other pollutants.

Best Available Control Measures (BACM) - A term used to refer to the most effective measures (according to EPA guidance) for controlling small or dispersed particulates and other emissions from sources such as roadway dust, soot and ash from woodstoves and open burning of rush, timber, grasslands, or trash.

Best Management Practices (BMPs) - A term applied collectively to any administrative or on-the-ground procedure that reduces the negative impacts of some action. An example of a Best Management Practice with respect to air quality would be conducting a prescribed burn when atmospheric ventilation is good, which in turn promotes smoke dispersal.

Class I Area - See Mandatory Class I Area and Non-Mandatory Class I Area.

Control of Fire Emissions# - Actions may be taken to control fire emissions by utilizing best management practices such as the use of alternatives, biomass utilization, and other emission reduction techniques.

Criteria Pollutants - The 1970 amendments to the CAA required EPA to set National Ambient Air Quality Standards (NAAQS) for certain pollutants known to be hazardous to human health. EPA has identified and set standards to protect human health and welfare for pollutants**:** ozone, carbon monoxide, particulate matter (PM_{10} and $PM_{2.5)}$, sulfur dioxide, lead, and nitrogen oxide. The term, "criteria pollutants" derives from the requirement that EPA must describe the characteristics and potential health and welfare effects of these pollutants. It is on the basis of these criteria that standards are set or revised.

Cumulative Effects - The effect on the environment that results from the incremental impact of the action when added to other past, present, and reasonable foreseeable future actions regardless of what agency, entity or person undertakes such action. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

Deciview - A unit of visibility proportional to the logarithm of the atmospheric extinction. Under many circumstances a change in one deciview will be perceived to be the same on clear and hazy days.

Ecosystem Maintenance Burning# - A prescribed fire or wildfire managed for resource benefits, in an ecosystem that is currently in an ecologically functional and fire resilient condition, that is utilized to mimic the natural role of fire.

Ecosystem Restoration Burning# - The re-establishment of natural vegetation that may be accomplished through the reduction of unwanted and/or unnatural levels of biomass, which may have accumulated due to management action. Prescribed fires, wildfires managed for resource benefits and mechanical treatments may be utilized to restore an ecosystem to an ecologically functional and fire resilient condition.

Emission - Pollution discharged into the atmosphere. Examples of emissions sources are smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; and from motor vehicle, locomotive, aircraft, or other non-road engines.

Emission Inventory - A listing, by source, of the amount of air pollutants discharged into the atmosphere.

Emission Cap - An enforceable limit on the amount of specific air pollutants that can be released or on the amount of a specific pollutant that is allowed to be in the air in a defined geographic area, and that has regulatory consequences. See also Emission Goal and Emission Target.

Emission Goal - A desired future outcome that may be represented by a numeric indicator, but without regulatory consequences, and as distinguished from a limit (i.e., target or cap). See also Emission Cap and Emission Target.

Emission Reduction - A strategy for controlling smoke from prescribed fires that minimize the amount of smoke output per unit of area treated or other objective unit of accomplishment.

Emission Target - A firm limit on the amount of specific air pollutants that can be released or on the amount of a specific pollutant that is allowed to be in the air in a defined geographic area, but without regulatory consequences (as distinguished from a cap). See also Emission Cap and Emission Goal.

Enhanced Smoke Management Program (ESMP) - A program for fire emissions that considers visibility effects, in addition to health and nuisance objectives, and is based on the criteria of efficiency, economics, law, emission reduction opportunities, management objectives, and reduction of visibility impact.

Federal Class I area - see Class I Area.

Fire* - When this term appears, it refers inclusively to wildfire, prescribed natural fire/wildland fire managed for resource benefits, prescribed fire, rangeland fire, and agricultural fire.

Fire Source Sector - A segment of fire attributed to a particular management or ownership, e.g., wildland prescribed fire, agricultural prescribed fire, wildfire, and wildland fire use. Also known as a fire source.

Fire Use - A term utilized in federal land management that includes both prescribed fire and wildland fire use.

Fuel Moisture Content - The quantity of moisture in fuel expressed as a percentage of the weight when thoroughly dried at 212 degrees F.

Fuel Reduction - The manipulation, including combustion, or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control.

Fuel Treatment - Manipulation or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control (e.g., lopping, chipping, crushing, piling and burning).

Implementation Plan - Plans devised by states and/or tribes to carry out their responsibilities under the CAA. SIPs/TIPs must be approved by the U.S. Environmental Protection Agency and include public review.

Interagency Monitoring of Protected Visual Environments (IMPROVE) - A cooperative visibility monitoring effort, using a common set of standards across the United States, between the EPA, federal land management agencies, and state air agencies.

Jurisdiction - A geographic area of authority.

Land Managers* - When this term appears, it refers inclusively to federal, state, tribal, and private land managers.

Manage Fire Emissions[#] - Actions may be taken to manage fire emissions to minimize impacts on visibility, public health, and nuisance concerns. Some management actions include concepts such as the timing of ignitions for better dispersion and consideration of downwind air quality and visibility. It may also include consideration of factors related to the area to be burned such as the fuel moisture condition and other physical parameters. Manage fire emissions is analogous to smoke management.

Mandatory Class I Area - An area set aside under the CAA to receive the most stringent protection from air quality degradation. Mandatory Class I Federal Areas are (1) international parks, (2) national wilderness areas and memorial parks larger than 5,000 acres in size, (3) national parks that exceed 6,000 acres in size and which were in existence when the 1977 CAA amendments were enacted. The extent of a mandatory Class I Federal area includes subsequent changes in boundaries, such as park expansions.

Modeling - The artificial simulation of some event or action that has quantifiable results. Mathematical expressions and computers are frequently used in modeling.

National Ambient Air Quality Standards (NAAQS) - See Criteria Pollutants.

National Environmental Policy Act (NEPA) - Establishes procedures that federal agencies must follow in making decisions on federal actions that may impact the environment.

National Visibility Goal - Section 169A of the CAA sets forth a national goal for visibility which is the "prevention of any future, and the remedying of any existing, impairment of visibility in Class I areas which impairment results from manmade air pollution."

Natural Background Condition[#] - An estimate of the visibility conditions at each Federal Class I area that would exist in the absence of human-caused impairment.

Natural Emissions Source Classification ("natural")[#] - A categorization that designates which fire emissions can result in a natural reduction of visibility for each Federal Class I area in the WRAP region. This classification includes natural and human-caused ignitions.

Natural Ignition[#] - Fire/burn ignited due to a natural (i.e., non-human-caused) event, e.g., fire ignited by lightning or volcanic eruption.

Natural Visibility Goal - The ultimate goal of the regional haze program is the absence of visibility impairment due to human-caused emissions.

Non-Attainment Area (NAA) - An area identified by an air quality regulatory agency through ambient air monitoring (and designated by the EPA) that presently exceeds federal, state/tribe or local ambient air quality standards. See Attainment Area above.

Non-Mandatory Class I Areas - Class I areas designated by states or tribes, but are not deemed mandatory by the CAA. As of January 2002, Class I areas designated by tribes include: Fort Peck Reservation in MT, Northern Cheyenne Reservation in MT, Flathead Reservation in MT, Yavapai-Apache Reservation in AZ (Class I status under litigation), and Spokane Reservation in WA.

Nuisance Smoke **-** Unwanted smoke that does not exceed NAAQS primarily for particulate matter.

Particulate Matter - Any liquid or solid particles. "Total suspended particulates" as used in air quality are those particles suspended in or falling through the atmosphere. They generally range in size from 0.1 to 100 microns.

Plume Blight - Visual impairment of air quality that manifests itself as a coherent plume.

PM_{10} - Particulate matter of aerodynamic diameter less than or equal to 10 micrometers. Emissions of PM_{10} are significant from fugitive dust, power plants, commercial boilers, metallurgical industries, mineral industries, forest and residential fires, and motor vehicles.

$PM_{2.5}$ - Particulate matter of aerodynamic diameter less than or equal to 2.5 micrometers. A measure of fine particles of particulate matter that comes from fuel combustion, agricultural burning, woodstoves, etc.

Point Source - A fixed source of pollution. An example is the smoke stack of a coal-fired power plant or smelter.

Prescribed Fire* - Any fire ignited by management actions to meet specific objectives, i.e., managed to achieve resource benefits.

Rangeland[#] - Land on which the historic climax plant community is predominantly grasses, grass-like plants, forbs, or shrubs. Includes lands re-vegetated naturally or artificially when routine management of that vegetation is accomplished mainly through manipulation of ecological principles. Rangeland includes natural grasslands, savannas, shrub lands, most deserts, tundra, alpine communities, coastal marshes and wet meadows (Natural Resources Conservation Service National Range and Pasture Handbook, 1997).

Regional Haze - Visibility impairment caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area.

Smoke Effects* - The effects on visibility (both plume blight and regional haze), public nuisance, and the health-based NAAQS due to emissions from fire.

Smoke Intrusion - Smoke from prescribed fire entering a designated area at unacceptable levels.

Smoke Management Efforts - Programs, practices and techniques to minimize and/or reduce smoke emissions or impacts from fire.

State Implementation Plan (SIP)# - See Implementation Plan.

Suppression - A management action intended to protect identified values from a fire, extinguish a fire, or alter a fire's direction of spread.

Transport Region State - One of nine states that make up the Grand Canyon Visibility Transport Region: Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Wyoming.

Tribal Implementation Plan (TIP)# - See Implementation Plan.

Visibility Impairment - Any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions.

Wildfire* - Any unwanted, non-structural fire.

Wildfire Managed for Resource Objectives # - The management of naturally ignited fires, regardless of land type or ownership, to accomplish specific, pre-stated resource management objectives in predefined geographic areas with or without a plan in place. This term is considered to be analogous with the terms Wildland Fire Managed for Resource Benefits and Prescribed Natural Fire that are used in regulations and policies regarding federal wildlands.

Wildland*- An area where development is generally limited to roads, railroads, power lines, and widely scattered structures. The land is not cultivated (i.e., the soil is disturbed less frequently than once in 10 years), is not fallow, and is not in the USDA Conservation Reserve Program (CRP). The land may be neglected altogether or managed for such purposes as wood or forage production, wildlife, recreation, wetlands, or protective plant cover (EPA Interim Air Quality Policy). The land is not "agricultural land" as operationally defined above. Silvicultural land and rangelands (per the FEJF charge), woodlots, and private timberlands will be included with wildlands for the purposes of the FEJF work.

Wildland Fire[#] - All types of fire (see definition of fire above), except fire on agricultural land.

Wildland Fire Managed for Resource Benefits/Prescribed Natural Fire* - These terms both have current use in regulations and policies. They are considered to be synonymous and are used interchangeably in this work plan. These terms refer to the management of naturally ignited fires to accomplish specific, pre-stated resource management objectives in predefined geographic areas outlined in the fire management plan. Also referred to as Wildland Fire Use.

Appendix B
Related Documents Listing

Regional Haze Rule
Published in the Federal Register on July 1, 1999, 64 FR 35714.
http://www.epa.gov/ttn/oarpg/t1/fr_notices/rhfedreg.pdf

Grand Canyon Visibility Transport Commission Report
Grand Canyon Visibility Transport Commission, Recommendations for Improving Western Vistas, Report to the U.S. EPA, June 10, 1996.
http://www.wrapair.org Go to the GCVTC link.

EPA Interim Air Quality Policy on Wildland and Prescribed Fire
U.S. EPA, Office of Air Quality Planning and Standards, Interim Air Quality Policy on Wildland and Prescribed Fires, April 23, 1998.
http://www.epa.gov/ttn/oarpg/t1/memoranda/firefnl.pdf

AAQTF Recommendation on Air Quality Policy
Agricultural Air Quality Task Force, Air Quality Policy on Agricultural Burning, Recommendation to the U.S. Department of Agriculture, November 10, 1999.
http://fargo.nserl.purdue.edu/faca/Archives/2000/Policy/Burning%20Policy.htm

Tribal Authority Rule
Published in the Federal Register on February 12, 1998, 63 FR 7253.
http://www.epa.gov/fedrgstr/EPA-AIR/1998/February/Day-12/a3451.htm

WRAP Policy for Categorizing Fire Emissions
Approved by the Western Regional Air Partnership, November 15, 2001.
http://www.wrapair.org/commindex.htm Go to the FEJF Task Teams, then Natural Background.

Wildland Fire: Elements of a Basic Smoke Management Program Draft Report
Completed for the FEJF on July 10, 2001.
http://www.wrapair.org/commindex.htm Go to the FEJF Task Teams, then Basic Smoke Management.

Smoke Management Program Surveys
http://www.wrapair.org/commindex.htm Go to the FEJF, then Basic Smoke Management.
1) Wildland Smoke Management Program Survey, January 26, 2001
2) Boulder Wildland Smoke Management Program Survey, February 2, 2001
3) Agricultural Burning Smoke Management Program Survey, March 30, 2001
4) An Assessment of Tribal Air Quality Data and Programs in the Western United States, The Institute for Tribal Environmental Professionals (ITEP), September 2001

Class I Area Map
http://www.wrapair.org Go to About WRAP, then WRAP Boundaries and Regional Visibility Planning in the West.

Appendix C
Enhanced Smoke Management Program: Implementation Guidance

C. 1 Regional Haze Rule Implementation Plan Process

The Rule requires states to develop State Implementation Plans (SIPs) for addressing regional haze in the Nation's 156 mandatory Class I areas.[49] Additionally, the Rule requires effective management of fire sources.

In general, the SIP/TIP process includes the following steps: state/tribal agency technical analyses; identification of necessary emission reductions; identification of control strategies to achieve emission reductions; demonstration of reasonable further progress; submittal of SIP/TIP to EPA for consideration/approval; public review/comment; EPA approval of SIP/TIP; five-year state/tribe review for reasonable progress and SIP/TIP re-submittal.

Under Section 309, states are required to, and tribes may, have a regional haze implementation plan that addresses the Class I areas of the Colorado Plateau (the 16 Class I areas specified by the GCVTC) [50] submitted by December 31, 2003. The Rule stipulates that states must commit to implement all SIP measures from December 31, 2003 through December 31, 2018.[51] Further, all mandatory Class I areas in the GCVTC Transport Region, other than the Colorado Plateau 16, may be addressed in SIPs/TIPs by the 2008 Section 309 deadline.[52]

Under Section 308 states must, and tribes may, incorporate the requirements of the Rule into their implementation plans within 12 months of designation as $PM_{2.5}$ attainment, or within three years after designation as $PM_{2.5}$ non-attainment, but no later than December 31, 2008. Under Section 308, all mandatory Class I areas, except those addressed under Section 309, will be addressed in the SIP/TIP submittal tied to the $PM_{2.5}$ designation.[53]

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[49] The Rule is only applicable to mandatory Class I areas (see Appendix A & Appendix B for additional information on mandatory Class I areas). States/tribes in the WRAP region may utilize the WRAP ESMP Policy to protect visibility in non-mandatory Class I areas.

[50] The GCVTC Report specified 16 mandatory federal Class I areas on the Colorado Plateau that were adopted into Section 309 of the Regional Haze Rule. These 16 Class I areas are: Grand Canyon National Park, Sycamore Canyon Wilderness, Petrified Forest National Park, Mount Baldy Wilderness, San Pedro Parks Wilderness, Mesa Verde National Park, Weminuche Wilderness, Black Canyon of the Gunnison Wilderness, West Elk Wilderness, Maroon Bells Wilderness, Flat Tops Wilderness, Arches National Park, Canyonlands National Park, Capital Reef National Park, Bryce Canyon National Park, and Zion National Park. 64 FR 35770, §51.309 (b) (1).

[51] 64 FR 35770, §51.309. EPA Region 9 has determined that implementation schedules may be negotiated as part of the SIP/TIP process and has previously accepted up to one year for implementation of SIP/TIP programs.

[52] 64 FR 35773, §51.309.

[53] 64 FR 35765, §51.308 (b) (1), (2).

It is anticipated that the establishment of enhanced smoke management programs will be incorporated into the SIPs/TIPs submitted to EPA in order to meet the requirements of the Rule. Within the context of smoke management, it is recommended that states/tribes integrate their NAAQS and visibility SIP/TIP requirements.

Under the WRAP ESMP Policy there are nine elements of an enhanced smoke management program that meet the requirements of the Rule. For each of the enhanced smoke management program elements, there are implementation examples listed to assist states/tribes in developing their enhanced smoke management programs. This is not meant to be an exhaustive list, and states/tribes may also want to review the Fire Emissions Joint Forum (FEJF) draft report on Wildland Basic Smoke Management Program Elements as well as the EPA Interim Policy and the AAQTF Recommendation on Air Quality Policy for additional suggestions.[54] The level of effort each state/tribe would apply to the nine elements of the enhanced smoke management program needs to be based on a pre-determined process or metric developed collaboratively.

C. 2 Elements of an Enhanced Smoke Management Program

<u>C.2.1. Element 1. Actions to Minimize Emissions from Fire</u>

A wide range of opportunities to minimize emissions exists depending upon the fire source. Emission reduction techniques may be as simple as changing ignition timing to allow for more efficient combustion. Other techniques may include the use of mechanical means. Options to provide incentives and emission goals may also serve this purpose.

C.2.1.1 Emission Reductions Techniques

Under an enhanced smoke management program, provisions are made to account for emission reduction techniques that are utilized when burning. Documentation of emission reduction practices that were considered in the planning or implementation of burns also support annual emission goals and associated emissions tracking requirements. This documentation may be part of a burn plan or other data collection or reporting system that is used to meet annual emission goals and associated emissions tracking requirements as developed by the FEJF.

- Reducing the fuel load to be burned can reduce emissions. This can be accomplished on forestland by not treating (no burning) portions of the unit, yarding, consolidating, or isolating non-merchantable material; providing public firewood access before the burn; finding off-site use for more of the wood before the burn; using chemicals; burning when non-target fuels have a high fuel moisture; using alternative mechanical treatments, and rapid mop-up.

- In agriculture, emissions can be reduced by baling and removing some of the residue, spot burning only needed areas of the field, strip burning and backing fires. Emissions can also be reduced by moving the burning season into a different

[54] See Appendix B, Related Documents Listing.

time of the year if changes in fuel consumption or emissions factors can be achieved.

- Land managers/owners should strive for the most efficient combustion possible. Vegetation should be dry and in a condition that will minimize the smoke emitted during combustion. When pile burning, material should be burned in dirt-free, not overly compressed, cured, and dry piles. Piled material should be covered if possible. Fires should be ignited so as to burn as rapidly as possible, in ways that shift the proportion of the burn from the smoldering phase to the flaming phase. Minimizing duff consumption and smoldering through fuel moisture considerations will reduce emissions as well. Land managers/owners should only burn those fuels essential to meet resource management objectives and burn piles when other burns are not feasible, such as in snow or rain.

Regulatory authorities and other interest groups may also use WRAP guidance information, such as its Alternatives to Burning document that is currently under development by the FEJF, as a reference for specific alternatives. Another resource is the Smoke Management Guide for Prescribed and Wildland Fire, 2001 Edition (in press).[55]

C.2.1.2 Burn Manager Qualification

Another manner in which to reduce emissions is a burn manager qualification program that certifies the land manager/owner is knowledgeable of alternative burning practices and emission reduction techniques, and is capable of implementing them. Burn manager qualification programs already exist in most federal, state and tribal land management agencies.

A certification and qualification process could be established by prescribing what training meets requirements, such as training provided by the National Wildfire Coordination Group (NWCG), and by implementing training seminars and other institutional opportunities for land managers/owners to gain the necessary skills and knowledge to implement proper smoke management techniques. Land manager/owner certification/qualification programs may be similar to those required by federal land management agencies like those offered by the NWCG. For non-federal land managers/owners that cannot participate in federal sponsored training, states/tribes could develop their own certification processes and host training courses such as a "State Forestry Prescribed Fire Correspondence Course" or an "Interagency Basic Prescribed Fire Course".

In an enhanced smoke management program, burner qualifications might be required on permit applications and tracked by the regulatory agency. Burn size or emission output might be limited depending on the level of burner qualification. For example, a Level I qualified burner can burn up to *abc* acres/tons while a Level II qualified burner can burn up to *cde* acres/tons, and so on.

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[55] Smoke Management Guide for Prescribed and Wildland Fire, 2001 Edition (in press), produced by the National Wildfire Coordinating Group (NWCG) Fire Use Working Team.

As examples, a few types of burner qualifications are listed below:

- Satisfactory completion of the "State Forestry Prescribed Fire Correspondence Course" and direct experience in three prescribed burns prior to taking the course, or satisfactory completion of the "Interagency Basic Prescribed Fire Course" and direct experience in three prescribed burns before or after the course.
- Completion of a NWCG or federal/state/tribe land manager equivalent course dedicated to smoke management or attendance at a state approved smoke management workshop.
- Successful completion of a training program (which includes home study, 8-hour classroom session, and a written exam), documented practical experience in prescribed burning, and a signed agreement to conduct all burns in compliance with all applicable laws and ordinances,
- Land management agencies and the state/tribe develop and present interagency training to promote understanding of the regulatory context and affects of air pollution, fire ecology, and smoke management.

C.2.1.3 Incentives

Providing incentives to landowners and land managers for practicing emission reduction techniques and utilizing alternatives to burning is yet another option for states/tribes to include in enhanced smoke management programs. This approach could be seen as addressing equity issues in that those who make efforts to reduce emissions are rewarded for their efforts. The reward to the landowner/land manager could be seen in terms of environmental gains as well as financial gain. The reward to communities could be seen in retaining property values, and maintaining economic development and tourist-related industries.

Environmental win-win options may be that by decreasing emissions, a burner is given a higher priority when allocating burn days. Or, by utilizing alternatives, a higher priority is given to a burner when attempting to burn. Similarly, financial win-win options may be to decrease any assessed fees or burn costs when alternatives are used before burning. The system rewards those that take the extra time, effort and money to utilize emission reductions and alternatives. Those who either choose not to, or for land management constraints, cannot utilize emission reductions/alternatives, would pay more.

Landowners/land managers could be afforded the opportunity to deal with other sources to negotiate emissions management strategies for financial gain that would result in a net emissions decrease. In January 2001, the EPA issued a policy document that provides information on discretionary economic incentive programs.[56] In May 2002, the EPA provided additional guidance on voluntary and backstop approaches to emissions reduction in its Section 309 Annex to the Regional Haze Rule for stationary sources of sulfur dioxide.[57] In an enhanced smoke management program, an incentive may be

[56] EPA Improving Air Quality with Economic Incentive Programs (EIP Guidance), January 2001.
[57] 67 FR 30418.

available if a landowner/land manager can reduce his/her emissions and gain financially from not only supplying a marketplace with raw materials, but also receiving payment for emissions not generated.

C.2.1.4 Emissions Goal/Limit

Another action that could be taken by regulatory authorities to minimize emissions is to establish an emissions goal or limit within portions of a state/tribe, the entire state/tribe or over a multi-state/tribe region. How to meet the goal or limit would be left to the discretion of the land managers/owners. Establishing such a goal or limit would encourage land managers/owners to seek alternative methods of burning and alternatives to burning so as to retain the ability to burn where no alternatives are available.

C. 2.2 Element 2. Evaluation of Smoke Dispersion

A variety of tools and methods exist by which a land manager/owner could reduce smoke impacts over periods ranging from several hours to several days. Enhanced smoke management programs could contain the following criteria to support the dispersion estimation process.

- States/tribes may provide or find ways to provide websites of current weather and fuels information (i.e., fuel moisture) specific to meet the needs of land managers/owners. Land managers/owners would utilize this information to time ignitions during periods of expected good smoke dispersion.

- Acceptable weather and climatic conditions can be prescribed for burning in specific areas so as to avoid impacting Class I areas. A predefined set of weather elements would provide a degree of certainty as to when burning opportunities would be most likely to occur. Burning should be banned during periods when air stagnation advisories or air pollution alerts are in effect.

- As described previously, a burner qualification and certification program could be established that includes advanced training on understanding the relationships between weather and smoke dispersion. Individuals who have greater knowledge and understanding of the factors affecting smoke behavior may make better decisions on when and when not to burn.

- A more sophisticated and more comprehensive effort to evaluate smoke behavior would be to conduct smoke dispersion modeling in the planning and implementation process for burning. Dispersion modeling may be conducted by a state/tribal agency or other delegated regulatory authority. Such modeling results could be used as a screening approach to determine if there should be extra reason for concern about the proposed burn(s). This approach may assist in determining cumulative effects of multiple burns.

- Centralized decision-making of burn decisions with coordination among land managers/owners (either by source type or between sources) would require a more intensive effort of involvement by groups involved in burning. Land managers/owners would check-in with a centralized burn authority to receive information about other source activity prior to conducting a burn.

- A rigorous, timely, centralized decision-making system established with the intent of providing "go/no-go" decisions affords a greater level of coordination that would rely on greater infrastructure and resources for support. Meteorologists and other specialists with knowledge of air quality, fire, weather and fuels interaction would provide services that direct where and when burning could occur.

C. 2. 3 Element 3. Alternatives to Fire

The WRAP through its FEJF has commissioned two reports on alternatives to burning that will aid states and tribes in addressing this element of the enhanced smoke management program. These reports show potential methodologies for regulatory entities and their affected stakeholders to assess the potential for alternative use on both wildlands and agricultural lands in their respective jurisdiction. These reports also provide information on barriers to the use of alternatives, which is a requirement of section 309 of the Rule. States/tribes could establish websites with information describing the alternatives.

Land managers/owners may be required to assess the feasibility of using alternatives to fire where there are many competing sources or large amounts of burning occurring. This assessment could be based on established criteria, such as sustainability or potential fuel reduction. Burn plans and data systems could contain information that helps track the practice of using alternatives to fire. Emissions tracking systems[58] and reasonable further progress assessments could use this information to validate landowner/land manager's implementation of alternative practices as an emissions reduction technique.

Sources of smoke from geographic areas that continue to adversely affect a mandatory Class I area's 20 percent “worst” and “best” days, according to the Rule, may be required to implement measures that utilize alternatives to burning to the maximum extent feasible as a condition of further burning. Incentives could be identified wherein land owners/land managers have the opportunity to substitute emissions not produced in one area for emissions produced in another geographic area not affecting a Class I area's visibility as long as there is a net emissions decrease as a result of using the alternatives.

Geographic areas with sustained sources of adverse smoke impacts in mandatory Class I areas may consider burn curtailments if programs to minimize emissions, impacts and alternatives to fire use do not provide the necessary tools to meet reasonable progress toward the natural visibility goal. Such actions could be considered on a fire source basis so as to not impair one source's ability to use fire because of the failure of another source type to take needed actions to meet the natural visibility goal.

[58] The WRAP’s FEJF is currently preparing a policy on emissions tracking systems to assist states/tribes.

C. 2. 4 Element 4. Public Notification of Burning

Public notification is a significant part of the CAA, and is inherent in the Rule. Public notification under an enhanced smoke management program should be at least what is required by EPA for a certifiable smoke management program,[59] and may include extra activities, depending on location. Generally, regardless of what kind of smoke management program is in place, significant effort should be made to educate and notify the public about burning, its impacts on visibility as well as its benefits.

Public notification includes public education and media relations, and consists of activities such as issuing notices through the local news media including name and phone number of person/agency, fuel type, expected time and date of burn, location of burn, and the expected plume direction, extent, and duration. Public notification of non-burning alternatives that have been considered for a project could also be included.

Other means of notification may include the use of a website, public open houses or meetings, signs at burn sites, distribution of fact sheets that include information on smoke impacts, brochures, posters, notices, personal contact by phone or visit, or legal advertisements. It is a good practice to maintain a contact list of interested and affected publics, and make sure that notification of planned burns gets to everyone on that list. A plan for notifying the public could be part of the burn plan.

Effective public involvement, notification, and education can decrease complaints and resistance to burning projects, as well as prepare the public to manage their activities around scheduled burns. Public notification and education activities can also increase the public's faith in the different agencies and landowners, knowing that their health and welfare is being carefully considered in both planning and implementation. A well-developed public education and awareness program would not only serve the public but also fulfills a recommendation from the GCVTC.

Public awareness and education activities may be conducted by states/tribes, land managers/owners, or in cooperation by all. Training and guidance in public notification techniques could be provided to land managers/owners not accustomed to conducting such work, i.e., non-federal land managers/owners. Program administrators might consider developing an in-state/tribe public notification process to assist the non-federal land managers/owners. Programs could strive to enhance non-federal land managers'/owners' ability to involve public in planning by providing training and guidance, or open forums for disseminating information on planned burning activities that may affect visibility. If the public is involved in the planning of such activities regarding potential affects to them, there is less chance of resistance to the burn while it is in progress.

[59] See Appendix B Related Documents Listing, EPA Interim Policy.

Finally, developing involvement by the community and participation by land managers/owners in the SIP/TIP and National Environmental Policy Act (NEPA) planning processes may be beneficial in developing common expectations.

C. 2. 5 Element 5. Air Quality Monitoring

Monitoring of smoke impacts may be a very sophisticated effort using sampling equipment and extensive modeling or it may be as simple as creating a log of smoke behavior.

Minimal procedures would be most likely in areas of little burn activity or when farther away from Class I areas. On-site record keeping with subsequent submittal to the state/tribe regulatory authority should be substantive enough for use in analysis of reasonable further progress tracking or emission reduction programs.

As burning activity increases, states/tribes and land owners/managers could consider conducting a more widespread and comprehensive monitoring program. The use of cameras, satellite imagery and aerial monitoring to track and document smoke movement could be considered. The use of IMPROVE monitored data may have to be supplemented by air quality monitoring outside of Class I areas to track smoke movement.

Also, using visitor surveys in Class I areas regarding visibility impairment perceived during their stay may be a way of generating subjective assessments of smoke impacts. Such information would only be used to provide further validation of impacts, as relying on surveys alone would be too subjective for states/tribes to administer reasonable smoke management programs.

C. 2. 6 Element 6. Surveillance and Enforcement

Good communication between regulators, land managers/owners and the public can significantly reduce the need for surveillance and enforcement. An atmosphere of trust and cooperation between regulators and land managers/owners can go a long way toward facilitating emissions reductions and compliance with air quality regulations.

Four primary methods under which surveillance and enforcement activities may occur are:

- Voluntary (Land manager/owner self-enforcement)
- Source sector regulator (e.g., Agricultural Burn Manager, Smoke Management Meteorologist)
- State/tribe oversight
- Centralized regulatory authority (state or tribe)

Criteria and activities described below may be applicable for use in any of the four methods. Some of the criteria can, obviously, only be enforced by a body that has legal standing to do so. Whichever of the four methods a state/tribe may choose to implement would be dependent upon the severity of the visibility impacts that are being addressed.

If states/tribes have regulations in place that govern smoke impacts, public complaints can serve to monitor compliance. Such regulations should define criteria for establishing these smoke impacts. The number and location of public complaints may be used to monitor air quality impacts of fires. The number of complaints may not necessarily be a trigger, rather the nature of the complaints and external verification of circumstances leading to the complaints. In some cases, smoke regulations may apply only to non-certified burning. In such cases certified burners cannot be shut down for complaints related to visibility, but can be shut down for a threat to health or safety.

Some criteria for taking action on smoke impacting visibility include:

- Is the visibility impact occasional or constant?
- Is the use of property affected?
- What are the economic impacts of both burning and not burning?
- Is the location of the impact within or outside of a Class I area?
- What is the duration of the impairment?
- What is the number of people affected?
- How many complaints have been received?
- Was the burn conducted in compliance with applicable regulations?
- Has the visibility impact been mitigated to the extent practicable?
- Is the public health threatened?
- Is the impact a result of poor planning or of something that could not be anticipated?

Criteria of performance standards in an enhanced smoke management program must be stated clearly. Methods for detecting non-compliance could also be defined. Some criteria or standards might include:

- Numerical standards for optical data at specific Class I areas (e.g., deciviews)
- NAAQS
- Comparison with photos taken of certain pre-determined visibility conditions (most impaired, least impaired days)

Accordingly, some methods for detecting compliance might include:

- IMPROVE sites
- Photo points
- NAAQS ambient air monitors

If performance standards are established in code, random audits and inspections can provide assistance with compliance. Unannounced burn inspections and burn report audits, including smoke dispersion information, are means of ensuring compliance with air quality regulations. Aerial observations are another surveillance method.

If no visibility impact-related regulations are in place, violation of NAAQS or violation of other codified permit conditions or authorizations might trigger enforcement actions. Enforcement actions must be based on established statute and regulation, and must be applied equitably to all land managers/owners. Depending on state/tribe needs and compliance history, a written report or warning may be issued on the first instance of violation, while subsequent observed violations result in appropriate legal action.

Example enforcement actions may include:

- 5-day moratorium on ignitions
- Civil/criminal penalties, depending on how regulations are written
- Burn shutdown/mop-up
- Notice of violation/compliance order
- Liability for cost of suppression or damages
- Revocation of permit
- Felony punishment for willful or intentional violation
- Misdemeanor for careless violation

C. 2. 7 Element 7. Program Evaluation

Enhanced smoke management programs need to be reviewed on a periodic basis for their effectiveness by the regulatory authority and affected stakeholders. It is incumbent upon the state/tribe to submit progress reports to EPA describing how well the enhanced smoke management program is being implemented as part of meeting reasonable further progress requirements. Formal periodic progress report intervals could coincide with time intervals used to evaluate reasonable progress. The Rule requires progress reports every five years.[60] However, shorter review and evaluation time periods would better determine if enhanced smoke management programs are effective.

Generally, daily interaction between land managers/owners and program administrators can provide a continuous means of program evaluation, but a formal method could be in place to document periodic evaluations. Annual evaluations of the overall smoke management program will provide the information needed for periodic reports. Each element of the enhanced smoke management program should consider evaluating:

- Implementation
- Compliance and enforcement
- Sections needing clarification or improvement
- Progress towards goals
- Recommendation for revisions
- Scientific advancements (modeling or other technological needs)

These annual evaluations could include, but not be limited to:

- An accounting of progress toward defined visibility improvement/impact reduction goals
- An accounting of progress toward emission reduction goals
- Review of project burning for the next year, as well as additional out-year planning
- Regional information, considering visibility impacts to and from adjoining states/tribes

[60] 64 FR 35768, §51.308 (g) and 35772, §51.309 (d) (10).

- Burn activity summaries
- Burning restrictions or air quality alerts
- Significant smoke intrusions or visibility impacts
- Summaries of IMPROVE and other monitored air quality data
- Emission inventory summaries
- Information tracking summaries
- Smoke complaint summaries
- Discussion of alternatives to burning

In an enhanced smoke management program, federal land managers responsible for protecting air quality related values in Class I areas should be given the opportunity to provide input to annual program evaluations.

Where MOUs or other agreements govern smoke management programs, an annual meeting should be held where members share successes and failures, data is summarized and the program is evaluated. In cases where review criteria are established in state code, performance can be compared against standards. Permit files may be kept for a period of time, including complaint files, and statistics generated to evaluate trends in the program.

C. 2. 8 Element 8. Burn Authorization

Burn authorization requirements are expected to vary depending upon the amount of burning that is occurring, the fire source types that are conducting the burning, and the degree of impairment that exists or may be expected to occur as a result of the burning. The proximity of non-attainment areas may also have a bearing on the complexity of the burn authorization procedure that should be implemented. Four broad levels of stringency may be considered in the development and adoption of an enhanced smoke management program.

- Establish a permit-by-rule system
- Establish a burn permitting system by source sector or a coalition of source sectors
- Establish a centralized burn authority
- Establish a regional burn authority

Establishment of any of these authorization situations would also entail the development of coordination procedures described in (9) below.

C.2.8.1 Permit by Rule

The AAQTF Recommendation on Air Quality Policy describes a process in which a set of requirements are established under which burning may take place. These requirements may include acreage, time of year, time of day and meteorological factors.[61] A written permit may or may not be required. As long as the conditions are met, then burning may occur. There is no daily decision-making by a coordinating authority in this scenario.

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[61] AAQTF Recommendation on Air Quality Policy, p.9.

Such a system may be applicable for any fire source type in geographic areas of low fire use. This system should, however, still allow for the collection of enough information by an appropriate regulatory authority so that source activity and emissions may be tracked.

C.2.8.2 Burn Permitting System

A burn permitting system that is established by fire source type would include a local burn manager and/or state, tribe, local agency, whose responsibility is to develop the conditions under which burning may occur and then ensure that burning occurs within the requirements that are established. The elements described in this WRAP ESMP Policy would be implemented by the burn manager to ensure that visibility in Class I areas is protected.

C.2.8.3 Centralized Burn Authority

A more intensive level of smoke management would involve the creation of a centralized authority at the state, tribal or local level that provides daily coordination and approval of burns if significant state/tribe-wide burning is occurring. The centralized authority may be responsible for activities of one particular source type or a combination of sources. This type of program could include the detailed use of meteorological information, burn information and a permitting system to avoid cumulative impacts of smoke from a variety of burns.

C.2.8.4 Regional Burn Authority

Establishment of a regional burn authority may be required if there are continued and extensive inter-state impacts from burning. States/tribes would agree to have oversight of burning by an authority that equitably considers burning opportunities for all source types while addressing the Class I area impacts over broad areas. A regional burn authority would likely, in most cases, be working with the most severe and persistent problems.

<u>C. 2. 9 Element 9. Regional Coordination</u>

Coordination of burning activity is critical to avoiding cumulative visibility impacts within and across source types. Coordination may range from a passive mode of information sharing between land managers/owners and/or the public to a more complex, active coordination in which burn decisions are altered based on other activities that are occurring or have recently occurred.

Coordination can occur at locations that reflect the affected level of concern. When burns are located near Class I areas or non-attainment areas, coordination will be carried out at a level that is appropriate. If burns are located adjacent to state/tribe boundaries, coordination will occur appropriate to the smoke transport/emission path and quantity.

A common mode of coordination regardless of the complexity and magnitude of burning would be information sharing via use of the web. Operationally, certain information needs to be established and updated as needed. This would include:

- Burn information (size, location, ignition date, etc.)
- Names and locations of sensitive receptors and/or special protection zones; sensitive receptors should include sensitive populations
- Locations of monitors (state, tribe, EPA or local)
- Database of known significant users of fire (name, phone number)
- Identification of airsheds or air administered units
- Possible identification of Clean Air Corridors
- Updateable database of non-attainment and maintenance areas for criteria pollutants of concern
- Identification of the centralized burn authority that maintains oversight

A minimal level of coordination would include the use of websites to post burn activity. This passive mode of coordination would be used regardless of the burn authorization method that is in place in a particular geographic area. Land managers/owners and regulators could use this information to encourage and promote voluntary coordination among land managers/owners. Burn locations and weather conditions may be posted or linked at a common webpage or series of webpages.

C.2.9.1 Source Sector Authority Coordination

A more advanced coordination concept is that of using burn managers or smoke coordination centers to actively time burning to avoid cumulative smoke impacts from burns within a source sector. In addition to creating awareness of other sectors' burning via tracking information on the web, radio or phone communications would be used to distribute that burning information to land managers/owners.

A step further in this process is active management of burning with coordination occurring between burn managers of different source types. Considerations that would be taken into account by the burn managers are parameters such as special weather conditions needed for a particular burn, fire safety considerations, etc. These considerations can be identified in the early periods of burn planning so that all parties are aware of the rationale behind burn decisions.

C.2.9.2 Centralized Authority Coordination

A centralized coordination authority within a state/tribe provides for a greater level of control of smoke production and reduction of impacts. In this scenario, potential state/tribe-wide impacts may be better managed and problems avoided than is the case with more fragmented coordination points. Central authorities for each source type would coordinate activities or one central authority would coordinate activities across all source types. In most cases this coordination would occur through a statewide coordination center that has access to information from all burning sources. Such a coordination center would also be more likely to have sophisticated meteorological, air quality, modeling and fire behavior and effects expertise upon which decisions would be made.

C.2.9.3 Regional (Multi-State/Tribe) Coordination

Burning that creates inter-jurisdictional impacts may require the establishment and use of multi-state/tribal coordination information procedures. If states'/tribes' Class I areas are consistently and measurably being impacted by smoke from outside of their own boundaries, then more information sharing may be needed on day-to-day burning activities. State/tribe centralized coordination centers would share information and resources to limit cumulative impacts from external sources as well as from those within its own boundaries.

Each state's/tribe's central coordination center would prioritize burns in areas that would be most likely to create cross-jurisdictional impacts. On a regional basis, acres or emissions may be limited by each state's/tribe's burn authority to minimize air quality impacts in neighboring areas. Regional meteorological and air quality information would be shared by coordination centers, with the result being regional approval and real-time tracking of burns and their smoke impacts.

A segment of fires that are considered to be natural under the WRAP Fire Categorization Policy may best be suited for regional coordination opportunities. Such fires are more likely to be of longer duration and have the greater potential for generating regional haze. Coordination in this case may range from monitoring smoke from such fires and reporting impacts to nearby states/tribes, to limiting other burning until the smoke from the natural fires has abated.

Methods for this inter-jurisdiction and regional coordination will need to be developed. The development process should be a collaborative one, involving state, tribal, local and federal agencies, and private parties. Entities to be involved in this process could include WRAP, the Western States Air Resources Council (WESTAR), the National Tribal Environmental Council (NTEC), the Wildfire Leadership Council, the Western States Fire Managers, and national/regional agricultural organizations.

C. 3 Responsibilities Under an Enhanced Smoke Management Program

Throughout all the enhanced smoke management program elements outlined in this Policy, it is assumed that the regulatory authority (i.e., state, tribe, or EPA on behalf of the tribe) has the oversight for the enhanced smoke management program through its implementation plan, although it may choose to delegate implementation to another entity, e.g., county, municipality, fire source sector representative or other non-governmental organization.

It is the regulatory authority's responsibility to ensure that the mechanisms and infrastructure are in place to implement the enhanced smoke management program. The state/tribe is responsible to track emissions and determine the amount of the contribution to visibility impairment in Class I areas. It is also incumbent upon the regulatory authority to develop a SIP/TIP that is consistent with Section 118 of the CAA pertaining to equitable treatment of federal activities.[62] Finally, failure of the regulatory authority to develop appropriate and necessary oversight and responsibilities may result in EPA's disapproval of the regional haze SIP/TIP.

It is the land manager's/owner's responsibility to meet the enhanced smoke management program requirements. The land manager/owner needs to ensure that data and information submitted to the regulatory authority are accurate, timely, and complete. In some instances this may be no more onerous than a form faxed by the land manager/owner to the regulatory authority at the end of the year; in others, extensive information on a daily basis regarding planned and accomplished burning will be required.

C.4 Funding Mechanisms for Enhanced Smoke Management Programs

Funding for enhanced smoke management programs can come from many possible sources. Further, funding mechanisms will depend on the magnitude or complexity of the enhanced smoke management program needed. The following is a list of possible methods for funding enhanced smoke management programs:

A. Funds obtained from users of prescribed fire.
   a. Memorandum of Understanding (MOU)/Memorandum of Agreement (MOA)/Consortium Funds
      - Each member/signatory pays an annual membership fee and there is an additional per acre fee for accomplished burns.
   b. Fees
      - Permit Fees
      - Emissions-based Fees
      - Acreage-based Fees

B. Funds Obtained from Users of Class I Areas

C. Grants and/or Appropriated Funding
      - A combination of many sources including EPA grants, state/tribe, city and county governments, fire protection assessments, property taxes.
      - General revenue program/appropriated funds received from a legislative body.

D. Provision of Resources
      - Fire source sector provides personnel or other resources to aid or manage the enhanced smoke management program in lieu of direct permit payments to defray overall costs of the enhanced smoke management program.

[62] Clean Air Act §118 (a).

<u>Appendix A-10i. Arizona Revised Statute 49-501</u>

49-501. Unlawful open burning; definition; exceptions; fine

A. Notwithstanding the provisions of any other section of this article, it is unlawful for any person to ignite, cause to be ignited, permit to be ignited, or suffer, allow, or maintain any open outdoor fire except as provided in this section.

B. "Open outdoor fire", as used in this section, means any combustion of combustible material of any type outdoors, in the open where the products of combustion are not directed through a flue. "Flue", as used in this subsection, means any duct or passage for air, gases or the like, such as a stack or chimney.

C. The following fires are excepted from the provisions of this section:

1. Fires used only for cooking of food or for providing warmth for human beings or for recreational purposes or the branding of animals or the use of orchard heaters for the purpose of frost protection in farming or nursery operations.

2. Any fire set or permitted by any public officer in the performance of official duty, if such fire is set or permission given for the purpose of weed abatement, the prevention of a fire hazard, or instruction in the methods of fighting fires.

3. Fires set by or permitted by the director of the department of agriculture or county agricultural agents of the county for the purpose of disease and pest prevention.

4. Fires set by or permitted by the federal government or any of its departments, agencies or agents or the state or any of its agencies, departments or political subdivisions for the purpose of watershed rehabilitation or control through vegetative manipulation.

5. Fires permitted by any rule or regulation issued pursuant to this article, by any conditional permit issued by a hearing board established under this article or by any rule or conditional permit issued pursuant to article 2 of this chapter when the department of environmental quality pursuant to section 49-402 has assumed jurisdiction of the county in which the fire is located.

6. Fires set for the disposal of dangerous materials where there is no safe alternate method of disposal.

D. Permission for the setting of any fire given by a public officer in the performance of official duty under subsection C, paragraph 2, 3 or 4 shall be given in writing and a copy of the written permission shall be transmitted immediately to the director and the control officer of the county, district or region in which such fire is allowed. The setting of any such fire shall be conducted in a manner and at such time as approved by the control officer or the director, unless doing so would defeat the purpose of the exemption.

E. Notwithstanding section 49-107, the director may delegate authority for the issuance of open burning permits to a county, city, town or fire district. A county, city, town or fire district that has been delegated authority for the issuance of open burning permits may assign the issuance of these permits to a private fire protection service provider that performs fire protection services within that county, city, town or fire district. Any private fire protection service provider that is authorized to issue open burning permits pursuant to this subsection shall maintain a copy of all currently effective permits issued including a means of contacting the person authorized by the permit to set the fire in the event that an order to extinguish the open burning is issued. Permits issued pursuant to this subsection shall contain both of the following:

1. Conditions that limit the manner and time of setting the fire and that are consistent with this section and rules adopted pursuant to this section.

2. A provision that all burning be extinguished at the discretion of the director or the director's authorized representative during periods of inadequate atmospheric smoke dispersion, periods of excessive visibility impairment that could adversely affect public safety or periods when smoke is blown into populated areas so as to create a public nuisance.

F. The director may issue a general permit to allow persons engaged in farming or ranching on forty acres or more in an unincorporated area to burn household waste, as defined in section 49-701, that is generated on site, if no household waste collection and disposal service is available. The general permit shall include the following:

1. Conditions governing the method, manner and times for burning.

2. Limitation on materials which may be burned, including a prohibition on burning of materials which generate noxious fumes.

3. A requirement that any person seeking coverage under the general permit shall register with the director on a form prescribed by the director. Upon receipt of a registration form, the director shall notify the county in which the farm or ranch is located of such registration.

4. A statement that the director, a local air pollution control officer, or any other public officer may order the extinguishment of burning or may prohibit burning during periods of inadequate smoke dispersion or excessive visibility impairment or at other times when public health or safety could be adversely affected.

G. Nothing in this section is intended to permit any practice which is a violation of any statute, ordinance, rule or regulation in a county with a population in excess of one million two hundred thousand persons according to the most recent United States decennial census.

H. A person who violates any provision of this section may be served a notice of violation and be subject to the enforcement provisions of this article to the same extent as a person violating any rule or regulation adopted pursuant to this article.

I. Any violation of this section shall be punishable by a fine not to exceed twenty-five dollars.

<u>Appendix A-10j. WRAP report "Annual Emission Goals for Fire"</u>

Western Regional Air Partnership Policy
on
Annual Emission Goals for Fire

Approved by the Western Regional Air Partnership
April 2, 2003

Prepared by the Annual Emission Goals Task Team
of the
Fire Emissions Joint Forum

WRAP Policy

Annual Emission Goals for Fire

Executive Summary

The Western Regional Air Partnership (WRAP) is charged with developing technical and policy tools to assist states (or the delegated regulatory authority) and tribes with implementing the Regional Haze Rule (Rule).

The WRAP Policy on Annual Emission Goals for Fire (WRAP AEG Policy) has been developed over a six-month period through a stakeholder-based consensus process to assist the WRAP region states and tribes in addressing emissions from fire sources. In this Policy, the WRAP seeks to provide a consistent framework that states and tribes can use to efficiently develop their individual implementation plans. The WRAP recognizes states' and tribes' authority and responsibility to develop, adopt and implement their regional haze implementation plans, and recognizes the Rule as the principal document on which states and tribes should rely.

The Rule requires states to develop implementation plans (SIPs) for addressing regional haze in the Nation's 156 mandatory Class I areas. Additionally, the Rule requires effective management of fire sources. The Rule provides two pathways for western states to follow as they implement the requirements of the Rule: 1) develop their regional haze implementation plans per the nationally applicable provisions of Section 308, or 2) Transport Region states may choose to incorporate the Grand Canyon Visibility Transport Commission (GCVTC) Recommendations into their regional haze implementation plans under Section 309 of the Rule.

The GCVTC recognized that projected increases in fire activity will result in episodic impacts on visibility in the West, and called for the development of annual emission goals that would minimize these impacts. Section 309 of the Rule specifically requires the establishment of annual emission goals that minimize emission increases from fire to the maximum extent feasible. Further, these goals must be developed in cooperation with states, tribes, land management agencies and private entities.

The WRAP defines the annual emission goal as a quantifiable value that is used to measure progress each year toward the desired outcome of achieving the minimum emission increase from fire. In this WRAP AEG Policy, the WRAP outlines a process by which states/tribes may establish annual emission goals, based on the utilization of currently available emission reduction techniques (ERTs), to include in their regional haze implementation plans.

Although Section 309 of the Rule specifically requires the establishment of annual emission goals, the strategy outlined here for the utilization of ERTs could be considered by states and tribes that choose to follow the requirements of Section 308 of the Rule and/or may be used to protect visibility in non-mandatory Federal Class I areas.[1]

Tribes are not subject to the same requirements of the Rule as states, but tribes wishing to assume the regional haze requirements outlined in the Rule may, according to the CAA, seek approval to be treated in the same manner as states, under the Tribal Authority Rule (TAR), 40 CFR 49. The intent of this Policy is to assist both states and tribes with the development of their regional haze implementation plans (SIPs/TIPs), and therefore, tribes are included in all references to states, except where specific requirements and/or deadlines of the Rule are cited. In the case of annual emission goals, the WRAP considers them a viable tool for all tribes in the WRAP region to use to achieve the minimum emission increase from fire.

The WRAP AEG Policy document is comprised of four major sections. Section 1 is the seven WRAP AEG Policy statements. Section 2 provides overall background for the WRAP AEG Policy. Section 3 is an annotation of each of the seven policy statements, further explaining and defining them. Finally, the Appendices include (A) a glossary of terms, (B) a related documents listing, (C) additional guidance for states/tribes on the implementation of annual emission goals, and D) an example of a table that will be developed as a separate guidance document by the WRAP Fire Emissions Joint Forum for use with annual emission goals.

[1] The Rule is only applicable to mandatory Class I areas. States/tribes in the WRAP region may utilize the AEG Policy to protect visibility in non-mandatory Class I areas.

WRAP Policy

Annual Emission Goals for Fire

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Policy Statements

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B) Annual emission goals will achieve the minimum emission increase from fire. Annual emission goals are quantifiable values that are distinct from emission limits.

C) Annual emission goals are applied to all fire sources (excluding wildfire) due to their potential impacts on visibility.

D) The minimum emission increase from fire is accomplished through the optimal application of emission reduction techniques, which provides the basis for annual emission goals.

E) The use of emission reduction techniques to achieve annual emission goals is subject to economic, safety, technical and environmental feasibility criteria, and land management objectives.

F) States, tribes or the designated authority will establish annual emission goals in cooperation with federal land management agencies and private entities on a yearly basis.

G) States and tribes will need to develop a procedure for verifying the use of emission reduction techniques and for tracking the achievement of annual emission goals.

2. Background

2.1 Clean Air Act and Grand Canyon Visibility Transport Commission

In 1990, Congress amended the Clean Air Act (CAA), and as part of these amendments created the Grand Canyon Visibility Transport Commission (GCVTC).[3] The GCVTC was charged with assessing the current scientific information on visibility impacts and making recommendations for addressing regional haze in the western United States. The GCVTC signed and submitted more than 70 recommendations to the Environmental Protection Agency (EPA) in a report dated June 1996 that indicated that visibility impairment was caused by a wide variety of sources and pollutants, and that a comprehensive strategy was needed to remedy regional haze.

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[2] "Control" as used in this Policy means the use of techniques that result in a quantifiable reduction in emissions from individual fire sources.

[3] The GCVTC was composed of the governors of eight western states (AZ, CA, CO, NM, NV, OR, UT, WY), four tribes (Acoma Pueblo, Hopi, Hualapai, and Navajo), four Federal land management agencies (Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Forest Service, National Park Service), the Columbia River Inter-Tribal Fish Commission, and the Environmental Protection Agency.

The GCVTC Report recognized that fire plays a significant role in visibility on the Colorado Plateau. According to the GCVTC Report, emissions from wildfire and prescribed fire are "an important episodic contributor to visibility-impairing aerosols, including organic carbon, elemental carbon, and particulate matter ($PM_{2.5}$)."[4] The GCVTC Report also stated that agricultural burning emissions and their effects have been identified as a concern, but have not been quantified due to insufficient data.[5]

2.2 Western Regional Air Partnership

The Western Regional Air Partnership (WRAP) was established in 1997 as the successor organization to the GCVTC. The WRAP is a voluntary organization comprised of western governors, tribal leaders and federal agencies,[6] and is charged "to identify regional or common air management issues, develop and implement strategies to address these issues, and formulate and advance western regional policy positions on air quality."[7] These policies and technical tools are developed through inclusive, stakeholder-based processes and approved by consensus of the WRAP.

WRAP participants include state air quality agencies, tribes, federal/state/private land managers, the EPA, environmental groups, industry, academia and other interested parties. There are over 400 tribes within the WRAP region. The large number of tribes limits the participation of all of them in WRAP activities, and accordingly, in the development of this Policy. Therefore, the tribal representatives involved in the development of this Policy may not represent all tribal concerns.

2.3 Regional Haze Rule

Following the issuance of the GCVTC Report, the EPA issued the Regional Haze Rule (Rule) in July 1999 to improve visibility in 156 national parks and wilderness areas across the country. The Rule outlines the requirements for states and tribes to address visibility impairment in mandatory Class I areas due to emissions from all sources, including fire activities. EPA incorporated all of the GCVTC recommendations into Section 309 of the Rule, which may be used by some of the WRAP states/tribes. The remaining WRAP states must utilize the nationally applicable Section 308 provisions of the Rule.

Tribes are not subject to the same requirements of the Rule as states, but tribes wishing to assume the regional haze requirements outlined in the Rule may, according to the CAA, seek approval to be treated in the same manner as states, under the Tribal Authority Rule (TAR), 40 CFR 49.[8] In these

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[4] GCVTC Report, p. 47.

[5] Ibid.

[6] The WRAP membership is comprised of the governors of thirteen western states and thirteen western tribes. The current WRAP members include the States of AK, AZ, CA, CO, ID, MT, ND, NM, OR, SD, UT, WA, and WY, and the Tribal Nations of Pueblo of Acoma, Campo Band of Kumeyaay Indians, Cortina Indian Rancheria, Hopi Tribe, Hualapai Nation of the Grand Canyon, Nez Perce Tribe, Northern Cheyenne Tribe, Salish and Kootenai Confederated Tribes, Pueblo of San Felipe, and Shoshone-Bannock Tribes of Fort Hall. Federal WRAP members are the Department of the Interior, the Department of Agriculture, and the Environmental Protection Agency.

[7] WRAP Charter, Purpose, p. 1.

[8] 64 FR 35759.

cases, EPA still recognizes that "unlike States, tribes are not required by the TAR to adopt and implement CAA plans or programs, thus tribes are not subject to mandatory deadlines for submittal of implementation plans."[9] Although provision for flexibility in the submission of programs and implementation plans for tribes is made under TAR, EPA does "encourage tribes choosing to develop implementation plans to make every effort to submit by the deadlines to ensure that the plans [TIPs] are integrated with and coordinated with regional planning efforts."[10]

EPA recognizes the WRAP as the Regional Planning Organization that is developing the necessary policy and technical tools to implement the Rule in the WRAP region. A WRAP policy, once approved, represents the WRAP's consensus position on the best means for states and tribes to implement the portion of the Rule at issue.

The WRAP recognizes states' and tribes' authority and responsibility to develop, adopt and implement their regional haze state and tribal implementation plans, and the seminal guidance to do this is the Rule.[11] States are required by the Rule to submit periodic reports to the EPA to assess the adequacy of the implementation plan. If the state determines that the implementation plan is or may be inadequate to meet reasonable progress goals, the state is required to develop additional strategies to address deficiencies in the plan. These strategies are then submitted to EPA for approval.

3. Annotated Policy

<u>3.1 Introduction</u>

The WRAP AEG Policy is the result of the WRAP region-wide, multi-state/tribe stakeholder planning and coordination effort. The intent of the WRAP AEG Policy is to assist states (or the delegated authority) and tribes to address smoke impacts on visibility associated with fire in a way that is adequate for SIP/TIP implementation.

The WRAP AEG Policy provides states and tribes with a consistent method for the identification, use, and tracking of emission reduction techniques (ERTs) to meet the annual emission goals requirement of the Rule. Although this Policy promotes the use of ERTs to meet the annual emission goals requirement of Section 309 of the Rule, it does not prescribe how each state/tribe integrates this Policy into its regional haze SIP/TIP or limit the use of alternative approaches to the implementation of annual emission goals.

This WRAP AEG Policy has been developed to embody appropriate regulatory and policy requirements and to provide a predictable framework for annual emissions goals that can be reasonably implemented by states and tribes. The WRAP believes that states maintain the ultimate responsibility for the implementation of annual emission goals. Further, states are responsible for incorporating into their implementation plans federally enforceable processes to minimize emission increases from fire, whether they choose to use ERTs or some other method that meets Rule requirements. Tribes, or EPA on their behalf, may choose to utilize, as a severable element, annual

[9] 64 FR 35758.
[10] 64 FR 35759.
[11] WRAP Charter, p.1.

emission goals in their implementation plans. The WRAP recognizes that the implementation plans will be revisited and revised, per the schedule specified in the Rule, giving opportunities to refine individual programs for annual emission goals that reflect technical advances and policy updates.

3.2 Annual Emission Goals Required Under Section 309

Policy Statement A: *The establishment and implementation of annual emission goals is a viable technique to control fire emissions for WRAP states and tribes. Annual emission goals are required for states under Section 309 of the Regional Haze Rule.*

In this Policy, the WRAP seeks to provide a consistent and equitable framework that states and tribes can use to efficiently develop their regional haze implementation plans (SIPs/TIPs). Under Section 309, the Rule calls for "establishment of annual emission goals for fire (excluding wildfire) that will minimize emission increases from fire to the maximum extent feasible."[12] The Policy can be considered by all other states and tribes as a means to control fire emissions, and annual emission goals are a viable technique for controlling fire emissions if a state's or tribe's visibility impairment analysis for Section 308 of the Rule shows that fire sources contribute to visibility impairment in a mandatory Class I area.

3.3 Annual Emission Goal Defined

Policy Statement B: Annual emission goals will achieve the minimum emission increase from fire. Annual emission goals are quantifiable values that are distinct from emission limits.

In its Report, the GCVTC acknowledged federal and state land managers' projection of "significant increases in prescribed fire in order to reduce the effects of wildfire resulting from past decades of fire suppression."[13] The Rule also recognized that "forest fuels have built up over many years due to past management practices designed to protect public health and safety through fire suppression." And further, that this has "…led to an increased risk of catastrophic wildfire…" which would need to be offset by "the increased use of prescribed fire…."[14]

This increase in fire activity prompted the GCVTC to recommend the establishment of annual emission goals that would minimize increases from fire emissions, which the Rule then adopted as a requirement under Section 309.[15] The Rule utilizes the GCVTC's terminology in Section 309 and in the Preamble, both in its section on the Treatment of the GCVTC Recommendations and in the Annex to the GCVTC Report.[16] Therefore, for its definition of "annual emission goal" the WRAP looked to the GCVTC Report.

Although not formally defined, the term "goal" is specifically used in the GCVTC Report in the contexts of both Area Sources and Air Pollution Prevention to focus efforts on a desired outcome.[17]

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[12] 64 FR 35771 §51.309 (d)(6)(v).

[13] GCVTC Report, p. 23.

[14] 64 FR 35735.

[15] GCVTC Report, p. 50.

[16] 64 FR 35748 and 35756.

[17] GCVTC Report, p. 30.

This desired outcome may have a numeric measure associated with it, but is distinct from a limit. The GCVTC defines both the terms "cap" and "target" as emissions limits, and uses them in its section on Stationary Sources.[18] The GCVTC also distinguishes between "target" and "cap" as follows:

> … "targets" are intended as firm limitations on emissions and have the same effect as a "cap." However, we are reserving the term "cap" to refer to the limits set under a regulatory program, which would be triggered if the "targets" are exceeded.[19]

In using the term goal, and not target or cap, the GCVTC clearly intended the annual emission goal to be something other than an emission limit, and that it not have the attendant regulatory consequences of a cap, as supported by the specific use of these terms in its Report. Therefore, the WRAP AEG Policy defines annual emission goals as quantifiable indicators of progress toward the desired outcome of minimizing increases from fire emissions.

In distinguishing between goals and limits, it is not the intent of this Policy to preclude the establishment of emission limits. However, it currently does not appear that an adequate fire emissions inventory exists throughout the WRAP Region to support the establishment of an emissions limit on fire sources.[20] The WRAP does recognize that scientific advances may support the feasibility of an emissions limit (either target or cap) in the future.

<u>3.4 Applicability</u>

> *Policy Statement C: Annual emission goals are applied to all fire sources (excluding wildfire) due to their potential impacts on visibility.*

The Rule, the GCVTC and WRAP policy development to date acknowledge that all types of fire must be addressed equitably as part of a visibility protection strategy since all fire contributes to regional haze.[21] Therefore, the WRAP AEG Policy applies to all fire sources, except for wildfire, which is specifically excluded in Section 309 of the Rule.[22]

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[18] GCVTC Report, p. xi and pp. 32-37.

[19] GCVTC Report, p. 34, footnote 4.

[20] In order to implement an emission limit, states/tribes would need to have emissions inventory data adequate to establish an emissions baseline, establish the baseline, conduct periodic evaluations of the effectiveness of the baseline, and institute sufficient enforcement mechanisms. Even so, the baseline may not be a reliable tool due to the variability of fire emissions.

[21] GCVTC Report, p. 47, 64 FR 35735, WRAP ESMP and Fire Categorization Policies.

[22] 64 FR 35771 §51.309 (d)(6)(v).

The Rule excludes wildfire from the annual emission goals requirement of Section 309 due to the inability to directly control the emissions from wildfires. The same concern would be relevant to states under Section 308 or tribes that choose to use annual emission goals as a method to control fire emissions.

This Policy applies to federal, tribal, and state land managers and to private landowners that use prescribed fire, wildland fire used for resource benefits (WFU)[23] or agricultural burning to achieve land management objectives on agricultural land or wildland.[24] In accordance with Section 118(a) of the CAA requiring that all entities, federal and non-federal, be subject to the same requirements, authorities and processes,[25] the WRAP AEG Policy will be applied equitably to all fire sources, excluding wildfire.

The WRAP AEG Policy specifically does not apply to Native American cultural non-vegetative burning for traditional, religious, or ceremonial purposes (e.g., cremation, sweat lodge fires).[26] Nor does it apply to open burning activities on residential, commercial, or industrial property (e.g., backyard burning, garbage incineration, residential wood combustion, construction debris).[27] However, states/tribes may choose to consider the impacts of these fire sources when developing their regional haze implementation plans.

3.5 Emission Reduction Techniques (ERTs)

> *Policy Statement D: The minimum emission increase from fire is accomplished through the optimal application of emission reduction techniques, which provides the basis for annual emission goals.*

The WRAP AEG Policy provides a practical approach to establishing annual emission goals that states and tribes can use in their implementation plans. The WRAP has developed the AEG Policy to address three issues central to this visibility protection strategy.

First, *annual* emission goals are to be developed on an annual basis, for each year, and therefore need to be based on a measure that can be determined in one year's time. The annual level of fire activity is dependent on a variety of external factors such as crop type planted, funding for federal or state fire programs, weather, etc. These factors will also influence the potential use of fire emission control strategies. In order to accommodate this variability and address the annual nature of the Rule requirement, annual emission goals are to be determined each year through a collaborative process between burners and the regulatory jurisdiction.

Second, since annual emission goals are not emission limits, the goal is based on the sole purpose of minimizing emission increases from fire to the maximum extent feasible; therefore, annual emission

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[23] Also known as Prescribed Natural Fire (PNF).

[24] WRAP Policy for Categorizing Fire Emissions, November 15, 2001 (hereafter referred to as "WRAP Fire Categorization Policy"), p. 8. See also Appendix C for further details.

[25] Clean Air Act §118(a).

[26] WRAP Fire Categorization Policy, p. 24.

[27] Ibid, however "industrial property" would not include land such as industrial forestland.

goals can reasonably be tied to actions that have this result. Under this Policy, the process for establishment of the annual emission goal, rather than the specific numeric value (which varies from year to year), will be included in implementation plan submittal. In other words, the goal will focus on the efforts to minimize emissions; this process, being in the implementation plan, will be federally enforceable.

Third, the WRAP region represents wide variety with regard to basic fire activity tracking, fire emissions data, and fire use, and therefore, the annual emission goals strategy will need to be one that is both flexible and practical. The strategy must also be capable of being implemented using tools and information currently available to meet the Section 309 deadline of December 31, 2003.

To address these issues, the WRAP AEG Policy focuses on minimizing fire emission increases through the control of emissions on all fire projects where feasible. Control of fire emissions means utilizing methods that result in a reduction of the total amount of emissions generated from each fire project. Control of fire emissions is accomplished by using emission reduction techniques (ERTs), methods proven to reduce fire emissions.[28]

ERTs include biomass utilization prior to burning, increasing combustion efficiency, and others.[29] Additionally, methods exist for tracking and calculating the emissions averted from the use of ERTs for a broad array of vegetation types. For the purposes of this Policy, non-burning alternatives are not ERTs. Non-burning alternatives are techniques that replace fire as a means to achieve a particular land management objective (e.g., reduction of fuel-loading, enhancement of wildlife habitat, etc.).[30]

Control measures are distinct from smoke management techniques, which are currently used in the West by land managers to minimize smoke impacts on public health, nuisance and visibility. A key smoke management technique is the timing of ignitions for better smoke dispersion with the intention of avoiding smoke impacts to sensitive areas (e.g., non-attainment areas, Class I areas, nearby communities). Smoke management techniques may give consideration to downwind air quality (e.g., nuisance impacts and National Ambient Air Quality Standards [NAAQS]) and visibility/regional haze.

The emission reductions that are achieved through the use of ERTs are calculated on a project-specific basis, otherwise referred to as the operational phase of the fire project. The decision to burn a specific area has already been made prior to the implementation of a specific project; therefore, project-specific basis refers to projects where fire will be used to meet land management objectives. Annual emission goals, under this Policy, are established annually and apply to the upcoming year's projects where fire has been determined as the best tool for meeting specific land management objectives. The annual emission goal in this case would be the sum of emission reductions from all fire projects where ERTs are used across the state or tribal jurisdiction, for the upcoming year.

[28] The GCVTC projected that the use of optimal smoke management measures (which include the use of ERTs) could decrease fine particle ($PM_{2.5}$) emissions from prescribed fires by approximately 15-20%. This resulted in modeled visibility improvements over the planning period of the GCVTC. GCVTC Report, p. 87.

[29] See Appendix C for more examples of specific ERTs and the application of ERTs.

[30] For a more detailed discussion of non-burning alternatives, see Section 4.2 of Appendix C.

3.5.1 Implementation Options

Two options for the utilization of ERTs to meet the annual emission goal have been outlined below. These options are based on current use of ERTs, science and technology. The first option is based on estimations of emissions averted through the application of ERTs, and allows the calculation of an annual numeric value that indicates progress toward minimizing increases from fire emissions. The second option is provided for instances where estimates of emissions averted are not feasibly calculated due to insufficient data. In this second option, the annual numeric value is based on total percent use of ERTs with subsequent emission reductions inferred.

The two options explored here are not exhaustive or definitive in structure or design. Application of these or any other options can be considered for each individual fire source sector or for combinations of them. All options for use of ERTs are subject to the feasibility criteria as outlined in Policy Statement E. Additionally, state/tribal authorities will want to be mindful of equitable treatment of sources in the implementation of ERTs.

In either Option 1 or Option 2, state/tribes will need to determine the appropriate ERTs to be used for specific vegetation or crop types that will be treated to allow attainment of land management objectives. It is a common practice to apply a certain ERT to a specific vegetation or crop type, although more than one ERT may be feasible for a certain vegetation or crop type. Next, in establishing annual emission goals, the designation of all appropriate ERTs for each of the identified vegetation or crop type needs to be completed.

For use in this process, Appendix D provides an example of a table that will correlate the use of ERTs with emissions averted. Appendix D will be augmented by subsequent guidance by the WRAP Fire Emissions Joint Forum (FEJF) that will summarize ERT options for common vegetation and crop types for both prescribed fire on wildlands and agricultural burning. This guidance document can be used in combination with known local practices to determine appropriate ERTs for the respective vegetation or crop type.

Option 1

> Once applicable ERTs for the respective vegetation or crop type are agreed upon, the potential percentage use of ERTs is determined subject to the feasibility criteria for the specific project. The potential percentage use is estimated by determining the portion of the project where ERTs are to be applied. Then an estimate of the emissions averted can be made. The annual emission goal is the emissions averted through the use of ERTs for all projected fire projects across the state or tribal jurisdiction.

Option 2

> An estimate of emissions averted may not be feasible if ERT emission factors are not available (i.e., the specific amount of emissions reduction has not been determined through research). In this case, the annual emission goal is the percent of total acres on which ERTs are used where fire is to be employed across a state or tribal jurisdiction for the upcoming year.

Although annual emission goals using ERTs can be established unilaterally across fire source sectors for either Option 1 or 2, there are benefits to establishing them by source sector so as to account for differences in management practices between agricultural and wildland burning, as well as in the availability of ERTs. Establishing the annual goal using ERTs by source sector may also alleviate equity issues since the goal is applied across projects with similar vegetative or crop types and land management objectives. The annual goal should be established after the evaluation of all potentially applicable ERTs.

This Policy encourages states/tribes to coordinate with neighboring states/tribes to improve the knowledge base of ERTs and to maintain consistency in calculating emissions averted. Interstate coordination is key for minimizing visibility impacts in mandatory Federal Class I areas and for addressing regional haze in the WRAP region.[31]

3.6 Feasibility Criteria

> *Policy Statement E: The use of emission reduction techniques to achieve annual emission goals is subject to economic, safety, technical and environmental feasibility criteria, and land management objectives.*

The feasibility of ERT use is variable and dependent on criteria as established in the WRAP Fire Categorization Policy:

> Per the GCVTC Recommendations, economic, safety, technical and environmental considerations are part of the application of emission controls for the implementation of this Policy statement. Due to these considerations, the control of emissions from some fire types may not be feasible, which will be determined by the land manager in collaboration with the applicable air quality regulatory authority.[32]

The WRAP AEG Policy also recommends that land management objectives be included in these criteria during the decision-making process to ensure that ERTs are used appropriately and at levels of usage that are feasible. It should be noted that the specific land management objective for an area could preclude the use of a specific ERT where that ERT would prevent the attainment of the land management objective, e.g., if the land management objective is to reduce downed large fuels in an area, the use of burning under high fuel moisture of large woody fuels (i.e., the ERT being

[31] 64 FR 35728.
[32] WRAP Fire Categorization Policy, p. 11.

considered) would not be an option. See Appendix C for more detailed information on the application of ERTs.

3.7 Utilizing Collaborative Processes

Policy Statement F: States, tribes or the designated authority will establish annual emission goals in cooperation with federal land management agencies and private entities on a yearly basis.

Section 309 of the Rule requires that annual emission goals are "established in cooperation with States, tribes, Federal land management agencies, and private entities.[33] In addition, the WRAP's policies on fire to date endorse the importance of using this collaborative process. Annual emission goals will be reviewed and revised on a yearly basis. Coordination within states and across jurisdictional boundaries is key for minimizing visibility impacts in mandatory Federal Class I areas and for addressing regional haze in the WRAP region.[34]

3.8 Tracking Procedure

Policy Statement G: States and tribes will need to develop a procedure for verifying the use of emission reduction techniques and for tracking the achievement of annual emission goals.

A procedure for verifying the use of ERTs should be developed. Such a procedure could also facilitate the state's/tribe's ability to ensure accountability of individual sources in utilizing ERTs. A state's/tribe's fire tracking system, as based on the WRAP Fire Tracking System (FTS) Policy, could be augmented to provide a repository for the verification information.
The verification of the use of some ERTs could also be done indirectly, for example by tracking fuel moisture.

Procedures for tracking the actual emissions averted (Option 1) and/or the actual percent of total acres on which ERTs are used (Option 2) should be developed. At year-end, these actual values can then be compared to the estimated value(s) for that year to assess whether annual emission goals are being met and for the purposes of establishing the next year's annual emission goals. A state's/tribe's fire tracking system could be developed to support the tracking of the achievement of annual emission goals.

States/tribes can utilize the tracking procedure for the annual emission goal as a means for assessing the effectiveness of the control measures (i.e., ERTs) in their SIPs/TIPs. States under Section 309 are required to submit periodic reports to EPA that assess the effectiveness of their control measures, including "…a summary of the emissions reductions achieved throughout the State through implementation…" of such measures.[35]

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[33] 64 FR 35771 §51.309(d)(6)(v).

[34] 64 FR 35728.

[35] 64 FR 35772 §51.309(d)(10)(i)(A).

4. Appendices

Appendix A
Glossary

Agricultural Fire/Burning – Any fire ignited by management actions to meet specific objectives (i.e., managed to achieve resource benefits) on agricultural land.

Agricultural Land – Agricultural land includes croplands, pasture, and other lands on which crops or livestock are produced. Rangeland will be included with wildland for the purposes of the Fire Emissions Joint Forum work.

Alternatives to Burning – See Non-burning Alternatives definition below.

Best Available Control Measures (BACM) – A term used to refer to the most effective measures (according to EPA guidance) for controlling small or dispersed particulates and other emissions from sources such as roadway dust, soot and ash from woodstoves and open burning of brush, timber, grasslands, or trash.

Best Management Practices (BMPs) – A term applied collectively to any administrative or on-the-ground procedure that reduces the negative impacts of some action. An example of a Best Management Practice with respect to air quality would be conducting a prescribed burn when atmospheric ventilation is good, which in turn promotes smoke dispersal.

Control – To reduce emissions from an individual fire source.

Class I Area – An area set aside under the Clean Air Act to receive the most stringent protection from air quality degradation. Mandatory Class I Federal Areas are: 1) international parks, 2) national wilderness areas and memorial parks larger than 5,000 acres in size, 3) national parks that exceed 6,000 acres in size and which were in existence when the 1977 Clean Air Act amendments were enacted. The extent of a mandatory Class I Federal area includes subsequent changes in boundaries, such as park expansions. Class I areas can also include lands designated by states or tribes, but these areas are not deemed mandatory by the Clean Air Act.

Emission – Pollution discharged into the atmosphere from smokestacks, other vents, and surface areas of commercial or industrial facilities; from residential chimneys; from motor vehicle, locomotive, aircraft, or other non-road engines; and from area sources such as fire.

Emission Cap - An enforceable limit on the amount of specific air pollutants that can be released or on the amount of a specific pollutant that is allowed to be in the air in a defined geographic area, and that has regulatory consequences. See also Emission Goal and Emission Target.

Emission Goal - A desired future outcome that may be represented by a numeric indicator, but without regulatory consequences, and as distinguished from a limit (i.e., target or cap). See also Emission Cap and Emission Target.

Emission Reduction Technique (ERT) - A technique for controlling emissions from prescribed fires to minimize the amount of emission output per unit of area burned.

Emission Target - A firm limit on the amount of specific air pollutants that can be released or on the amount of a specific pollutant that is allowed to be in the air in a defined geographic area, but without regulatory consequences (as distinguished from a cap). See also Emission Cap and Emission Goal.

Enhanced Smoke Management Program (ESMP) - A program for fire that considers visibility effects, in addition to health and nuisance objectives, and is based on the criteria of efficiency, economics, law, emission reduction opportunities, management objectives, and reduction of visibility impact.

Fire - When this term appears, it refers inclusively to wildfire, prescribed natural fire/wildland fire managed for resource benefits, prescribed fire, rangeland fire, and agricultural fire.

Land Managers - When this term appears, it refers inclusively to federal, state, tribal, and private land managers.

Non-burning Alternatives to Fire - Techniques that replace fire as a means to achieve a particular land management objective (e.g., reduction of fuel-loading, manipulation of fuels, enhancement of wildlife habitat, ecosystem restoration, etc.). In this Policy, non-burning alternatives do not include techniques used in conjunction with fire. Techniques used in conjunction with fire are referred to as ERTs.

Prescribed Fire - Any fire ignited by management actions to meet specific objectives, i.e., managed to achieve resource benefits.

Rangelands - Land on which the historic climax plant community is predominantly grasses, grass-like plants, forbs, or shrubs. Includes lands re-vegetated naturally or artificially when routine management of that vegetation is accomplished mainly through manipulation of ecological principles. Rangeland includes natural grasslands, savannas, shrub lands, most deserts, tundra, alpine communities, coastal marshes and wet meadows (Natural Resources Conservation Service National Range and Pasture Handbook, 1997.)

Regional Haze - Visibility impairment caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area.

Smoke Effects - The effects on visibility (both plume blight and regional haze), public nuisance, and the health-based NAAQS due to emissions from fire.

Smoke Management - Programs, practices, and techniques to minimize and/or reduce smoke emissions or impacts from fire.

State Implementation Plan (SIP) - Plans devised by states to carry out their responsibilities under the Clean Air Act. SIPs must be approved by the U.S. Environmental Protection Agency and include public review.

Transport Region State - One of nine states that make up the Grand Canyon Visibility Transport Region: Arizona, California, Colorado, Idaho, Nevada, New Mexico, Oregon, Utah, and Wyoming.

Tribal Implementation Plan (TIP) - Plans devised by tribes to carry out their responsibilities under the Clean Air Act. TIPs must be approved by the U.S. Environmental Protection Agency and include public review.

Wildfire - Any unwanted, non-structural fire.

Wildland - An area where development is generally limited to roads, railroads, power lines, and widely scattered structures. The land is not cultivated (i.e., the soil is disturbed less frequently than once in 10 years), is not fallow, and is not in the USDA Conservation Reserve Program (CRP). The land may be neglected altogether or managed for such purposes as wood or forage production, wildlife, recreation, wetlands, or protective plant cover (EPA Interim Air Quality Policy on Wildlands and Prescribed Fires). The land is not "agricultural land" as operationally defined above. Silvicultural land and rangelands (per the FEJF charge), woodlots, and private timberlands will be included with wildlands for the purposes of the FEJF work.

Appendix B
Related Documents Listing

Regional Haze Rule
Published in the Federal Register on July 1, 1999, 64 FR 35714.
http://www.epa.gov/ttn/oarpg/t1/fr_notices/rhfedreg.pdf

EPA Interim Air Quality Policy on Wildland and Prescribed Fire
U.S. EPA, Office of Air Quality Planning and Standards, Interim Air Quality Policy on Wildland and Prescribed Fires, April 23, 1998.
http://www.epa.gov/ttn/oarpg/t1/memoranda/firefnl.pdf

Prescribed Burning Background Document and Technical Information Document for Prescribed Burning Best Available Control Measures
U.S. EPA, Office of Air Quality Planning and Standards, September 1992.
Research Triangle Park, NC. EPA-450/2-92-003.
http://www.epa.gov/ttncaaa1/t1bid.html

AAQTF Recommendation on Air Quality Policy
Agricultural Air Quality Task Force, Air Quality Policy on Agricultural Burning, Recommendation to the U.S. Department of Agriculture, November 10, 1999.
http://fargo.nserl.purdue.edu/faca/Archives/2000/Policy/Burning%20Policy.htm

Tribal Authority Rule
Published in the Federal Register on February 12, 1998, 63 FR 7253.
http://www.epa.gov/fedrgstr/EPA-AIR/1998/February/Day-12/a3451.htm

Smoke Management Guide for Prescribed and Wildland Fire
National Wildfire Coordinating Group Fire Use Working Team (NWCG), 2001 Edition.
http://www.nwcg.gov

On the WRAP Website (http://www.wrapair.org)**:**

Grand Canyon Visibility Transport Commission Report
Grand Canyon Visibility Transport Commission, Recommendations for Improving Western Vistas, Report to the U.S. EPA, June 10, 1996. Go to About WRAP, then the GCVTC link.

WRAP Policy for Categorizing Fire Emissions
Approved by the Western Regional Air Partnership, November 15, 2001. Go to the FEJF Task Teams, then Natural Background.

WRAP Policy on Enhanced Smoke Management Programs
Approved by the Western Regional Air Partnership, November 12, 2002. Go to the FEJF Task Teams, then Enhanced Smoke Management Programs.

WRAP Policy on Fire Tracking Systems
Approved by the Western Regional Air Partnership, April 2, 2003. Go to the FEJF Task Teams, then Fire Tracking Systems.

Non-Burning Management Alternatives on Agricultural Lands in the Western United States
Go to FEJF Task Teams, then Non-Burning Alternatives on Agricultural Lands.

WRAP Report: Integrated Assessment Update and 2018 Emissions Inventory for Prescribed Fire, Wildfire and Agricultural Burning (DRAFT).
Go to FEJF Task Teams, then Emissions.

WRAP Charter
Go to About, the to Charter.

Class I Area Map
Go to About, then the WRAP Map.

Appendix C
Annual Emission Goal Implementation Guidance

1. Applicability

As this Policy builds on the WRAP Fire Categorization Policy, the scope and applicability in regard to the "anthropogenic" or "natural" classifications defined by the WRAP Fire Categorization Policy is clarified below. Those interested should consult the WRAP Fire Categorization Policy for further detail.

Fire Categories[36]	WRAP AEG Policy Applicability
"Natural" Sources	
• Wildfire	Exempted by Rule
• Prescribed fire (including WFU) used for ecosystem maintenance purposes	Covered
• Native American cultural burning for traditional, religious, and ceremonial purposes	Covered
"Anthropogenic" Sources	
• Prescribed fire (including WFU) used for any purpose except ecosystem maintenance	Covered
Other Sources	
▪ Native American cultural non-vegetative burning	Not Covered
▪ Other open burning activities	Not Covered

2. Regional Haze Implementation Plans

2.1 Section 308/309 Requirements

It is anticipated that annual emission goals will be incorporated into the Section 309 implementation plans submitted to EPA in order to meet the requirements of the Rule. States/tribes complying with Section 309 are required to have a regional haze implementation plan that addresses the 16 mandatory Federal Class I areas of the Colorado Plateau submitted by December 31, 2003, with implementation of certain control measures, including annual emission goals, by the following year. All other mandatory Federal Class I areas in the GCVTC transport region will be addressed by 2008 under the Section 308 or 309 implementation plan schedule.

[36] WRAP Fire Categorization Policy, p.8.

Although Section 309 of the Rule specifically requires the establishment of annual emission goals for fire, the methods that are promoted in this Policy could be considered by states/tribes that choose to follow the requirements of Section 308 of the Rule as a viable means to control fire emissions.

The Rule requires under Section 309 that annual emission goals for fire (excluding wildfire) be established through 2018 as a means for demonstrating reasonable progress requirements.[37] The WRAP considers this approach to have merit beyond 2018.[38] Section 309 states may need to consider developing further contingency measures, e.g., a regional application of annual emission goals, in their implementation plans if the annual emission goals do not adequately minimize emission increases from fire. The annual emission goal approach is a viable strategy to control fire emissions and, thereby, make reasonable progress toward the attainment of natural conditions by 2064, as required by the Rule.

2.2 Submission of Periodic Reports

Beginning in 2008, states are required by the Rule to submit periodic reports to the EPA to assess the adequacy of its implementation plan, including assessing the adequacy of certain elements, such as the annual emission goals. These periodic reports are due every five years. If the state determines that the implementation plan is or may be inadequate to meet reasonable progress goals, the state is required to develop additional strategies to address deficiencies in the plan. These strategies are then submitted to EPA for approval.

3. Use of ERTs

ERTs are proven to be effective methods to control fire emissions and are applied in different ways by regulatory authorities. For example, some regulatory authorities promote the use of ERTs as part of a voluntary management program while others enforce the use of ERTs through rule making. For example, the California Agricultural Burning Guidelines enforce the use of ERTs by specifying requirements for the burning of rice, barley, oat, and wheat straw. The Guidelines require the use of a "crackle test" to determine if the fuel is dry enough to burn. In the state of Washington, wildland land managers are encouraged to use techniques, such as fans, crane piling, mass ignition, accelerated mop-up, and other methods of increasing combustion efficiency and reducing the smoldering stage of burning.

Although a few states in the WRAP region do promote or require the use of ERTs and specify burning conditions that must be met in order to burn, currently no systems are in place to track the emissions averted from the application of such methods across all fire source sectors. Currently programs do exist in some areas for tracking of emissions averted through the use of ERTs for wildland prescribed fires.

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[37] 64 FR 35771 §51.309 (d)(6)(v).

[38] WRAP Initiatives Oversight Committee (IOC), Transmittal Letter, November 15, 2001, Appendix C of the WRAP Fire Categorization Policy.

The following paragraphs provide a summary of some of the current efforts by regulatory entities to use ERTs as a means to reduce emissions from prescribed fire and agricultural burning.

3.1 California

Title 17 of the California Code of Regulations requires district smoke management programs to include general burning requirements for agricultural burning, prescribed burning, and prescribed fires in wildland and wildland/urban interface areas. In addition to the general requirements, the law includes specific requirements for rice, barley, oat, and wheat straw, such as certain firing techniques and specific burning windows. There are also specific fuel moisture burning requirements for rice straw burning.

3.2 Oregon

In Oregon the rules for agricultural burning include, but are not limited to, measures to ensure that crop residues are evenly distributed and in good burning condition, rapid ignition techniques are employed, and alternatives to open burning of fields are considered. For prescribed fires on wildlands, the Oregon Smoke Management Program requires land managers to consider utilization of residue, fuel reduction measures, alternate treatment practices, and reduction of prescribed burning emissions to achieve emissions reduction goals established within the Oregon Visibility Protection Plan. Burning during the spring when the 1000-hour and larger fuels have high fuel moisture is promoted. Post-burn reports require the tracking of fuel moisture content, ignition method, and other information to support calculation of ERT use.

3.3 Washington

In Washington, wildland land managers are encouraged to use techniques, such as fans, crane piling, mass ignition, accelerated mop-up, and other methods of increasing combustion efficiency and reducing the smoldering stage of burning. No tracking of specific ERTs is required. The Washington Smoke Management Plan for silvicultural burning does establish a tracking system to measure progress toward specific emission reduction targets. Burn days and specific burning conditions are established by the Department of Ecology for agricultural burning and a permitting system is in place.

3.4 Utah

Agricultural burning is not regulated by the State of Utah. However, counties require such burns to be conducted during optimal dispersion conditions. State air quality regulations require wildland land managers to take measures to prevent smoke impacts. State law requires identification of best management practices including the use of ERTs. Land managers are required to identify the techniques that are employed in addition to fuel moisture and ignition method in their daily emissions report.

4. Establishment of Annual Emission Goals

4.1 Current ERT Application

Research has shown that ERTs can result in emission reductions, which, in turn, reduce smoke impacts on air quality. According to the National Wildfire Coordination Group's (NWCG) *Smoke Management Guide for Prescribed and Wildland Fire*, methods used to reduce emissions generated from prescribed burning on wildlands are: reducing the area burned, reducing fuel loading, reducing fuel production, reducing fuel consumed, scheduling burning before new fuels appear, and increasing combustion efficiency.[39]

EPA's *Prescribed Burning Background Document and Technical Information Document for Prescribed Burning Best Available Control Measures* states that the methods for reducing the amount of emissions generated from agricultural burning include: reducing the acres burned annually, altering the fuel distribution, improving firing techniques, and burning under optimum fuel moisture.[40]

4.2 Non-burning Alternatives and Annual Emission Goals

Annual emission goals, under this Policy, are established annually and apply to the upcoming year's projects where fire has been previously determined as the best tool for meeting specific land management objectives. Therefore, this Policy makes a distinction between those ERTs that are used *with* fire and those techniques that *replace* fire (i.e., non-burning alternatives, sometimes grouped with ERTs).[41] For public lands, non-burning alternatives that replace fire are typically considered in long-term programmatic plans and do not coincide with annual operational plans for fire projects. By the time the project plan is being implemented, the decision to use fire as a tool to meet the land management objective has been made.

Land management decisions for federal land managers and possibly other land managers are made years in advance of actual project implementation and for multi-year periods, under long-term land management plans or project plans. These plans, and the supporting NEPA analyses, are the process under which alternatives to burning and levels of management application of fire are established. This land management decision process is on a different temporal/spatial scale from project level operations. In addition, the decision by federal land managers to replace fire is based on other environmental considerations that cannot be adequately addressed on an operational basis, which is the focus of the application of ERTs for annual emission goals, as defined by the Policy. Although specific projects may also go through a NEPA analysis during which non-burning alternatives may

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[39] NWCG's Smoke Management Guide For Prescribed And Wildland Fire, 2001 Edition (hereafter referred to as "2001 Smoke Management Guide"), pages 143-151.

[40] EPA's Prescribed Burning Background Document and Technical Information Document for Prescribed Burning Best Available Control Measures, September 1992, (hereafter referred to as "EPA's BACM Document"), p. 9-13.

[41] See the Glossary in Appendix A for the definition of non-burning alternatives as used in this Policy. This definition is not meant to contradict EPA's as described in its BACM Document, but rather refers to the application of non-burning alternatives specific to annual emission goals, as defined in this Policy.

be assessed, again, these are typically done well in advance of the operational effort.

In distinguishing between ERTs used on fire projects and non-burning alternatives used to replace fire on other land management projects, it is the WRAP's intent only to clarify the application of ERTs as the basis for annual emission goals. The WRAP supports efforts to utilize alternatives to burning (such as collection and removal of residue for use offsite with no subsequent on-site burning) in land management and fire management plans or other equivalent long-term plans. The use of non-burning alternatives is one of the key elements of the enhanced smoke management program as defined by the WRAP ESMP Policy. Further, the WRAP encourages each state/tribe to work cooperatively with land managers to develop ways to identify, implement, and track all feasible non-burning alternatives.[42]

Several guidance documents provide information on the use of various types of non-burning alternatives that could be used by land managers. WRAP's 2001 *Non-Burning Management Alternatives on Agricultural Lands in the Western United States* identifies potential non-burning management alternatives for agricultural burning including methods for assessing the impacts of alternatives. The WRAP's draft *Comprehensive Manual on Non-Burning Alternatives* provides a catalogue of alternatives to prescribed burning on wildlands, including a risk versus benefit decision-making process related to the use of alternatives. Although these guidance documents are useful for identifying non-burning alternatives, methods for calculating the benefits of using non-burning alternatives are not universally available for the WRAP region.

4.3 Determination of Appropriate ERTs

The opportunity for the application of ERTs varies greatly. The 2001 Smoke Management Guide states, "ERTs vary widely in their applicability and effectiveness by vegetation type, burning objective, region of the country, and whether fuels are natural or activity-generated."[43]

For example, a maintenance burn in a brush vegetative type within a wilderness area may have virtually no options for ERT application. Alternatively, multiple ERTs may be applicable in a ponderosa pine vegetation type where activity such as logging or thinning has occurred. The applicability of a particular technique or practice will depend, in part, on the objectives of that burn. For example, the objective of a prescribed burn on wildlands may be to create open space for wildlife. A backing fire, which is a firing technique that is used to reduce the amount of emissions generated, may not produce sufficient fire characteristics to achieve the management objective.

It is important to note that while ERTs offer an excellent tool for meeting goals for visibility protection, ERTs may cause negative effects such as soil compaction, nutrient loss, and impaired water quality on other valuable resources. Therefore, it is imperative that ERTs are used carefully, and that land managers and air regulators are provided the information and training necessary to make informed decisions.

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[42] See the WRAP Policy on Fire Tracking Systems.

[43] 2001 Smoke Management Guide, p. 141.

4.4 Feasibility Criteria

The use of ERTs should be based on economic, safety, technical and environmental feasibility criteria, as well as land management objectives. The WRAP recommends that education and training are also included as feasibility criteria. It is imperative that education and training are provided to ensure that ERTs are used appropriately. All of the above criteria will affect the application of certain ERTs for vegetation or crop types, burning objectives, and area in the WRAP region.

Examples of how to apply the feasibility criteria are listed below.

Economic: What are the economic costs of applying a certain ERT? Is a specific ERT more economical than others? Any ERT that significantly reduces crop yields or exceeds the cost of a crop is not likely to be accepted by farmers or growers. The same concern is relevant to the application of ERTs on wildlands.

Safety: Are certain ERTs not feasible due to public and firefighter safety concerns? Are certain ERTs not feasible due to concerns related to containment of the fire, i.e., keeping the fire within certain boundaries? Do certain ERTs minimize the possibility of nuisance and hazard smoke?

Technical: Are the equipment and resources available to utilize a specific ERT? Are sufficient training programs available in the use of ERTs for the land managers?

Environmental: Are there specific air quality and non-air quality environmental limitations (e.g., vegetation/crop type, fire type, time of year, area in WRAP region, soil compaction, water quality, etc.) that influence the use of certain ERTs?

Land Management Objectives: Is a certain ERT not feasible due to conflicts with land management objectives? Do certain ERTs maximize the likelihood of achieving the land management objective of the burn?

4.5 Existing Guidance Documents

Several guidance documents provide information on the use and effectiveness of various types of ERTs that could be used by land managers to control fire emissions and reduce smoke impacts. EPA's BACM Document, the 2001 Smoke Management Guide, and the GCVTC's Fire Emission Project[44] are three examples.

EPA's BACM Document provides information on ERTs for both wildland and agricultural burning. The BACM Document is one of the best comprehensive references on potential ERTs for agricultural burning. Most of the WRAP states do not have agricultural smoke management programs, so the demand for additional research is minimal. Once agricultural smoke management programs are developed, further research on common ERTs for agricultural burning applications may be available.

[44] WRAP Report: Integrated Assessment Update and 2018 Emissions Inventory for Prescribed Fire, Wildfire and Agricultural Burning (DRAFT), Appendix A, pp. 61-96.

The 2001 Smoke Management Guide presents information on the use and effectiveness of ERTs, frequency of specific ERT usage, and qualitative assessment of emission reductions achieved through the use of ERTs. The majority of the information presented in the Guide was gathered from fire practitioners at three national workshops held during the fall of 1999. Much of the research into ERTs and subsequent emissions benefits for wildlands, such as the Consume software program,[45] has been conducted in the Pacific Northwest, although the general principles are applicable elsewhere in the WRAP Region.

The GCVTC's Fire Emission Project assessed the potential application of ERTs by wildland vegetation type and fire type on a region-wide basis. Included in the assessment was percentage of feasible use of ERTs for these wildland vegetation and fire types, with the emissions reduced as a result of the use of ERTs also evaluated.

4.6 Research Needs

ERTs have been proven to reduce fire emissions through documented research, but more research is needed to make them a more quantifiable tool for land managers. The 1999 Air Quality Policy on Agricultural Burning emphasized this fact by stating, "Emission reduction technology to reduce the impact of pollutants emitted from agricultural burning on ambient concentrations is needed".[46]

The identification of common ERTs for agricultural burning is a difficult task since most of the WRAP states do not have smoke management programs to address agricultural burning, and therefore the demand for such information is not great. Information regarding availability, applicability, and cost effectiveness of ERTs can be found in various research documents, but a comprehensive guide does not currently exist.

The research on ERTs for wildland fire was predominantly conducted in the Pacific Northwest. Although the general principles are applicable elsewhere in the WRAP Region, more research is needed on ERTs for wildland fire, with emphasis placed on vegetation types located outside of the Pacific Northwest.

4.7 Calculation of Averted Emissions

According to the 2001 Smoke Management Guide, "The overall potential for emission reductions from prescribed fire depends on the frequency of use of emission reduction techniques and the amount of emission reduction that each method offers."[47] Therefore, in order to determine the potential for emission reductions from prescribed fire, land managers will need to calculate the specific amount of emission reduction that each method offers. Consume 2.1, a fuel consumption and emissions model, can be used to estimate potential emission reductions that may be achieved by

[45] Pacific Northwest Research Station, Forestry Sciences Laboratory, Consume Software, Version 2.1.

[46] Agricultural Air Quality Task Force's (AAQTF) Air Quality Policy on Agricultural Burning, Recommendation to the U.S. Department of Agriculture, November 10, 1999.

[47] 2001 Smoke Management Guide, p. 152.

employing certain ERTs.[48]

The WRAP recognizes the need for a more comprehensive guide for estimating potential emission reductions achieved through the use of ERTs for agricultural burning and wildland fire. This guidance will be developed by the WRAP in a similar format to that of Appendix D to support states' and tribes' use of annual emission goals. Appendix D provides a table that lists ERT options that can be applied by land managers and the corresponding emissions averted by using a particular ERT.

The 2001 Smoke Management Guide contains several tables that may be useful to states/tribes in order to establish annual emission goals. The tables include information on the frequency of use of specific ERTs by region of the country, the general effectiveness of specific ERTs, the significant constraints limiting the wider application of ERTs, and the potential emission reductions that may be achieved by employing various ERTs as estimated by Consume 2.1. There are some limitations to the information contained in the 2001 Smoke Management Guide, as some vegetation types that are found in the WRAP region are not included.

These tables should be utilized with the understanding that the effectiveness of a particular ERT may vary considerably. Considering all burning nationally, if ERTs were optimally used, emissions could probably be reduced by approximately 20-25 percent assuming all other factors (vegetation types, acres, etc.) were held constant and land management goals were still met.[49] Individual states/tribes or regions may be able to achieve greater emission reductions than this or much less depending on the states' or regions' individual situations.

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[48] Ottmar, Roger D.; Reinhardt, Timothy E.; Anderson, Gary; DeHerrera, Paul J. Consume 2.1 User's Guide. Gen. Tech. Rep. PNW-GTRxxx. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station.

[49] J. Peterson and B. Leenhouts, "What Wildland Fire Conditions Minimize Emissions and Hazardous Air Pollutants and Can Land Management Goals Still Be Met?" (Draft), August 20, 1997.

APPENDIX D
Example of ERT & Associated Emission Averted Table
(This example demonstrates the future guidance that will be issued by the FEJF.)

ERT Category	Practice	Treatment	Size Class	Vegetation Type	Smolder	Equation	Reduction Factor
Increased Combustion Efficiency	Backing Fires	First Entry	All	Ponderosa Pine	N/A	ERT Emissions = Total Emissions x 0.9	0.1
			All	Pinyon/Juniper Woodland, Oak Brush, Sage, Desert Shrub, Annual Grass, Perennial Grass	N/A	ERT Emissions = Total Emissions x 0.9	0.1
		Maintenance	All	Ponderosa Pine, Pinyon/Juniper, Woodland, Oak Brush, Sage, Desert Shrub, Annual Grass, Perennial Grass	N/A	ERT Emissions = Total Emissions x 0.9	0.1

REGIONAL HAZE STATE IMPLEMENTATION PLAN FOR THE STATE OF ARIZONA

APPENDICES - VOLUME III

Appendix A-12 through Appendix A-18

Air Quality Division
Arizona Department of Environmental Quality

LIST OF APPENDICES

APPENDIX VOLUME I

LIST OF APPENDICES (Cont.)

APPENDIX VOLUME II

LIST OF APPENDICES (Cont.)

APPENDIX VOLUME III

<u>APPENDIX A-12. POLLUTION PREVENTION</u>

This appendix contains work products and references relied upon by Arizona in the development of Chapter 12 of the Regional Haze SIP.

Appendix A-12a. Arizona Pollution Prevention Work Group Review of WRAP Policy on Renewable Energy and Energy Conservation

November 13, 2002

Jeff Burks
Utah Energy Office
Department of Natural Resources
1594 W. North Temple
Box 146480
Salt Lake City, UT 84114

R.T. "Hap" Boyd
GE Wind Energy
444 S. Flower Street, Suite 4545
Los Angeles, CA 98071

Dear Jeff and Hap:

The Arizona Regional Haze Pollution Prevention Workgroup (P2WG) would like to provide the following comments on the WRAP's Air Pollution Prevention Forum's renewable energy report, "Recommendations of Air Pollution Prevention Forum to Increase the Generation of Electricity from Renewable Resources." Items 1 – 10, below, are fairly general in nature and relate to the body of the Report. We have also included an attachment of comments that relate specifically to the Report's Appendix A for Arizona.

The P2WG was very impressed with the report. The group greatly appreciated the wealth of information contained in the report and the fact that the report was one of the few that quantifies the costs and benefits of renewable energy. This type of information will be very useful to agencies promoting the use of renewable energy.

We do have a few specific comments and suggestions.

1. The report should include a statement or paragraph that certain economic factors referenced in the report (e.g., financial impact of incorporating various recommendations, differential costs of renewable energy) corresponding to a particular state could be significantly different from the regional estimates identified in the report. Adding an explanation in the report to clarify that the numbers are based on regional averages and must be tailored to each state for specific use would prevent confusion and erroneous expectations.

2. The Executive Summary should clarify that it will be difficult to meet the 10/20 goals. Although such a statement is included on the bottom of page ii ("The 10/20 goals are ambitious by any standard."), it would be helpful to have an expanded explanation that the Regional Haze Rule has established the 10/20 goals as just that – goals. What is expected is a full and reasonable attempt to attain the goals and, if the goals aren't met, an explanation of strategies used to make progress towards the goals. In addition, each state will be unique in its ability to meet or make progress towards the goals.
3. Page III-4: Arizona has adopted a Renewable Portfolio Standard, ACC R14-2-1618.
4. Page IV-1: The Wisconsin report analysis numbers seem very generous, and the report does not have a reference for the cited figures. It would be helpful to add a citation for the Wisconsin report.
5. There appear to be inconsistencies about the cost of state agency renewable purchase requirement. Page III-17 of the report states a total cost of a 10% renewable purchase requirement at $4.2 million, based on an incremental cost of 1.5 cents/kWh and an additional demand for 280,000 MWh. Page IV-15 makes a similar calculation and arrives at a cost of $37.5 million based on an incremental cost of 2.5 cents/kWh and an additional demand for 600,000 MWh.
6. The report states different incremental costs for renewable energy in different places. It would be helpful to achieve consistency whenever possible and to explain any remaining differences. In addition the report should provide a source, evaluation, or other justification for incremental costs presented and qualify that the costs are based on a regional average. The incremental cost for renewable energy for a particular state may vary significantly from the regional average.
7. The report appears to assume new natural gas or combined cycle is being replaced, but that may not be the case.
8. Pages IV-11, 12: The report proposes that a state's contribution to the regional goal should be based on that state's energy consumption. This could be problematic for Arizona in that it could require us to rely on out-of-state renewable resources to meet that goal, which would dilute the state's investment in its most abundant resource, solar energy. The report should clarify that there are other feasible approaches.
9. Page IV-13: Principal 1 appears to be saying that the majority of State and Federal financial incentives should be directed at landfill gas, low-impact hydro and wind, and only a small percentage should be directed at solar. This could put our State at an economic disadvantage, as solar is our most abundant renewable resource. An alternative to this principle is that states should direct the majority of their financial incentives toward the resources that are viable and most abundant in that

state, thereby creating a greater diversity of renewable energy resources throughout the region.

10. Page I-14 says renewables will probably "supplant new gas fired generation." In many cases, renewables may supplant the oldest and least efficient peaking power plants.

Thank you for the opportunity to comment on the report.

Sincerely,

Ursula Kramer
Director, PDEQ

cc: Lee Alter, Western Governors' Association
Richard Tobin, II, Acting Director, ADEQ

Appendix Comments

Page I-14 states that renewable electricity will probably "supplant new gas-fired generation." While this is generally true, during peak hours of the summer in Arizona, renewables, such as solar, that are operating during peak times (generally from 3 PM to 7 PM) will often supplant the use of the oldest and least efficient gas combustion turbines. These older peakers are much more polluting than the new combined cycle gas units and their delivered costs per kWh are extremely high, due to their inefficiency and relatively few hours of operation each year. It is important to recognize this fact when calculating pollution abatement and the cost differential between renewables and the older peakers. Some of the old peakers produce electricity in a cost range that can be equal to or higher than many renewable resource costs.

The following comments relate specifically to the Arizona summary in Appendix A.

The Arizona Environmental Portfolio Standard was adopted after the date of the Draft Report. The following wording is suggested to replace the paragraph in the Draft Report:

Environmental Portfolio Standard

"In March 2001, the Arizona Corporation Commission approved rules implementing the Environmental Portfolio Standard, ACC R14-2-1618. The standard requires a minimum percentage of retail electricity sales to be from eligible solar electric or "environmentally friendly renewable electricity technologies." The standard began with .2% in 2001 and rises to 1.1% in 2007. At least 50% of the portfolio standard must be solar electric in early years, increasing to 60% solar electric in 2004."

Further information can be found at http://www.cc.state.az.us/utility/electric/R14-2-1618.htm

The following is an update for the various incentive programs offered in Arizona:

Arizona Public Service Projects

APS - Remote Solar Electric Services:
The Remote Solar Electric Services program was created by Arizona Public Service (APS) in 1997. It is designed to provide solar power to off-grid residential customers (those located more than one-third mile from power lines). APS stand-alone systems are available for purchase and include photovoltaic (PV) panels, 120/240 VAC electronic power conditioning equipment, a battery bank that stores electricity for use at night, and a backup propane generator for extra power when needed. APS service and maintenance can be purchased for an additional annual fee.

APS - Solar Partners Plus - EPS Credit Purchase Program
Arizona Public Service (APS) offers customers who install photovoltaic systems the opportunity to sell the credits associated with the energy generated by these systems to APS. These energy credits will be used to meet APS Environmental Portfolio Standards (EPS)

requirements. Through the EPS Credit Purchase Program, participating customers receive a one-time EPS Energy Purchase Credit of $2.00 per watt of DC electricity (based on the manufacturer's rating) for purchasing and installing a photovoltaic system capable of producing 5 kilowatts or less.

For grid-tied systems rated at 5 kW or less:

?? Customers must purchase a new photovoltaic solar system rated at 5 kW or less.
?? Installations must meet APS interconnection requirements.
?? Customers must sign an interconnection agreement with APS.
?? The system must use UL-rated components and meet IEEE 929 specifications.
?? A licensed contractor must install the system.
?? The system generation must be metered separately and the kWh credits may, at APS' option, be recorded annually.
?? The meter (not provided by APS) must be placed adjacent to the existing meter and marked "solar meter".

For remote systems rated at 5 kW or less:

?? The system must use UL components and meet IEEE 929 specifications.
?? A licensed contractor must install the system.

APS Solar Partner Green Power Program

In 1997, the City of Scottsdale joined the Arizona Public Service (APS) Solar Partners Program. At that time, the available role for the City was to provide facilities or land where APS, at no charge to them and no cost to the City, could install solar power generating systems. The solar power generated from these systems is added to the power grid where it became available for Scottsdale residents who subscribe to the Solar Partners Program. The first system installed was an 8,000 square-foot, 34-kW PV roofing system on employee parking lot carports at the City's Via Linda Campus. The Civic Center Library and Mustang Library are each host to a 2-kW PV system. The Water Campus system is comprised of two 150-kW single access tracking systems mounted on water storage reservoirs. The Water Campus system is the largest system of its type in the United States and is the first solar installation on a reservoir.

APS expanded the Solar Partners Program to enable commercial enterprises and those partners whose facilities included APS solar power generating installations to purchase a portion of the solar power they generated. In June 2000, Scottsdale began an annual purchase of 40,500 kWh of solar energy for its Civic Center and Mustang Libraries. Other partners include KNXV TV (34,200 kWh annually) and ST Micro (36,000 kWh annually and who has hosted a 20kW installation at their Phoenix plant).

Net Metering

In 1981, the ACC adopted a net metering rule (Decision No. 52345) requiring the state's regulated utilities to offer net metering for renewable and cogeneration resources with a capacity of 100 kilowatts or less. Excess electricity generated by the system is purchased at each utility's avoided cost.

No Arizona utility filed a net metering tariff until Arizona Public Service (APS) company filed in 1994 to allow net metering of all renewable energy generators under 10 kW. Net excess generation under the APS tariff is purchased at the utility's avoided cost. Tucson Electric Power Company (TEP) filed two net metering tariffs in 1996. The first is Tariff 101 applying to commercial customers, and Tariff 102 applies to all other customers. Under both tariffs, net metering is allowed for QFs 100 kW or smaller. Net excess generation is purchased at fixed seasonal rates. Commercial customers may receive 4.4¢/kWh May through October and 3.5¢/kWh for November through April. All other customers receive 4.84¢/kWh May through October and 3.85¢/kWh November through April.

Tucson Electric Power Projects

Tucson - Solar Dividend
The City of Tucson has implemented a Solar Dividend investment policy in which the rate savings from restructuring are converted into a budget line item for solar energy investment for the municipality. Implemented in fiscal 2000, the policy will be in effect for five years.

For further information, refer to http://www.aps.com/my_community/solar_main.html.

TEP GreenWatts:
Launched in January 2000, GreenWatts is a TEP program that enables supporters to invest directly in the creation of "Green" power. For each GreenWatt that a customer adopts, Tucson Electric Power (TEP) will generate 20-kilowatt hours per month from renewable energy resources. The first GreenWatt is $2.00 and each additional GreenWatt is $1.50. This amount appears as a line item on a customer's monthly statement. Every ten GreenWatts that are adopted save a ton of coal per year from being used and encourages environmental conservation in Southern Arizona. One hundred percent of the dollars raised go directly to building and maintaining renewable facilities in Arizona. The supply of GreenWatts is limited by the amount of "green" energy TEP produces.

TEP SunShare:
Launched in 2002, TEP's SunShare program is designed to encourage customers to install new photovoltaic equipment at their residence or business. TEP currently offers two options for those who are interested in investing in solar. SunShare, option #1, requires that customers provide their own photovoltaic equipment while SunShare Kit, option #2, requires that customers purchase the solar equipment from TEP.

Under the SunShare programs, systems of 1 kW to 5kW are eligible. The customer may either purchase a qualifying system 1 kW or larger from a third party or may purchase a 1-kW or 5-kW system kit from TEP.

Under SunShare, option #1, TEP will credit the customer $2,000 per AC kW of proven, installed solar generating capacity. Under the SunShare Kit, option #2, TEP will credit the customer $2,000 for the 1 kW system and up to $10,000 for the 5 kW system. The kit includes panels, inverter, supports, meter, and meter socket. The retail cost for a 1 kW solar kit is approximately $9,000 plus installation costs. However, a kit purchased from TEP will cost $4000 after the $2000 credit. TEP also offers a net metering option which credits the customer with the energy sent into the grid on a kWh basis.

To qualify for the buy down program, participants must: 1) be a customer of TEP; 2) have at least 550-sq. ft. of unobstructed space; 3) have a roof facing true south; 4) be within 100 ft of where tying to the grid; and 5) have a roof that can accommodate panels at a 32-degree angle. Installations must have been made after January 1, 1997. Annual inspections and maintenance labor for repairs will be provided by TEP. The PV equipment must meet TEP and Arizona Corporation Commission requirements for self-generation equipment.

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Solar and Wind Energy Systems Tax Credit, ACC R14-2-1618:

Provides a personal income tax credit of 25% of the cost of a solar or wind energy device. A credit of up to $1,000 can be claimed the year the system is installed. If the credit exceeds a taxpayer's liability in that year, the unused portion of the credit may be carried forward for up to five years. A taxpayer may claim the credit under this section only once in a tax year and may not accumulate over different tax years tax credits under this section exceeding, in the aggregate, one thousand dollars for the same residence. Qualifying technologies include passive solar heating, active solar space heating, solar water heating, photovoltaics, and wind systems. Passive systems shall clearly be designed as a solar energy device, such as a trombe wall, and not merely as a part of a normal structure, such as a window.

Solar and Wind Energy Equipment Tax Exemption:

Provides a sales tax exemption to retail businesses of up to $5,000 for solar and wind energy equipment. Qualifying equipment includes passive solar heating, active solar space heating, solar water heating, photovoltaics, wind electric generators, and wind-powered water pumps. Passive systems shall clearly be designed as a solar energy device, such as a trombe wall, and not merely as a part of a normal structure, such as a window. Before deducting any amount under this exemption, the retailer shall register with the department as a solar energy retailer. By registering, the retailer acknowledges that it will make its books and records relating to sales of solar energy devices available to the department for examination.

The following is a fact sheet from Salt River Project's Environmental Initiative:

Salt River Project's
Environmental Initiative

In February 2000, SRP initiated a four-year, $29 million program to fund a renewable energy program. This significant investment in the future was made without raising the standard electricity rates of SRP customers. SRP is taking steps to establish renewable energy programs that help protect the environment and provide reassurance for today's families and future generations.

Assessing Clean Technologies
EarthWise Energy is the first green power program in Arizona that offers a diverse mix of local renewable energy sources. Participating SRP customers make a small additional payment on their monthly electric bill to help support our effort to build, operate and maintain new renewable electric generating stations. These new facilities will further improve the quality of the air in the Salt River Valley and reduce our dependence on non-renewable fuels.

EarthWise Energy uses a variety of "clean" technologies to achieve the greatest cost effectiveness and environmental benefits for SRP and its customers.
Under this new program, we have completed a 200-kilowatt solar power plant in Glendale and are pursuing other opportunities for solar generation. We have also installed a 4,000-kilowatt (four megawatt) generation facility on the Salt River Pima Maricopa Indian Community that uses landfill gas from the Tri-Cities Landfill. This plant will produce enough electricity to power 2000 homes for one year. By capturing this naturally occurring gas and converting it to energy, we are improving community safety and the environment (methane is explosive and is a suspected global warming agent).

SRP's newest project, Arizona Falls, is a low impact hydro facility located on a canal at 56th Street and Indian School in Phoenix. The power of the 20-foot drop in elevation in the canal will be used to generate 750-kilowatts of clean energy.

Implementing The Program
SRP established an operations committee to implement the renewable energy program. The committee is responsible for program design, implementation, budget, administration, management and measurement.

The program will proceed with these goals:
?? Develop a market for renewable and sustainable energy sources.
?? Demonstrate the ability of renewable technologies to improve air quality.
?? Build community and public relationships to showcase renewable energy technologies.
?? Establish SRP as a national leader in renewable energy.
?? Demonstrate fiscal stewardship.

Involving The Public

In addition to encouraging customers to participate in the program, we have formed a Customer Support Group to help us with program development and evaluation, and to assist in communicating program messages to the community.
This committee consists of 30 residential, commercial and industrial customers, educators, media representatives, elected officials and government officials.
We have also formed a Technical Advisory Committee of industry experts to review and evaluate new and existing renewable technologies, and to provide technical expertise in our program development.

Through a public process, SRP will review the program during its fourth year to determine if the stated goals were met and the future direction of its renewable energy activities.

More than 3,000 residential customers participate in the program by paying an additional $3/per month for a 100-kwh block of energy. In addition, 45 small commercial customers participate in this program, and a new large governmental customer, Maricopa County is purchasing the largest amount of green energy in the state.

<u>Appendix A-12b. Details of Renewable Energy Generation and Capacity</u>

Appendix A-12b. Details of Renewable Energy Generation and Capacity

Pursuant to 51 CFR 309 (d) (8) (i), The Table below summarizes all renewable energy generation capacity and production in use or planned as of 2002.

Project #	SYSTEM	Year Installed	2002 kW	Planned kW	KWh in 2002	Source
Solar	**APS Installations**					
	Flagstaff 82 kW	1997	80	80	168,026	1
	Rooftop Demos	1997	4	4	7,560	1
	RSES	1997	6	6	11,340	1
	Ocotillo #1	1998	80	80	167,980	1
	RSES	1998	7	7	13,230	1
	Ocotillo #2	1999	93	93	195,447	1
	San Luis	1999	2	2	3,780	1
	Deer Valley School	1999	4	4	7,560	1
	Gilbert High School	1999	2	2	3,780	1
	NAU	1999	2	2	3,780	1
	Scottsdale Library	1999	2	2	3,780	1
	Tempe Recycling	1999	2	2	3,780	1
	Scottsdale Parking	1999	34	34	0	1
	Glendale #1	1999	78	78	156,897	1
	STAR Parking	1999	4	4	5,058	1
	STAR Dishes	1999	40	40	301	1
	RSES	1999	19	19	35,910	1
	STAR Amonix - 2, 3, 4	2000	60	60	116,905	1
	ST Micro	2000	22	22	32,260	1
	SOL	2000	10	10	18,900	1
	RSES	2000	5.5	5.5	10,395	1
	Gilbert	2001	122	122	257,760	1
	Glendale #2	2001	100	100	178,508	1
	Prescott	2001	194	194	445,920	1
	STAR Tilted Trackers	2001	60	60	125,191	1
	STAR Amonix - 1, 5, 7	2001	75	75	141,897	1
	RSES	2001	14.6	14.6	27,518	1
	Yucca	2002	103	103	222,640	1
	Ocotillo East Yard	2002	125	125	129,200	1
	Mustang Library - Scottsdale	2002	2	2	1,890	1
	Ocotillo Parking	2002	20	20	23,276	1
	Gray Wolf Landfill	2002	24	24	911	1
	Scottsdale Water #1	2002	131	131	206,800	1
	Scottsdale Water #2	2002	125	125	193,440	1
	ADEQ Parking Canopy	2002	127	127	0	1
	STAR Amonix - 6	2002	35	35	5,672	1

	Prescott Airport	2002	734	734	30,310	1
	RSES	2002	8.32	8.32	7,862	1
	TOTAL		**2,556**	**2,556**	**2,965,465**	
Solar	**Tucson Electric Power**					
	Habitat Home	1999	0.75	0.75	2,783	2
	Reid Park Zoo	2000	0.84	0.84	3,661	2
	Pima Air Museum	2000	0.9	0.9	2,660	2
	Stafford Middle School	2000	4.5	4.5	17,684	2
	U of A agricultural Station	1996	5.62	5.62	9,280	2
	Hayden / Udall #1	2002	21.6	21.6	12,092	2
	Hayden / Udall #2	2002	21.6	21.6	12,092	2
	Fort Huachuca	1997	30	30	109,427	2
	Utility TEP Trailers	1998	3.97	3.97	20,771	2
	Gate 2 Solarex Panels	2000	2.31	2.31	11,328	2
	OH3	2000	21.6	21.6	74,778	2
	OH4	2000	21.6	21.6	74,822	2
	Springerville	2000	21.6	21.6	75,715	2
	St. John's Test	2000	1.5	1.5	3,512	2
	DMP1	2000	108	108	345,118	2
	DMP2	2000	108	108	337,002	2
	SGS C1	2001	135	135	293,297	2
	SGS C2	2001	135	135	304,365	2
	SGS C3	2001	135	135	266,390	2
	SGS C4	2001	135	135	256,246	2
	SGS C5	2001	135	135	245,376	2
	SGS C6	2001	135	135	241,712	2
	SGS C7	2002	135	135	93,479	2
	SGS C8	2002	135	135	101,674	2
	SGS C9	2002	135	135	101,757	2
	SGS C10	2002	135	135	70,069	2
	SGS C11	2002	135	135	127,121	2
	SGS C12	2002	135	135	103,941	2
	SGS TF1	2001	135	135	268,258	2
	SGSTF2	2001	135	135	180,655	2
	SGS TF5	2001	129	129	269,654	2
	SGS TF6	2001	129	129	289,309	2
	SGS TF7	2001	129	129	266,225	2
	SGSTF8	2001	129	129	265,986	2
	OH SB/ASE Test	2002	1.1	1.1	2,158	2
	OH Tc/ASE Test	2002	0.8	0.8	1,109	2
	OH/TC/BP Test	2002	1.2	1.2	1,850	2
	Tohono Chul	2002	2.8	2.8	310	2
	Global Solar Test	2002	1.4	1.4	52	2

	BP 1.4 Xtal Test	2002	1.4	1.4	55	2
	SunShare 29 Units	2002	61.3	61.3	41,457	2
	TOTAL		**2,850**	**2,850**	**4,905,230**	
Solar	**Salt River Project**					
	South Mountain Community College	1998	1.8		3,311	5
	Scottsdale Community College	2000	1		1,850	5
	Cesar Chavez High School	2000	1		1,850	5
	Chandler Research House	1997	2.4		4,415	5
	Palomino Residence	1998	1		1,850	5
	Calex Homes Johnson Ranch	2001	1		1,850	5
	Calex Homes Johnson Ranch	2001	0.85		1,564	5
	Calex Homes Johnson Ranch	2001	1		1,850	5
	Calex Homes Johnson Ranch	2001	0.7		1,288	5
	Calex Homes Johnson Ranch	2001	1.4		2,575	5
	Calex Homes Gold Canyon	2002	0.5		920	5
	ASU East	2002	1		1,850	5
	Agua Fria PV	2001	200		431,000	5
	Roger Solar Park PV1 and PV2	2003		200	0	5
	Rogers Solar Park PV3	2003		200	0	5
	Tempe Warehouse	2003		200	0	5
	City of Phoenix Park & Ride	2003		100	0	5
	City of Mesa Red Mountain Branch Library	2003		25	0	5
	TOTAL		**214**	**725**	**456,173**	
Solar	**LAW Fund/Native Sun**					
	2001 Purchases	1997	4.473	4.473	8,454	1
		1998	6.491	6.491	12,268	1
		1999	1.251	1.251	2,364	1
		2000	0.384	0.384	726	1
		2001	0.150	0.150	284	1
	2002 Purchases	1997	4.511	4.511		1
		1998	1.354	1.354		1
		1999	0.128	0.128		1
		2000	0.000	0.000		1
		2001	0.053	0.053		1
		2002	14.270	14.270		1
	TOTAL		**17.260**	**17.260**	**24,096**	
Solar	**Customer Programs**					
	2002 Systems	2002	28.85	28.85	27,263	1
	TOTAL		**28.85**	**28.85**	**27,263**	

Solar	**Yuma Proving Grounds**					
	450 System	1997	450	450	897,000	1
	SWTR Site	1998	105	105	198,450	1
	Signs	1999	0.00	0.00	2	1
	Lights	1999	0.20	0.20	1,752	1
	Jog Path	2000	0.09	0.09	166	1
	TOTAL		**555**	**555**	**1,097,370**	
Solar	**ORC Trough**					
	1MW trough plant	2004			0	1
	TOTAL		**0**	**0**	**0**	
Solar	**IST**					
	Prison Water System	1999			1,104,167	1
	TOTAL		**0**	**0**	**1,104,167**	
Methane						
	TEP Landfill methane	1999	5,500	5,500	45,000,000	1
	Butterfield Landfill Methane	2003		70		1
	Mesa NW Water Treatment Plant					1
	Allied Waste Apache Junction Landfill					1
	Tri-Cities Landfill Generation Plant	2001	4,000	4,000	18,715,000	3
	TOTAL		**9,500**	**9,570**	**63,715,000**	
Wind	**Army Depot (Wind)**					
	Wind Turbine					1
	TOTAL		**0**		**0**	
Wood Chips	**Environmental Forest**					
	Wood chips	2003		3,000	0	1
	TOTAL		**0**	**3,000**	**0**	
Low Impact Hydro	**Salt River Project**					
	Arizona Falls Project	2003		750		3
	Total		**0**	**750**	**0**	

	Sub-Totals			*Existing & Planned*		
	SOLAR		*6,222*	*6,733*	*10,579,764*	
	METHANE		*9,500*	*9,570*	*63,715,000*	
	WIND		*0*	*0*	*0*	
	WOOD CHIPS		*0*	*3,000*	*0*	
	LOW-IMPACT HYDRO		*0*	*750*	*0*	
	TOTAL		**15,722**	**20,053**	**74,294,764**	
Sources						
1	Information from the Arizona Corporation Commission Environmental Portfolio Tracking March 2002.					
2	Information from the Arizona Corporation Commission Environmental Portfolio Tracking March 2002, Tucson Electric Power Photovoltaic Systems Installed and In Service at the End of 2002.					
3	See generally http:///www.srpnet.com/environmental/comparison.asp and linked from that page.					
4	"Overview of SRP'S Renewable Energy Program," Presentation by Herjinder Hawkins to PPWG on March 24, 2003.					
5	Information from Renewable Energy Program files					

<u>Appendix A-12c. ICF Assessment of Renewable Energy and Energy Conservation Programs</u>

REPORT

Economic Assessment of Implementing the 10/20 Goals and Energy Efficiency Recommendations

Prepared for

Western Regional Air Partnership
Air Pollution Prevention Forum

Prepared by

ICF CONSULTING

ICF Consulting Group

October 2002

Preface

Regulatory Framework for Tribal Visibility Implementation Plans

The regional haze rule explicitly recognizes the authority of tribes to implement the provisions of the rule, in accordance with principles of federal Indian law, and as provided by the Clean Air Act §301(d) and the tribal authority rule (TAR) (40 CFR §§49.1– .11). Those provisions create the following framework:

1. Absent special circumstances, reservation lands are not subject to state jurisdiction.
2. Federally recognized tribes may apply for and receive delegation[1] of federal authority to implement CAA programs, including visibility regulation, or "reasonably severable" elements of such programs (40 CFR §§49.3, 49.7). The mechanism for this delegation is a tribal implementation plan (TIP). A reasonably severable element is one that is not integrally related to program elements that are not included in the plan submittal, and is consistent with applicable statutory and regulatory requirements.
3. The regional haze rule expressly provides that tribal visibility programs are "not dependent on the strategies selected by the state or states in which the tribe is located" (64. Fed. Reg. 35756), and that the authority to implement §309 TIPs extends to all tribes within the GCVTC region (40 CFR §51.309(d)(12)).
4. The EPA has indicated that under the TAR tribes are not required to submit §309 TIPs by the end of 2003. Rather, they may choose to opt-in to §309 programs at a later date (67 Fed. Reg. 30439).
5. Where a tribe does not seek delegation through a TIP, EPA, as necessary and appropriate, will promulgate a federal implementation plan (FIP) within reasonable timeframes to protect air quality in Indian country (40 CFR §49.11). EPA is committed to consulting with tribes on a government-to-government basis in developing tribe-specific or generally applicable TIPs where necessary (See, e.g., 63 Fed. Reg. 7263-64).

The amount of modification, if any, needed for this report to fulfill tribal needs may vary considerably from tribe to tribe. The authors have striven to ensure that all references to tribes in the document are consistent with principles of tribal sovereignty and autonomy as reflected in the above framework. Any inconsistency with this framework is strictly inadvertent and not an attempt to impose requirements on tribes which are not present under existing law.

[1] Tribes also possess a more fundamental source of authority to regulate their environments, based on their inherent authority as sovereign nations, which predates the formation of the United States. However, in the context of air pollution regulation and visibility planning in particular, tribal authority will more likely be based on delegation of federal authority.

Tribal Participation in the WRAP

Tribes, along with states and federal agencies, are full partners in the WRAP, having equal representation on the WRAP Board as states. Whether Board members or not, it must be remembered that all tribes are governments, as distinguished from the "stakeholders" (private interest) which participate on Forums and Committees but are not eligible for the Board.

Despite this equality of representation on the Board, tribes are very differently situated than states. There are over four hundred federally-recognized tribes in the WRAP region, including Alaska. The sheer number of tribes makes full participation impossible. Moreover, many tribes are faced with pressing environmental, economic, and social issues, and do not have the resources to participate in an effort such as the WRAP, however important its goals may be. These factors necessarily limit the level of tribal input into and endorsement of WRAP products.

The tribal participants in the WRAP, including Board members Forum and Committee members and co-chairs, make their best effort to ensure that WRAP products are in the best interest of the tribes, the environment, and the public. One interest is to ensure that WRAP policies, as implemented by states and tribes, will not constrain the future options of tribes who are not involved in the WRAP. With these considerations and limitations in mind, the tribal participants have joined the state, federal, and private stakeholder interests in approving this report as a consensus document.

Executive Summary

With a view towards improving visibility and air quality in the national parks and wilderness areas of the Colorado plateau, the Grand Canyon Visibility Transport Commission (GCVTC) issued several recommendations in 1996 on strategies for air pollution prevention. In its recommendations, the GCVTC emphasized the need to integrate air pollution prevention with cost-effective pollution control strategies in order to prevent degradation of natural resources in the West.[1]

Two key recommendations from the GCVTC focused on the development of renewable energy sources and the promotion of energy conservation. Labeled the “10/20 goals”, the recommendation on development of renewable energy sources encouraged states and tribes in the Transport Region to undertake steps that would increase the use of renewable energy to 10 percent of the regional power needs by 2005 and 20 percent of the regional power needs by 2015. For energy conservation, the commission supported the continued development of energy efficiency standards and suggested that the emphasis on energy conservation be maintained within the changing electric power markets. In addition to the 10/20 goals and energy conservation recommendations, the GCVTC suggested that future modeling work be conducted to analyze the potential emission reductions, cost savings and secondary benefits associated with the use of renewable energy, energy efficiency and pollution prevention.

The Regional Haze Rule issued by the US Environmental Protection Agency in April 1999 included the air pollution prevention recommendations of the GCTVC. Under the rule, the states of the Transport Region must include in their State Implementation Plans (SIP) an outline of the programs and policies that each state will rely on to work towards meeting the air pollution prevention recommendations. Tribal governments may seek approval from EPA to incorporate the requirements of the regional haze regulations, including the GCVTC recommendations, in their Tribal Implementation Plans (TIP) under the provisions of the Tribal Authority Rule (TAR).

The Air Pollution Prevention (AP2) forum of WRAP has been charged with implementing the air pollution prevention recommendations of the GCVTC. The AP2 forum commissioned ICF Consulting to analyze the potential emissions reductions, costs and secondary regional economic impacts of meeting the 10/20 goals and energy efficiency recommendations.

This study documents the analytic and technical support to the AP2 forum’s report detailing its recommendations regarding renewable energy and energy efficiency to the WRAP Board. The AP2 forum’s report provides a discussion of the policy imperatives and broader implications of the GCVTC air pollution prevention recommendations, while this report describes the emissions reductions, costs and secondary economic impacts of meeting the 10/20 goals and implementing the energy efficiency recommendations, given the assumptions and scenarios developed by the AP2 forum. The analysis examines the impacts for the nine states and tribal lands of the Transport region and was focused around stationary sources engaged in the production of electricity and

[1] “Recommendations for Improving Western Vistas,” The Grand Canyon Visibility Transport Commission, June 1996, page 28.

industrial steam along with and process-related SO_2 sources such as refineries and smelters.

Analytical Framework

The AP2 forum developed a three-phase analytical framework to assess the potential emissions reduction, costs and secondary regional economic impacts of implementing the 10/20 goals and energy efficiency recommendations. These included: (1) assumptions and scenario development, (2) modeling of the electric, steam and process source sectors, and (3) modeling of the secondary regional economic impacts.

The AP2 forum developed two types of scenarios in order to examine the emissions, costs and secondary regional economic impacts of meeting the 10/20 goals and implementing the energy efficiency recommendations. The first was the Business-As-Usual (BAU) scenario that characterized how the future might unfold with the proposed regional backstop SO_2 trading program but without any policy measures designed to accomplish the 10/20 goals and energy efficiency recommendations. The second set of scenarios reflected a future with the regional backstop SO_2 trading program and policy drivers designed to meet the 10/20 goals or energy efficiency recommendations, or both. Assessments of emissions, costs and secondary regional economic impacts were estimated by analyzing the changes in the policy scenarios relative to the BAU scenario.

The AP2 forum selected as the business-as-usual scenario the Annex cap-and-trade scenario developed by the WRAP/Market Trading Forum (MTF)[2] for its economic analysis, with minor modifications to account for the planned additions to renewable energy capacity. The policy scenarios developed by the AP2 forum were focused around objectives of implementing the 10/20 goals and energy efficiency recommendations with some additional scenarios designed to analyze the sensitivity of the results to higher gas prices and improvements in renewable energy technology cost and performance.

In designing the policy scenarios and in developing the data for those scenarios, the AP2 forum modified some of the assumptions on the cost and performance of renewable energy technologies from those used in the MTF Annex scenario. The AP2 recognized that the 10/20 goals had the potential to not only affect the level of renewable energy generation in the West, but would also had to potential to influence the underlying market conditions for those technologies. Under a climate where policies are in place designed to achieve the 10/20 renewable energy goals and energy efficiency recommendations, the AP2 forum believes that the wind resource development costs could improve over time because of the cost benefits of “learning by doing”, because of better alignment of incentives for improving technologies’ cost and performance and because of reduced barriers to entry.

The adjustments in the assumptions for the policy scenarios were focused only around wind technologies because wind was likely to be the largest renewable energy and it was resource also where the forum anticipated most improvements in cost and performance would occur. However, recognizing the uncertainty inherent in such

[2] “Economic Impacts of Implementing a Regional SO2 Emissions Program in the Grand Canyon Visibility Transport Region,” Western Regional Air Partnership/ Market Trading Forum, September 2000. (MTF 2000).

assumptions about technology improvements, the AP2 forum developed a sensitivity scenario to test the cost implications of implementing the 10/20 goals without the assumed improvements in renewable technology cost and performance.

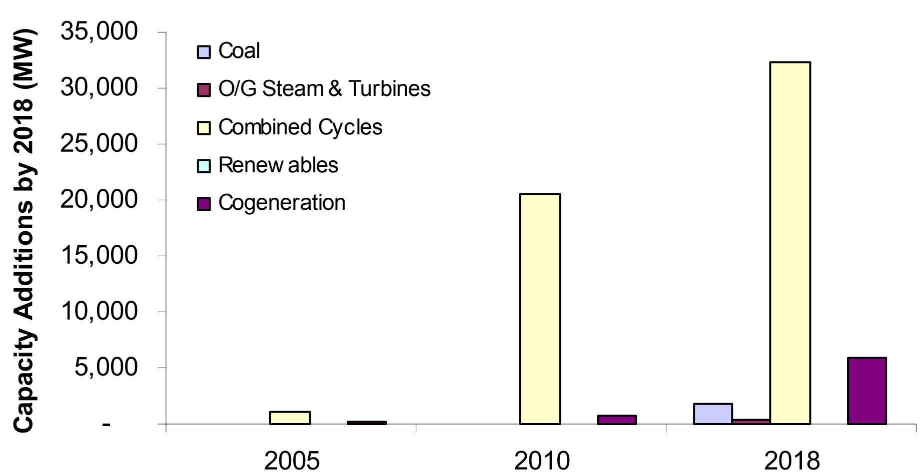
In Phase II of the analysis, ICF Consulting's Integrated Planning Model (IPM®) was used as the analytical tool for modeling the costs and emissions impacts of the policy scenarios. IPM simulates productions activity in the electricity generation and industrial steam production markets using an integrated view of fuel, emissions, capacity and generation markets. Results from IPM served as inputs to modeling of the secondary regional economic impacts in Phase III of the analysis. The Policy Insights model produced by Regional Economic Models Inc. (hereafter referred to as REMI) was used as the analytical tool for estimating the secondary regional economic impacts.

Emissions Reductions and Cost Impacts

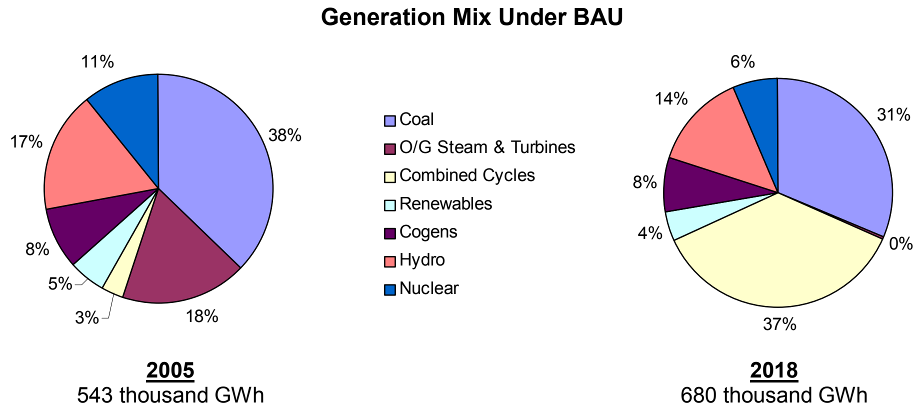
The 10/20 goals require renewable energy to satisfy 10 percent of the regional energy needs by 2005 and 20 percent of the regional energy needs by 2015. The energy efficiency recommendations developed by the AP2 forum calls for electricity demand reductions in the Transport Region to grow to 8 percent of the electricity generation demand by 2018. The analysis indicates that both these policy objectives could serve as cost-effective air pollution prevention strategies because they provide opportunities for emissions reductions at modest costs or with some savings.

Because the assessment of impacts are based on analysis of the differences between the policy scenarios and the BAU scenario, some notable elements of the BAU scenario are described below to provide a helpful context for understanding the results. One of the most important components of the BAU scenario driving the results is the growth of gas-fired generation capacity. Under the BAU scenario, the growth in electricity demand is met by additions of new gas-fired combined cycle capacity. As illustrated in Figure ES-1 below, almost 30 GW of new combined cycle capacity is projected under the BAU scenario by 2018. This represents 80 percent of the growth in capacity additions and accounts for 37 percent of all generation in the Transport Region in that year.

Figure ES-1: Capacity Additions Under the BAU Scenario[3]



3 O/G steam & Turbines refers to Oil/Gas Steam and Gas Turbines; combined cycles refer to gas-fired combined cycles and cogeneration refers to combined heat and power.



The mix of generation and capacity additions under the BAU scenario has important implications both for the growth in emissions under the BAU scenario and the potential for emissions reductions from the 10/20 goals and energy efficiency recommendations. Because generation from new gas capacity is assumed to be relatively clean, NO_x emissions under the BAU scenario remains relatively changed between 2005 and 2018, growing by 1 percent to 606 thousand tons in 2018. During that same period, the NO_x emissions rate for oil/gas units declines from 0.2 lbs/MWh in 2005 to 0.05 lbs/MWh, reflecting the projected turnover to newer efficient combined cycle generation.

As a result of increased fossil fuel generation, CO_2 emissions under the BAU scenario increases by 19 percent between 2005 and 2018 to 401 million metric tones. SO_2 emissions under the BAU scenario is held to the regional targets specified in the Annex because the scenario includes the assumptions that the regional SO_2 trading program proposed under the Annex will be in place. Because of the SO_2 cap-and-trade program, none of the policy scenarios will result in any changes in SO_2 emissions.

Implementation of the 10/20 goals and energy efficiency recommendations will lead to significant growth in renewable energy capacity, totaling 20 GW by 2018. The growth reflects the requirements of the 10/20 goals and the assumption that the policy climate of the 10/20 goals may better align incentives to spur the improvements in renewable technology cost and performance through accelerated learning by doing and by easing some of the barriers to entry for renewable energy. Figure ES-2 below summarizes the growth in renewable energy capacity under the 10/20 goals and Figure ES-3 below contrasts the generation mix in 2018 between the BAU and 10/20 goals policy scenario.

Figure ES-2: Renewable Energy Capacity Additions Under the 10/20 Goals

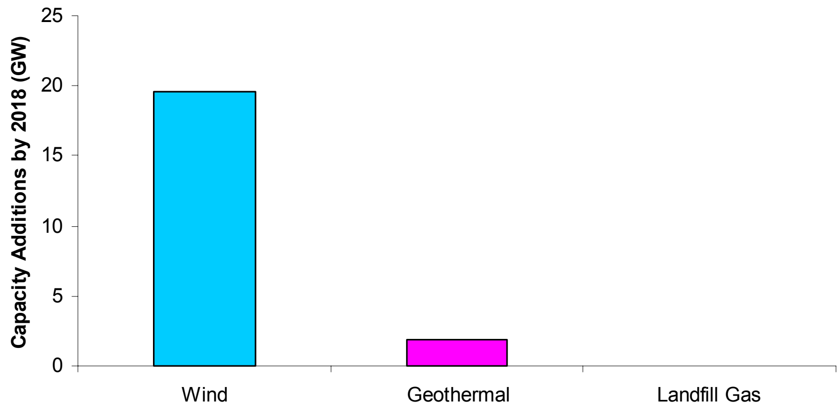
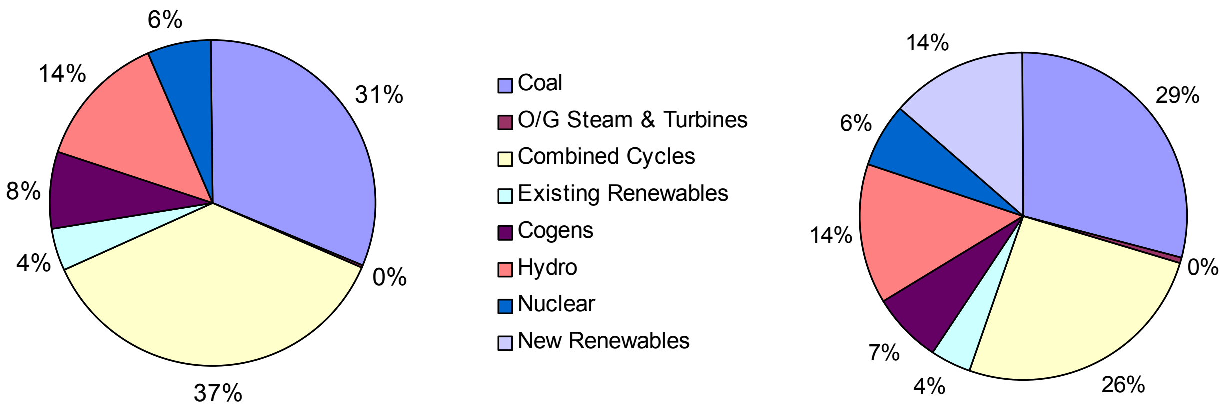


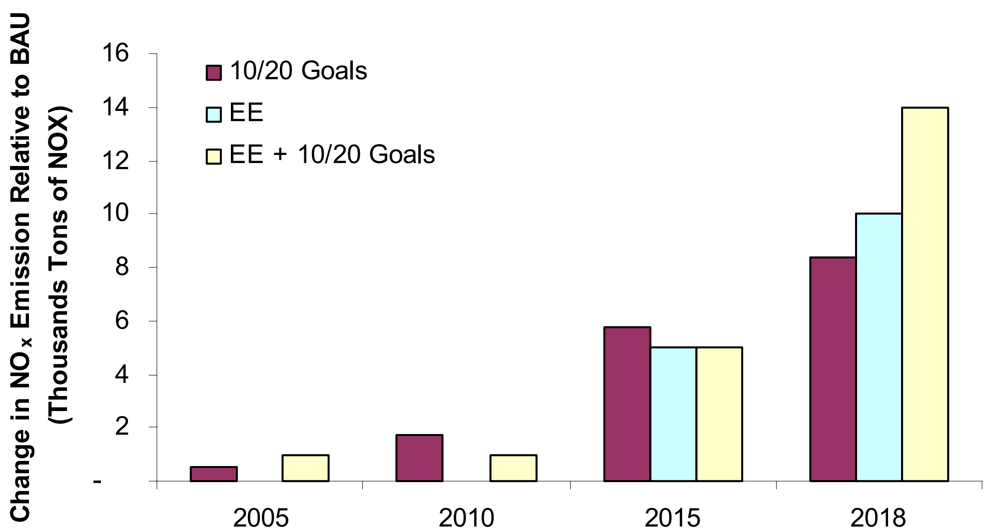
Figure ES-3: Generation Mix in 2018 Under the BAU and 10/20 Goals



As illustrated in Figures ES-2 and ES-3, wind power dominates most of the growth in new renewable capacity and the increased use of renewable energy displaces new gas-fired generation. While these results illustrate only the impact for the 10/20 goals, similar impacts occurs with increased use of energy efficiency. The important results in capacity changes of the 10/20 goals and energy efficiency is that new renewable energy capacity and energy conservation compete against new conventional capacity while leaving the existing electricity generation stock relatively undisturbed.

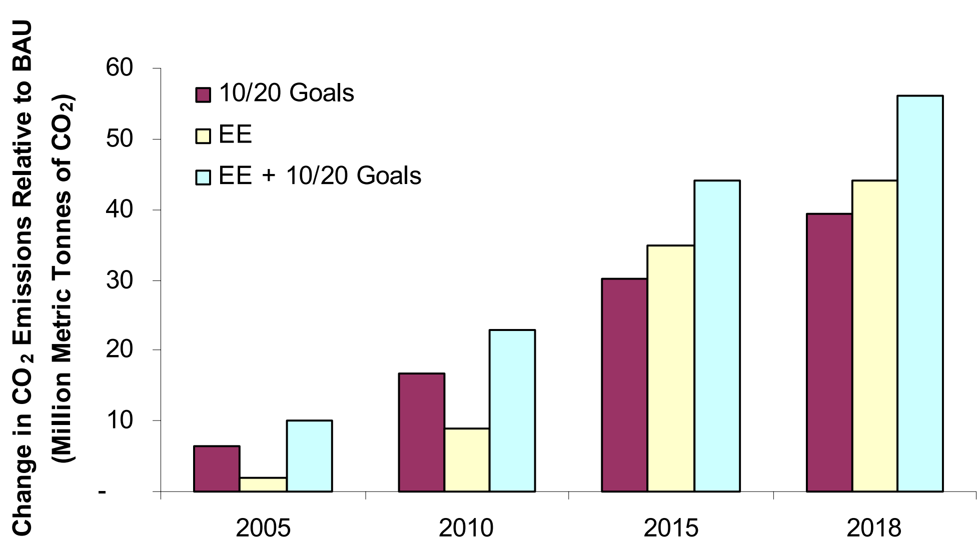
The fact that the renewable energy and energy efficiency are likely to compete against generation from new gas-fired capacity affects the emissions reductions projected under the 10/20 goals and energy efficiency recommendations. As illustrated in Figure ES-4 below, the analysis indicates that under the 10/20 goals and energy efficiency, the potential savings in NO_x emissions are likely to range between 8,000 tons and 14,000 tons (or 1 percent to 2 percent relative to the BAU). In Figure ES-4 below, the bars labeled "10/20 goals" represents the policy scenario with the 10/20 goals, "EE" represents the policy scenarios with the energy efficiency recommendations and "EE + 10/20 goals" represents the policy scenario with both the 10/20 goals and the energy efficiency recommendations.

Figure ES-4: Potential NO_x Emissions Reductions Under the 10/20 Goals and Energy Efficiency Recommendations



Implementation of the 10/20 goals and energy efficiency recommendations also lead to reductions in CO_2 emissions through displaced fossil fuel generation. As illustrated in Figure ES-5, CO_2 emissions savings in 2018 from meeting the 10/20 goals and implementing the energy efficiency recommendations is projected to range between 40 million metric tones and 55 million metric tones (or 10 percent to 14 percent relative to the BAU).

Figure ES-5: Potential CO_2 Emissions Reductions Under the 10/20 Goals and Energy Efficiency Recommendations

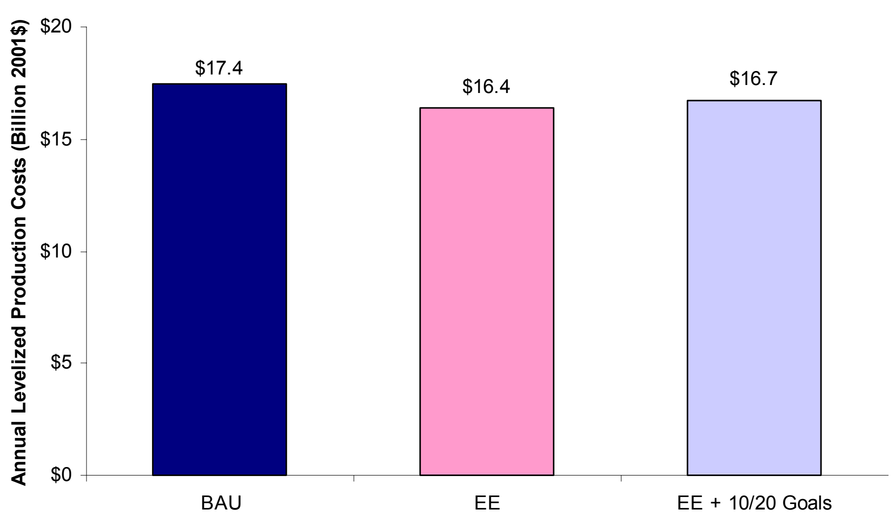


Though the emissions reduction potential for NO_x and CO_2 appears to be modest, it is important to recognize the source of those reductions and the implications for air pollution prevention. Because these emissions reductions come from new generating sources, the 10/20 goals and energy efficiency recommendations provide opportunities to hedge against future emissions growth.

Implementation of the 10/20 goals and energy efficiency scenarios does not reduce SO_2 emissions because of the regional SO_2 trading program proposed under the Annex. However, because the trading program creates a monetary value for emissions reductions, any potential for emissions reductions is fully offset by increases in SO_2 emissions from sources affected by the trading program. In other words, with the 10/20 goals and energy efficiency, the level of SO_2 emissions in 2013 and 2018 will remain unchanged from the emissions caps specified by the Annex. The 10/20 goals and energy efficiency could, however, decrease the compliance cost of the SO_2 trading program by as much as $ 7 million (or 10 percent of projected compliance cost[4]) in 2018 and could displace 1,200 MW to 1,700 MW of new scrubber capacity by 2018.

In addition to the potential emissions savings, implementation of the10/20 goals and energy efficiency recommendations could be achieved through modest production cost or with some savings. In particular, implementation of the energy efficiency recommendations leads to net annual levelized production costs[5] savings of $750 million to $1 billion (or 4 percent to 7 percent relative to the BAU scenario). These net savings reflect the cost of implementing the recommendations, the avoided investment costs of transmissions and distribution, and the reductions in electricity and steam production costs resulting from lower electricity demand. Figure ES-6 compares the production cost across the BAU and energy efficiency policy scenarios.

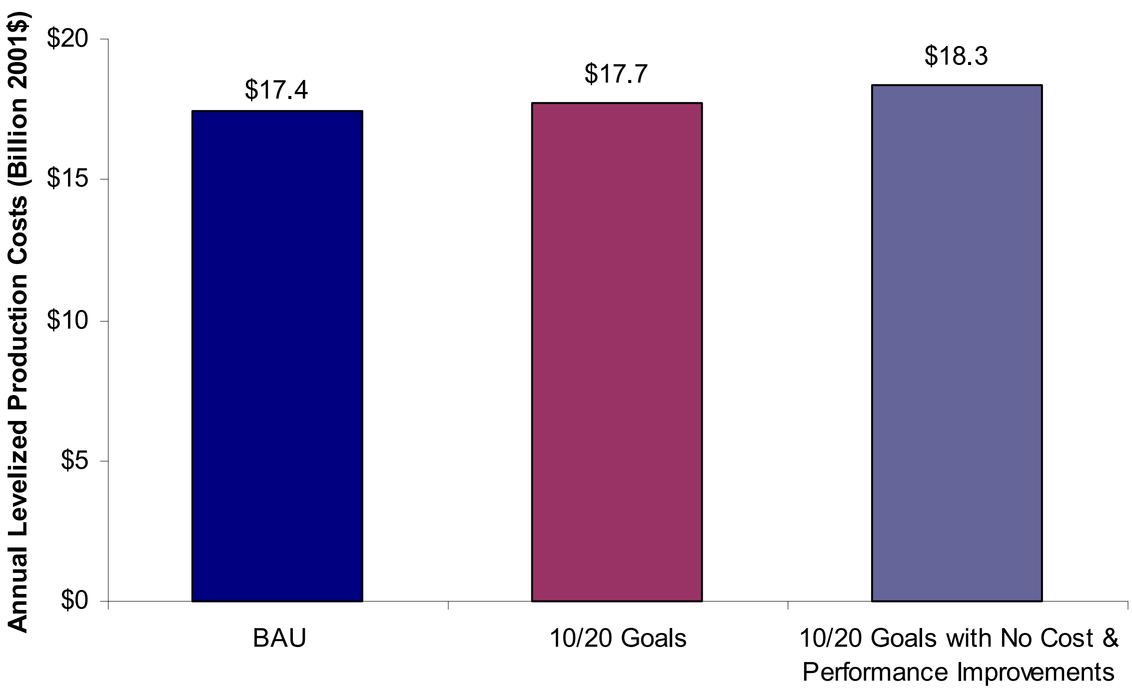
Figure ES-6: Annual Levelized Production Cost Under the BAU and Energy Efficiency Policy Scenarios



[4] MTF 2000.
[5] Annual levelized production costs reflect the capital, fuel and operation and maintenance expenditures associated with the production of electricity and industrial steam levelized over the years 2005 – 2022. These modeled production costs do not include the sunk costs (capital cost or carrying charges) of existing units.

Implementation of the10/20 goals by themselves will lead to modest increases in annual levelized production costs. The impact on production costs could range between $300 million and $900 million (or 2 percent to 5 percent relative to the BAU scenario). The range reflects the impacts under alternative assumptions about renewable technology cost and performance: the former includes the assumption that renewable technology cost and performance will improve over time, while the latter cost impacts do not allow for those improvements. The increase in production costs under the 10/20 goals is largely driven by the capital investments in new renewable energy generation capacity and is offset by the production cost savings from the displaced fossil fuel generation. Figure ES-7 compares the annual levelized production costs across the BAU and 10/20 goals policy scenarios.

Figure ES-7: Annual Levelized Production Costs Under the BAU and 10/20 Goals Policy Scenarios



Secondary Regional Economic Impacts

The objective of the secondary regional economic analysis was to assess the impacts of the 10/20 goals and energy efficiency recommendations on the regional economy of the Transport Region. For this analysis, the results from the IPM modeling served as inputs to the REMI model. This assessment of regional economic impacts is focused around changes in employment, gross regional product and personal disposable income.

Implementation of the 10/20 goals and energy efficiency recommendations has little or no impact on the regional economy. Most of the regional impacts are less than one half of one percent. Table ES-1 summarizes the annual average secondary region economic impacts under the policy scenarios for the years 2005 - 2020.

Table ES-1: Annual Average (2005 – 2020) Changes In Key Economic Indicators for the Transport Region Under the Policy Scenarios

	Employment		Gross Regional Product		Personal Disposable Income	
	(Persons)	(% Change)	(Million 2001$)	(% Change)	(Million 2001$)	(% Change)
10/20 Goals	627	0.00%	-312	-0.01%	73	0.00%
Energy Efficiency (EE)	8,415	0.02%	450	0.02%	776	0.04%
10/20 Goals + EE	4,097	0.01%	-58	0.00%	547	0.03%

The results of the regional economic analysis indicate that the 10/20 goals and energy efficiency may, on average, lead to an increase in economic activity. Over time, the policies lead to small increases in economic activity in the early years a small decline in later years. The impacts in the 2005 to 2015 time period are largely the result of investment in new renewable energy facilities that increase labor demand and have secondary impacts on output and income. Following the investment and construction boom, the region will see some decline in employment, gross regional product and personal disposable income.

On average, the 10/20 goals will lead to small increases in employment and personal income along with a small decline in gross regional product. Implementation of the energy efficiency recommendations results in small increases in employment, personal disposable income and gross regional product. The economic impacts under the 10/20 goals and energy efficiency are largely the result of increased capital investments in new renewable energy generating capacity. The boom in construction sparked by the investments appears to be the key reason for growth.

Caveats and Uncertainties

This analysis was conducted to help the AP2 forum understand the potential emissions reductions, costs and secondary regional economic impacts of the implementing the 10/20 goals and the energy efficiency recommendations. The assumptions developed by the AP2 for this study are based on a variety of different sources including research of existing literature, data developed by the Energy Information Administration, and the National Renewable Energy Laboratory. Key drivers affecting the results on projections of renewable energy capacity, emissions savings and costs include the assumptions on renewable energy technology cost and performance.

Though the modeling and analytical results provide detailed estimates of potential impacts, it is important to recognize that the magnitude of the results are quite small, particularly in estimates of the regional economic impacts. As with any analytical results, small perturbations are difficult to interpret precisely. In instances where the changes appear to be very small, analysis of broader trends, rather than specific numbers, will often provide a more robust and meaningful description of the impacts.

Conclusions

The analysis indicates that the 10/20 goals and energy efficiency recommendations could both serve as cost-effective air pollution prevention strategies. The 10/20 goals will lead to increases renewable energy capacity, while the energy efficiency recommendations will result in lower energy demand through conservation. Because both the 10/20 goals and energy efficiency displace new additions of fossil fuel capacity and generation, they are likely to provide a hedge against future emissions growth in

NO_x and CO_2. The 10/20 goals can be achieved under modest cost impacts, while energy efficiency will result some cost savings and both the objectives have little or no regional economic impacts.

I. Introduction

This analysis was commissioned by the Air Pollution Prevention (AP2) forum of the Western Regional Air Partnership (WRAP) to help WRAP participants, western states and Indian tribes understand the potential emissions reductions, costs and secondary economic impacts from meeting the 10/20 renewable energy goals and implementing the energy efficiency recommendations. This study builds upon the framework, data and assumptions previously developed by the Market Trading Forum[1] (MTF) of WRAP and examines the impacts on electricity, industrial and process sources located within the nine states and tribal lands of Transport Region.

This report includes seven sections discussing the analytical framework, data, assumptions and results. Specifically:

- Section II provides background to the study, describes the key objectives of the analysis and summarizes the main findings.
- Section III details the scenarios, data, assumptions and analytical framework. Details on renewable energy technology costs and performance assumptions developed by the AP2 forum are also described. The section also provides an overview of the modeling tools used -- ICF's Integrated Planning Model® (IPM) and REMI's Policy Insights® model-- and a discussion of the approach used to integrate the two models.
- Section IV discusses the emissions and production costs impacts of implementing the 10/20 goals and energy efficiency recommendations based on the IPM modeling results.
- Section V discusses the secondary regional economic impacts based on the results of the REMI model. The analysis focuses on impacts on employment, gross regional product and disposable income.
- Section VI contains a discussion of the caveats and uncertainties underlying the results.
- Section VII describes the conclusions of the study.

[1] "Economic Impacts of Implementing a Regional SO2 Emissions Program in the Grand Canyon Visibility Transport Region," Western Regional Air Partnership/ Market Trading Forum, September 2000. (MTF 2000).

II. Overview

II.1 Background

With a view towards improving visibility and air quality in the national parks and wilderness areas of the Colorado plateau, the Grand Canyon Visibility Transport Commission (GCVTC) issued several recommendations in 1996 on strategies for air pollution prevention in the West. In its recommendations, the GCVTC emphasized the need to integrate air pollution prevention with cost-effective pollution control strategies in order to prevent degradation of natural resources in the West.[2]

Two key GCVTC recommendations focused on the development of renewable energy sources and the promotion of energy conservation. The recommendation on development of renewable energy sources encouraged states and tribes in the Transport Region to undertake steps that would increase the use of renewable energy to 10 percent of the regional power needs by 2005 and 20 percent of the regional power needs by 2015 (hereinafter the "10/20 goals"). For energy conservation, the commission supported the continued development of energy efficiency standards and suggested that the emphasis on energy conservation be maintained within the changing electric power markets. In addition to the renewable resource and energy conservation recommendations, the GCVTC suggested that future analysis examine the potential emission reductions, cost savings and secondary benefits associated with the use of renewable energy and energy efficiency.

The Regional Haze Rule issued by U.S. Environmental Protection Agency in April 1999 included the air pollution prevention recommendations of the GCTVC. Under the rule, the states of the Transport Region must include in their State Implementation Plans (SIP) an outline of the programs and policies that each state will rely on to work towards meeting the air pollution prevention recommendations. Tribal governments may seek approval from EPA to incorporate the requirements of the regional haze regulations, including the GCVTC recommendations, in their Tribal Implementation Plans (TIP) under the provisions of the Tribal Authority Rule (TAR)[3].

The AP2 forum of WRAP has been charged with implementing the air pollution prevention recommendations of the GCVTC and commissioned ICF Consulting to examine the potential emissions reductions, costs and secondary economic impacts of meeting the 10/20 goals and energy efficiency recommendations.

II.2 Objective

This study serves as the documentation of the analytic and technical support to the AP2 forum's report detailing its recommendations regarding renewable energy and energy efficiency to the WRAP Board. While the AP2 forum's report provides a discussion of the policy imperatives and broader implications of the GCVTC air pollution prevention

[2] "Recommendations for Improving Western Vistas," The Grand Canyon Visibility Transport Commission, June 1996, page 28.
[3] 63 Fed. Reg. 7254-7274, codified at 40 CFR Part 49.

recommendations, this report describes the potential emissions reductions, costs and secondary economic impacts of meeting the 10/20 goals and implementing the energy efficiency recommendations, given the assumptions and scenarios developed by the AP2 forum. The analysis examined the impacts for the nine states and tribal lands of the Transport region and was focused around stationary sources engaged in the production of electricity and industrial steam along with process sources (e.g., copper smelters and refineries).

II.3 Summary of Key Findings

The analysis indicates that the 10/20 goals and energy efficiency could both serve as cost-effective air pollution prevention strategies.

- The objective of the 10/20 goals is to have renewable energy providing 10 percent of the regional energy demand by 2005 and 20 percent by 2015. The AP2 forum's recommendations for energy efficiency seeks to reduce electricity demand in the Transport region by 8 percent by 2018 from the Business-As-Usual (BAU) conditions through energy conservation in the residential, commercial, industrial and manufacturing sectors.

- Wind power is expected to provide the largest source of renewable energy generation in meeting the 10/20 goals, accounting for much as 80 percent of the growth in renewable energy capacity. By 2018, the expansion in wind capacity under the 10/20 goals is expected to reach 18 GW. The 10/20 goals will also lead to some expansion of renewable energy generation from geothermal and landfill gas.

- Penetration of energy efficiency and renewable energy will primarily compete against new conventional capacity additions. In the absence of energy efficiency and the 10/20 goals, most of the expansion in conventional capacity will likely consist of gas-fired combined cycles. New additions to renewable energy capacity and demand reductions motivated by the 10/20 goals and the energy efficiency recommendations are projected to displace new gas-fired combined cycle capacity while leaving the existing stock relatively unaffected.

- Under the scenarios analyzed, energy efficiency and 10/20 goals provide 1 to 2 percent reductions in NO_x emissions and 10 to 14 percent reductions in CO_2 emissions. The reduction potential appears to be modest partly because the displaced generation consists almost entirely of relatively clean gas-fired combined cycle. Since the 10/20 goals and energy efficiency primarily displace generation from new fossil fired capacity additions, the 10/20 goals and energy efficiency can provide a hedge against future emissions growth.

- The 10/20 goals and energy efficiency do not provide any SO_2 reductions in the presence of a regional SO_2 emissions cap and trading program proposed in the Annex. However, the 10/20 goals and energy efficiency may lower the compliance cost of the trading program by as much as $ 10 million in 2018 (or 7 percent) and displace the need for 1,200 MW to 1,700 MW of new scrubber capacity.

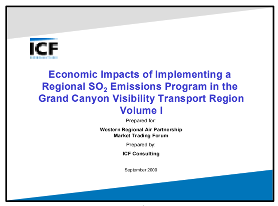
- The increase in annual levelized production costs under the 10/20 goals will range between $ 300 million and $ 900 million (or 2 percent to 5 percent relative to the business-as-usual scenario). Under an energy efficiency scenario, the savings in annual levelized production cost may range between $ 700 million to $ 1 billion (or 5 percent to 7 percent relative to the business-as-usual scenario).

- Implementation of the 10/20 goals and energy efficiency recommendations will have small or no impacts on the regional economy. Under the 10/20 goals scenario, employment and personal income is projected to increase on average by less than one half of one percent per year. Gross regional product is likely to decline by approximately the same percentage impact. Similarly, implementation of the energy efficiency recommendations is projected to lead to small increases in employment, gross regional product and personal income of less than one half of one percent each.

III. Analytical Approach

This section describes the analytical approach, data, assumptions, methodology and modeling tools used in the analysis. There were three distinct phases to the analysis: (1) assumptions and scenario development, (2) modeling of the electric and steam sectors, and (3) modeling of the secondary regional economic impacts. Figure I presented below illustrates the three phases of the analysis and the overall analytical approach. Details on each of the phases of the analysis are described below.

Figure I: Overview of Analytical Approach



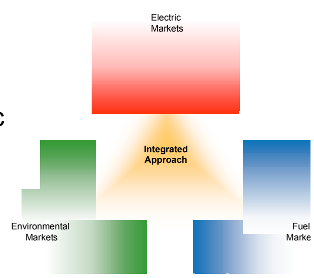
WRAP/MTF Economic Analysis

- Served as starting point for analysis
- AP2 selected Annex Scenario as Business-As-Usual scenario

Phase I:
Assumptions and Scenario Development

AP2 Forum

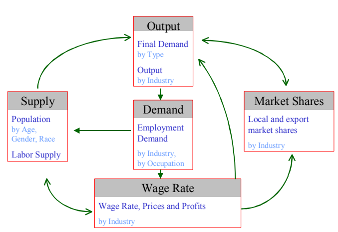
- Reviewed and revised assumptions for renewable energy technology
- Developed energy efficiency cost and performance assumptions
- Developed scenarios for analysis of 10/20 goals and energy efficiency (EE)



Phase II:
Modeling of Electric and Steam Sector

IPM® Modeling

- Modeled 10/20 and EE Scenarios developed under Phase I
  - ➢ Electric/Steam Sector System Impacts
  - ➢ Emission Impacts
  - ➢ Production Cost Impacts



Phase III:
Modeling of Secondary Economic Impact

REMI™ Modeling

- Secondary regional economic impacts
  - ➢ Employment Impacts
  - ➢ Gross Regional Product Impacts
  - ➢ Income Impacts

III.1 Scenarios Analyzed

The AP2 forum developed two types of scenarios in order to examine the emissions, costs and secondary regional economic impacts of meeting the 10/20 goals and implementing the energy efficiency recommendations. The first was the Business-As-Usual (BAU) scenario that characterized how the future might unfold without any policy measures designed to accomplish the 10/20 goals and energy efficiency recommendations. The second set of scenarios reflected a future with policy drivers designed to meet the 10/20 goals or energy efficiency recommendations, or both. Assessments of emissions, costs and secondary regional economic impacts were estimated by analyzing the changes in the policy scenarios relative to the BAU scenario.

This analysis examined the 10/20 goals and energy efficiency recommendations in the context of the regional backstop SO_2 trading program proposed in the Annex. In September 2000 the WRAP/MTF conducted extensive analysis of the economic impacts of the Annex proposal.[4] The AP2 forum selected the WRAP/MTF scenario with the Annex as the basis for the BAU scenario. However, the existing stock of renewable energy plants under the WRAP/MTF Annex scenario was modified to account for firm projected renewable energy plants.

The policy scenarios developed by the AP2 forum were focused around the policy objectives of the 10/20 goals and energy efficiency recommendations. Policy scenarios also included cases designed to test the sensitivity of the impacts to changes in technology improvements and higher gas prices. The results of the sensitivity scenarios are mentioned briefly in the report since they do not appear to add substantively to the insights gained from the core policy scenarios.

In designing the policy scenarios and in developing the data for those scenarios, the AP2 forum modified some of the assumptions on the cost and performance of renewable energy technologies from those used in the BAU scenario. There were two reasons for this. First, the AP2 forum felt that the BAU scenario, which was adopted from the WRAP/MTF Annex scenario, did not contain enough details on renewable energy technologies since that had not been the focus of the WRAP/MTF.

Second, and more importantly, the AP2 recognized that the 10/20 goals would not only affect the level of renewable energy generation in the west, but also had the potential to influence the underlying market conditions for those technologies. Under a climate where policies are in place designed to achieve the 10/20 renewable energy goals and energy efficiency recommendations, the AP2 forum believes that the wind resource development costs could improve over time because of the cost benefits of "learning by doing", from better alignment of incentives for improving technologies' cost and performance and from reduced barriers to entry. The adjustments in the assumptions for the policy scenarios were focused only around wind technologies since wind was likely to be the largest sources of renewable energy and it was also where the forum anticipated most improvements in cost and performance would occur.

Recognizing the inherent uncertainty in assumption on technological improvements over time, the AP2 forum developed a sensitivity scenario that did not include the assumed

[4] MTF 2000.

improvements in renewable technology cost and performance. The objective of this sensitivity scenario was to capture the higher end of the potential cost impacts of the 10/20 goals. Table 1 presented below provides a summary of the scenarios developed by the AP2 forum.

Table 1: Scenarios

<table>
<tr><th colspan="2">Scenario</th><th>Assumptions Used</th></tr>
<tr><td colspan="2">Business-As- Usual Scenario</td><td>• Used WRAP/MTF Annex scenario
• Includes firm new renewable projects in existing generation stock</td></tr>
<tr><td rowspan="4">Policy Scenarios</td><td>10/20 Goals</td><td>• Updated renewable technology cost and performance assumptions
• Includes 10/20 goals as requirements that electric system has to meet
• Retained all other assumptions from WRAP/MTF Annex scenario</td></tr>
<tr><td>10/20 Goals and Energy Efficiency</td><td>• Updated renewable technology cost and performance assumptions
• Includes energy efficiency recommendations
• Includes 10/20 goals as requirements that electric system has to meet
• Retained all other assumptions from WRAP/MTF Annex scenario</td></tr>
<tr><td>Energy Efficiency Only</td><td>• Updated renewable technology cost and performance assumptions
• Includes energy efficiency recommendations
• Retained all other assumptions from WRAP/MTF Annex scenario</td></tr>
<tr><td>Sensitivity Scenarios</td><td>• Impact of 10/20 goals assuming no improvements in renewable technology cost and performance over time
• Impact of higher gas prices on 10/20 goals</td></tr>
</table>

All the scenarios summarized in Table 1 above were modeled under Phase II of the analysis that examined the electric and steam sectors. In Phase III where the regional economic impacts were modeled, only selected policy scenarios were analyzed. These included the 10/20 goals policy scenario, the 10/20 goals and energy efficiency policy scenario and the energy efficiency policy scenarios.

III.2 Analytical Tool

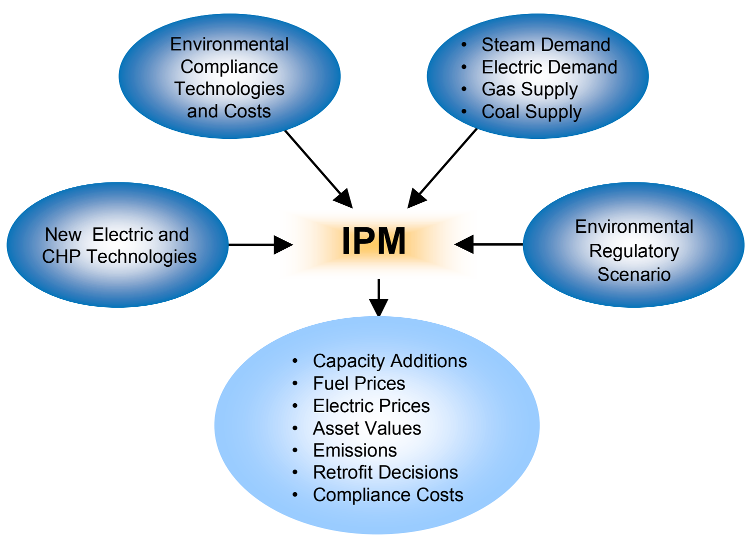
Integrated Planning Model (IPM®)

ICF's Integrated Planning Model (IPM) was used as the analytical tool for modeling the costs and emissions impacts of the policy scenarios under Phase II of the analysis. IPM is a well-established electric and industrial boiler sectors model. For the WRAP/MTF analysis of the SO_2 program, it was enhanced to capture emissions from process sources. The model has been used in a wide range of analyses by government and industry. Within WRAP, the model was used by WRAP/MTF for the economic analyses and for the analysis of market issues related to the SO_2 emissions trading program. The model is also currently being used by the National Tribal Environmental Council (NTEC) to analyze issues related to the tribal set-asides under the regional backstop SO_2 trading program.

IPM is a detailed engineering-economic capacity expansion and production-costing model of the power and industrial sectors supported by an extensive database of every boiler and generator in the nation. It is a multi-region model that provides least-cost capacity expansion plans, credible plant dispatch, and electric prices forecasts. IPM explicitly considers gas, oil, and coal markets, power plant costs and performance characteristics, environmental constraints and emissions markets, and other power market fundamentals.

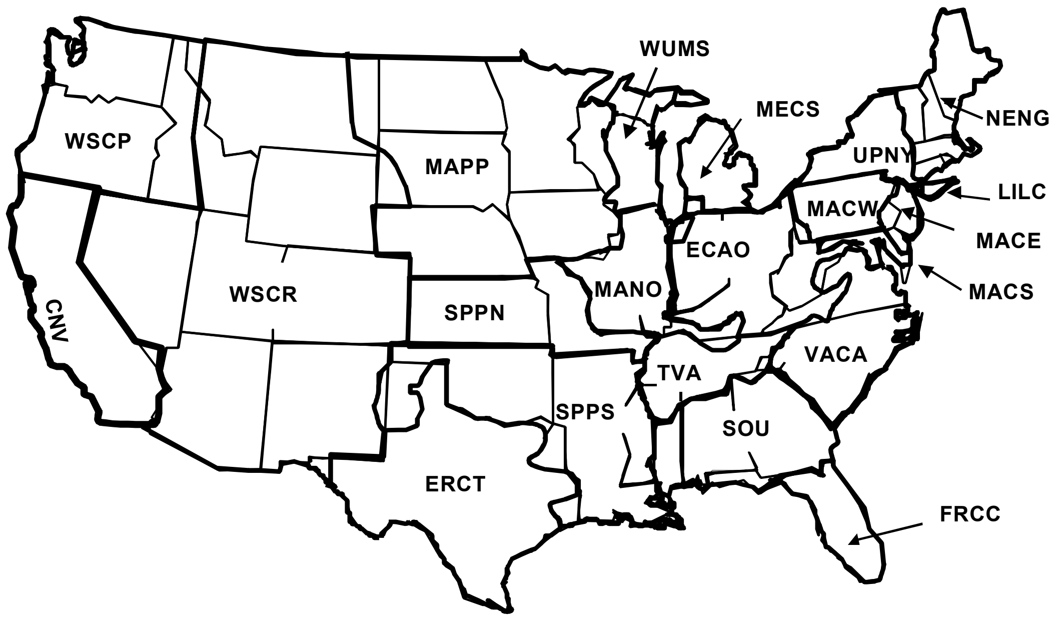
As illustrated in Figure 2 below, IPM provides an integrated analysis of electricity and steam markets. The model captures the interactions of real world constraints and simulates electric and steam markets based on economic fundamentals using a linear programming structure. Figure 2 illustrates the key components of IPM.

Figure 2: The Integrated Planning Model



IPM models the contiguous U.S. using distinct power markets represented as "model regions." These regions correspond in most cases to the regions and sub-regions of the North American Electric Reliability Council (NERC). For this analysis, the nine western states and tribes of the GCVTC region are contained within the model regions of California and Southwest Nevada (CNV), Pacific Northwest (WSCP) and interior West (WSCR). The models regions used in this study are illustrated in Figure 3 below.

Figure 3: Regional Structure of IPM for AP2 Forum Analysis



The modeling for this analysis covered the electricity, industrial steam and other industrial process sources of SO_2 emissions (e.g., copper smelters and refineries). The electricity sector includes all existing boilers and generators. IPM forecasts new capacity builds to meet the growth in electricity demand. The industrial steam sector includes sources that sell steam to industrial, commercial and institutional facilities. Expansion in steam demand is met through new boilers and/or combined heat and power (CHP) cogeneration facilities. Process sources of SO_2 such as refineries and smelters are also included in the modeling to capture their potential interactions in the regional SO_2 allowance markets. The analysis does not model production activity of these industrial process sources.

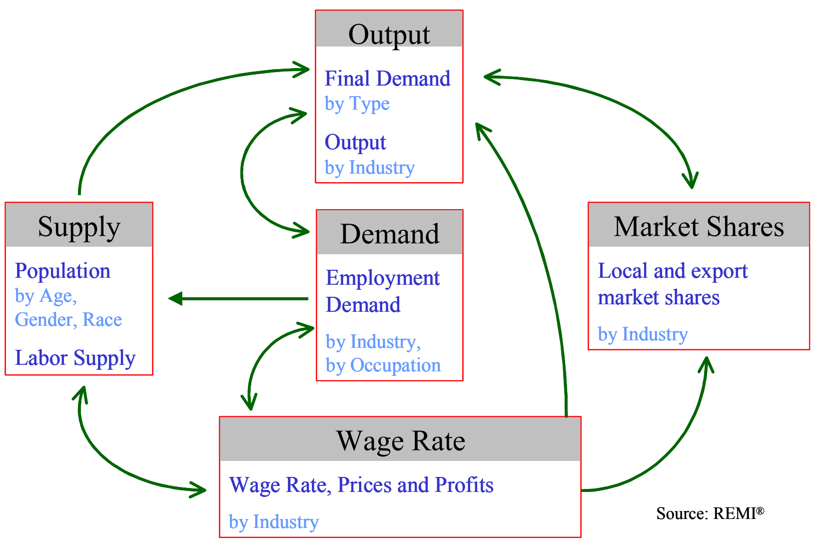
In IPM the 10/20 goals are modeled as electricity generation constraint on the power system that requires that the system must produce at a minimum the renewable generate targets specified by the 10/20 goals. The IPM model determines the optimal mix of renewable energy taking into account the target levels and their timing and geographic scope. In determining the optimal plan, the model also takes into account all existing and future air regulations included in the scenario, fuel prices and availability, and emission markets. The energy efficiency recommendations are modeled as reductions in energy requirements and peak demand levels. Reductions in demand are specified exogenously; the model responds to the new demand and determines the least cost method for satisfying that demand.

Regional Economic Assessment: REMI's Policy Insights® Model (REMI)

The Policy Insights® model produced by Regional Economic Models Inc. (hereinafter "REMI") was used to estimate the secondary regional economic impacts of the implementing the 10/20 goals and the energy efficiency recommendations. REMI is a widely accepted tool for analyzing regional economic impacts and was previously used by WRAP/MTF for economic analysis of alternative emissions milestones (or caps) on the regional SO_2 trading program.

The REMI model is composed of five basic blocks – output, supply, demand, market shares and wage rate - that broadly characterize the regional economy. These blocks are inter-linked and the model uses a single set of simultaneous equations to estimate how a change from a policy might filter through the economy. Figure 4 illustrates the analytical framework of the REMI model.

Figure 4: Analytical Framework in the REMI Model



The REMI model used in this analysis consists of 10 regions, which include Arizona, Colorado, California, New Mexico, Nevada, Utah, Wyoming, Oregon, Idaho and the rest of the country. Because of the analytical difficulty in modeling tribal areas as a separate model region, tribal areas have been integrated in with the state in which they are located.

The AP2 Forum selected three scenarios for analysis of the regional economic impacts. These include:

1. 10/20 Goals;
2. Energy Efficiency Recommendations; and
3. 10/20 Goals and Energy Efficiency Recommendations.

For all the three scenarios, the inputs to REMI are derived from the IPM modeling results. Most of the inputs to REMI require changes relative to a reference point and the Business-As-Usual (BAU) scenario was used as the reference case in developing the inputs to REMI. All REMI inputs are specified by year, state and sector.

There are three IPM outputs that form the basis for the inputs to REMI. These include

1. Incremental Production Cost Impacts;
2. Changes in Wholesale Electricity Price; and
3. Revenue Changes from Allowance Allocations.

The approach and methodology used in adapting the IPM outputs for use in REMI are discussed in detail below.

Incremental Production Cost Impacts

Incremental production costs in IPM are composed of the capital, fixed operating, variable operating and fuel costs associated with the 10/20 goals and energy efficiency recommendations. Under the 10/20 goals, for instance, the incremental annual levelized production cost was $ 300 million annually and reflects the total change in production costs in meeting the 10/20 targets.

Impacts on production costs of sectors aside from power generators as a result of the policies are captured through REMI variables that reflect the factors of production in these sectors. Within REMI, these changes in production costs affect both market shares and final demand for each sector's products through changes in the relative price of the products. Industries within these sectors that compete in regional markets (and thus are price setters for their product) are able to pass through cost via regional price increases, while sectors that compete nationally (and thus are "price takers") experience a change in competitiveness relative to other regions and rest of the U.S.

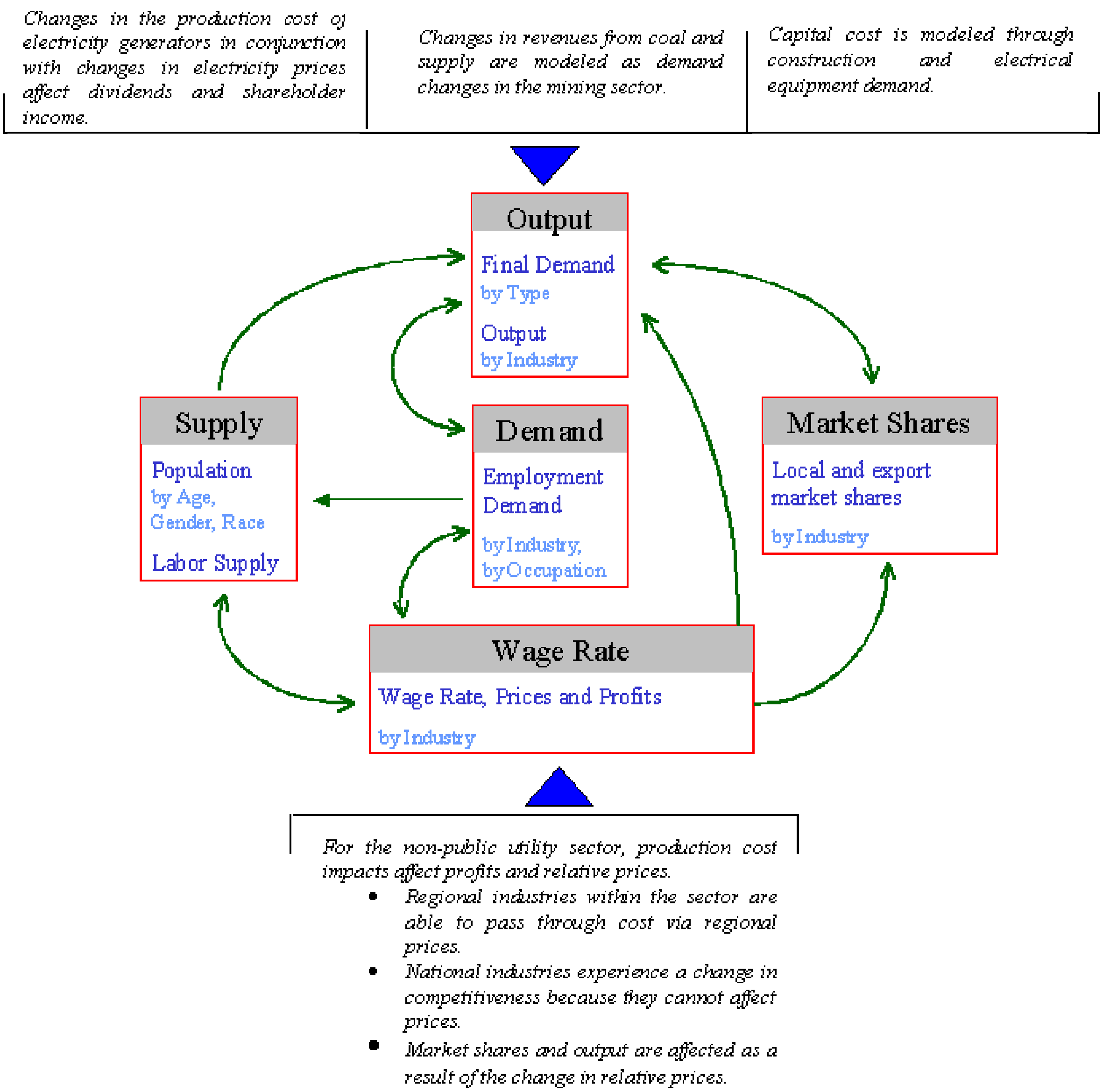
For electric generators, the production cost impacts are not modeled directly in REMI because the electricity price impact is already known through IPM modeling. Instead, the production cost impacts are combined with the electricity price change and the net revenue impacts are input into REMI as changes in dividends or shareholder income. Changes in dividends and shareholder income directly affect changes in personal income, which in turn affects output and employment demand. For purposes of REMI modeling, avoided transmission and distribution avoided costs under the EE recommendations are treated as changes in production cost.

The capital investments for new electric generation capacity projected in IPM were modeled as construction and electric equipment demand in REMI. An increase in construction demand has a pronounced effect on the regional economy because it leads to an increase in employment, which in turn affects output, income, wages, population and labor supply. The increase in electrical equipment demand also affects output but the regional impacts are less pronounced than construction demand impacts because some of the expenditures flow out of the region for capital purchases made elsewhere. The regional purchase coefficients in REMI determines how much of the expenditures are spent locally versus outside of the region.

Changes in fuel expenditures, which are a component of total production costs, have been modeled in REMI as mining demand impacts. The change in mining demand affects employment and also flows through to changes in income and output.

Figure 5 below illustrates how production cost impacts from IPM have been modeled in REMI and also describes how those impacts relate to changes in the regional economy.

Figure 5: Production Cost Impacts in REMI



Changes in Wholesale Electricity Prices

Wholesale electricity prices are outputs of IPM and have been used in REMI to describe how retail rates might change as a result of the policies. Wholesale electricity price impacts have been converted to retail rates based on the assumption that distribution and retailing cost do not change under the policies and that the changes in wholesale electricity price changes are fully realized by end use customers.

Under the 10/20 goals, the wholesale electricity price impacts modeled in REMI also include the premium necessary for implementing the renewable energy targets. In this analysis, the premium is based on a System Benefits Charge (SBC) type approach where every end user pays the levelized renewable energy credit price. Under the scenarios involving the EE recommendations, the EE implementations cost were also included in the electricity price impacts. EE implementation costs were provided by state and sector and were converted to a kWh basis using the share of electricity demand for that state and sector. In effect, the EE implementation costs are recovered through changes in electricity prices. In sum, the electricity price changes modeled in REMI include the following components:

1. Wholesale electricity prices;
2. Premium for 10/20 goals; and
3. EE implementation costs.

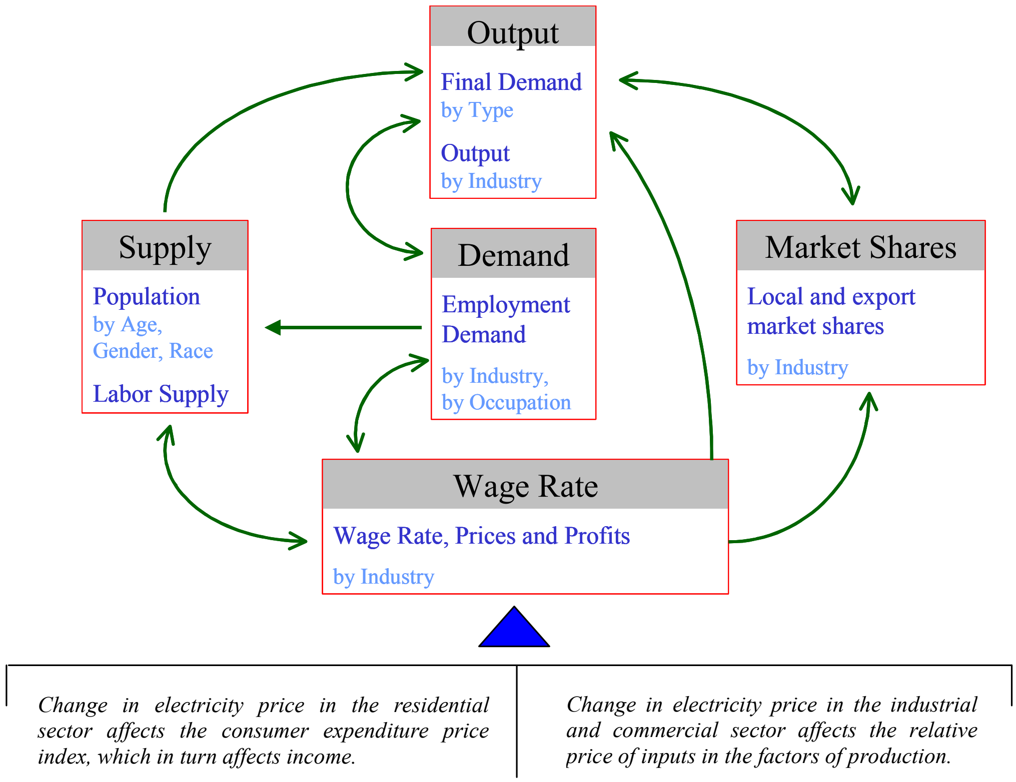
The changes in electricity prices are modeled separately for the residential, commercial and industrial sectors.

For the industrial and commercial sectors the changes in electricity prices affect their raw material cost. The change in the price of electricity affects the relative price of their factors of production and affects the type of resources (labor, capital) that the sectors might employ in production. With lower electricity prices, these sectors might substitute capital for labor thereby leading to an increase in investments, which in turn affects demand and output.

For the residential sector, the change in electricity price is modeled through the consumer price index. In this case, a reduction in electricity price implies an increase in income because consumers have more to spend on other goods and services, which in turn increases consumption, demand and output.

Figure 6 below illustrates how the electricity price impacts have been modeled in REMI and its linkages in the regional economy.

Figure 6: Electricity Price Impacts in REMI

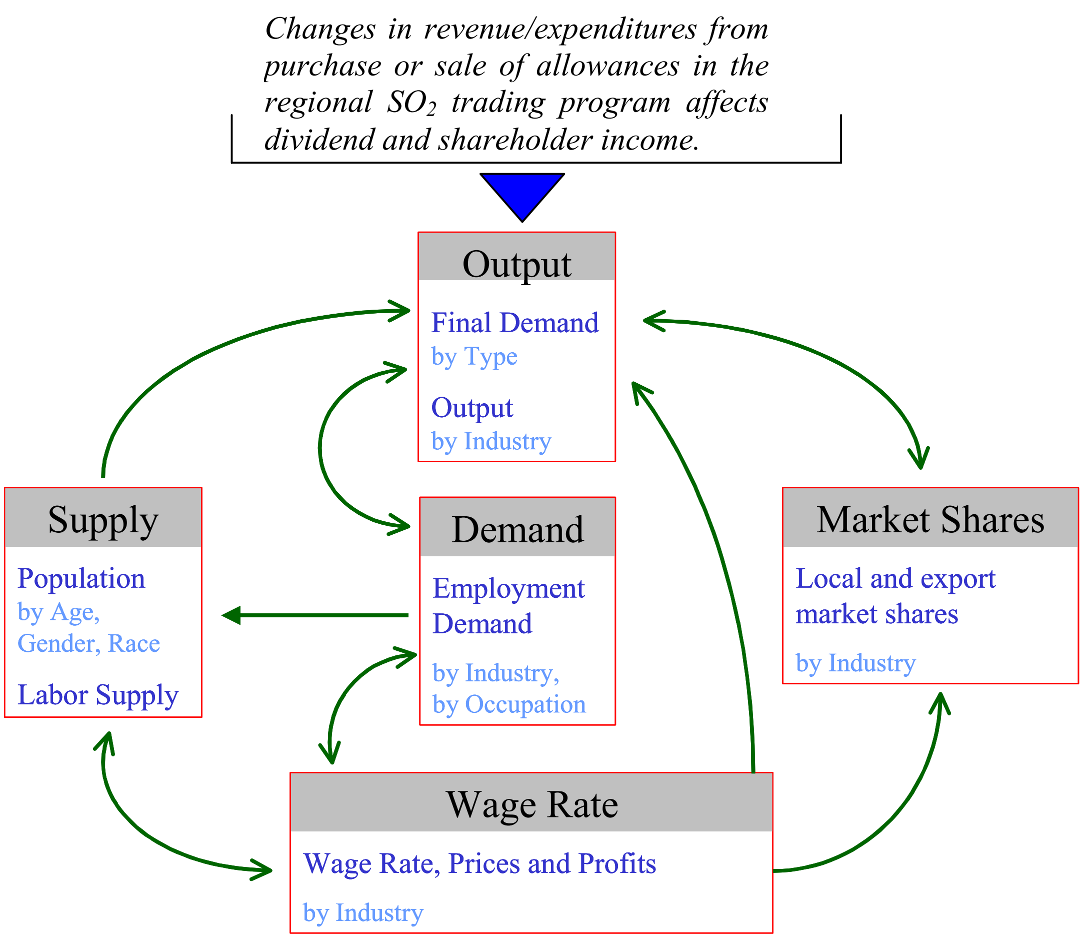


Revenue Changes from Allowance Allocation

The revenue changes from allowance allocation account for changes in the allowance position under the SO_2 trading program of the Annex. Although the cap in the trading program does not change under the 10/20 goals and the energy efficiency recommendations, the compliance strategy changes, which in turn affects the number of allowances that sources in a state will have to buy or sell.

The expenditures/revenues from the sale/purchase of allowances is based on the allowance price of the regional SO_2 trading program and the net allowance position of the state. A state that has allowances to sell will realize an increase in revenues, while a state that needs to purchase allowances will see an increase in expenditures. Because these revenues/expenditures accrue to the sources affected by the trading program, the changes in expenditures/revenues from allowance allocations have been modeled in REMI as dividend and shareholder income. The impact of the allowance allocation does not change the overall cost to the region (because expenditures and revenues cancel out) but merely redistributes the impacts across the region. Some of the dividend and shareholder incomes are assumed to flow out of the region based on the income distribution. Figure 7 illustrates how revenue changes from allowance allocations have been modeled in REMI and the related impacts on the regional economy.

Figure 7: Revenue Impacts from Allowance Allocations



III.3 Data and Assumptions

As noted before, for this analysis the AP2 forum used much of the data and assumptions developed by the WRAP/MTF. These assumptions are fully documents in the economic analysis report produced by the WRAP/MTF in September 2000[5] and have not been replicated in this report. The section describes only the data and assumptions that changed relative to the WRAP/MTF economic analysis. In addition, as noted before, the AP2 forum updated the renewable energy technology cost and performance assumptions for the policy scenarios. Because the BAU scenario did not include any projected additions to renewable energy capacity (outside of firm new capacity), for renewable energy technologies, this section describes only the assumptions used in the policy scenarios.

[5] MTF 2000.

Environmental Regulations

Regional and national existing environmental regulations affecting stationary sources that produce electricity and/or industrial steam are represented identically in both the BAU and policy scenarios. The regulations modeled include:

- 1990 Clean Air Act Amendments Title IV NO_x and SO_2,
- Title IV SO_2 national trading program,
- Northeast NO_x SIPCALL, and
- Regional backstop SO_2 trading program proposed under the Annex for the states and tribes of the Transport Region with the assumption that all states/tribes will participate in the trading program. The specific milestones used in modeling the Annex are summarized in Table 2 below.

Table 2: Milestones Used for the Regional Backstop SO_2 Trading Program Proposed In the Annex

	2013	2018
Thousands Tons of SO_2	630	507

Natural Gas Prices

The AP2 forum retained the natural gas price assumptions developed by the WRAP/MTF for this analysis. In addition, the AP2 forum developed the high natural gas prices for the sensitivity scenario based on the approach used in the WGA Transmission Report.[6] Table 3 below provides a summary of the natural gas prices assumed in the study. The BAU and policy scenarios both include the base price while the high prices were used only in the high gas price sensitivity policy scenario.

Table 3: Assumptions on Delivered Natural Gas Price

National Average Delivered Natural Gas Price (2001 $/mmbtu)		
Year	**Base**	**High Gas Price**
2005	$3.16	$4.44
2010	$3.31	$4.99
2020	$3.49	$5.93

Cost and Performance for Grid Connected Utility Scale Solar Technologies

The AP2 forum assumed that two types of grid-connected utility scale solar technologies -- solar photovoltaic and solar thermal -- would be available under the policy scenarios. Recognizing that some cost improvements in these technologies would occur over time, the forum allowed for some cost decline in both technologies after 2010. Table 4 presented below provides the cost and performance assumptions for solar photovoltaic and solar thermal.

[6] "Conceptual Plans for Electricity Transmission in the West," Report to the Western Governors' Association, August 2001. High gas prices were based on gas prices in Annual Energy Outlook 2001 plus 50%.

Table 4: Cost and Performance Assumptions for Solar Technologies[7]

Available Years	Technology	Annual Average Capacity Factor	Overnight Capital Cost (2001$/kW)	Fixed O&M Cost (2001$/kW-Yr)
2000-2009	Solar PV Solar Thermal	28% 42%	4,576 3,170	11 50
2010-2030	Solar PV Solar Thermal	28% 42%	2,737 2,853	11 50

The analysis reflects the fact that solar plants are not dispatchable by basing the generation estimates on generation profiles that describe the hourly generation for a typical day in the winter and summer. Furthermore, in order to account for the intermittency in generation from solar technologies, solar photovoltaic and solar thermal plants do not receive capacity credit on their entire nameplate capacity. Instead, the capacity credit is limited to their capacity factor in the peak 30 percent of hours.

Cost and Performance for Biomass Technologies

The AP2 forum assumed that both direct combustion and biomass gasification combined cycles (BGCC) would be available for commercial application to electricity generation. However, recognizing that BGCC is not yet a mature technology, the forum assumed that BGCC would be available only after 2010. Table 5 presented below summarizes the cost and performance assumptions for biomass technologies.

Table 5: Cost and Performance Assumptions for Biomass Technologies[8]

Available Year	Technology	Heat Rate (Btu/kWh)	Overnight Capital Cost (2001$/kW)	Fixed O&M (2001$/kW-Yr)	Variable O&M (2001mills/kWh)
2000	Direct Combustion	8,219	1,420	48	5.75
2010	Biomass Gasification Combined Cycle	13,000	1,489	66	7.74

Biomass fuel supply is reflected in a composite supply curve containing energy crops, agricultural residue, forestry residue, and urban wood waste and mill residue available for electricity generation. For each model region and year, the supply curve denotes the price-quantity relationship of biomass.[9]

[7] Annual Energy Outlook (AEO) 2001.
[8] Data for Direct Combustion Biomass from Technology Characterization report by DOE-NREL 1997. Data for Biomass Gasification Combined Cycle from Annual Energy Outlook 2001.
[9] Biomass supply curve based on data from Annual Energy Outlook 2001.

Cost and Performance for Geothermal Technologies

For geothermal generating technologies, the AP2 forum wanted to ensure that the effects of resource depletion were included in the cost and performance. Consequently, rather than a single option, the policy scenarios include a geothermal supply curve that characterize the relationship between available capacity and development-production cost. The supply curve is specified for each of the three model regions that circumscribe the Transport Region and is presented in Table 6 below.

Table 6: Cost and Performance Assumptions for Geothermal Technologies[10]

Region	Potential Capacity (MW)	Overnight Capital Cost (2001$/kW)	Fixed O&M (2001$/kW-Yr)	Capacity Factor (%)
CNV [California and Southern Nevada)	653	2,137	75	90
	6,782	2,312	98	90
	3,806	3,311	122	90
	12,836	5,979	258	90
WSCP [Pacific Northwest]	3,500	2,332	72	90
	2,200	3,563	130	90
	3,075	5,156	195	90
WSCR [Interior West]	920	2,113	70	90
	250	2,735	96	90
	5,713	3,515	122	90
	5,606	6,877	238	90

Cost and Performance for Landfill Gas Technologies

A limited amount of potential landfill gas capacity was expected to be available in the Transport Region in the future and this resource was included by the AP2 in its policy scenarios. The potential capacity reflects landfill gas with a gas collection system already in place; capital costs reflect addition of generating equipment. Table 7 presented below summarizes the cost and performance assumptions for landfill gas generation.

[10] Annual Energy Outlook 2001.

Table 7: Cost and Performance Assumptions for Landfill Gas Generation[11]

Region	Potential Capacity (MW)	Overnight Capital Cost (2001$/kW)	Fixed O&M (2001$/kW-Yr)	Variable O&M (2001 mills/kWh)	Capacity Factor (%)
CNV [California and Southern Nevada]	528	1,291	85	11	87
WSCP [Pacific Northwest]	128	1,291	85	11	87
WSCR [Interior West]	336	1,291	85	11	87

Cost and Performance for Wind Technologies

Because wind generation is the renewable energy resource most likely to penetrate in the future, the AP2 forum spent considerable time characterizing wind resources for the policy scenarios. In developing the assumptions, the forum sought to capture the issues of intermittency, resource availability, reliability and transmission access that are often associated with wind generation.

The AP2 forum assumed that grid-connected central station wind plants could be located in wind classes 6 or greater, 5 and 4[12]; lower wind classes were unlikely to support commercial electricity generation. Within each wind class, the total resource is divided into four cost categories to account for resource degradation and impact on electric system reliability stemming from the intermittency in wind generation.

Cost multipliers are applied to each of the four wind classes to reflect these factors. The four cost categories reflect multipliers of 1, 1.2, 1.4 and 1.6 applied to base cost. The result is a wind resource supply curve that limits how much wind capacity is available at each cost point. The AP2 forum assumed that the highest cost category could not exceed 1.6 since at the very most (or at high levels of wind generation) a combustion turbine could be used to provide backup for the intermittency in wind generation to guard against any system reliability concerns. The available wind capacity resources were distributed among the four cost categories as outlined below with the best wind resource being assigned to the lowest cost scalar first.[13]

- Cost Scalar 1.0: Wind capacity equal to 10 percent of the region's generation or 10 percent of available capacity whichever is lower;

[11] "Energy Project Landfill Gas Utilization Software Manual," Appendix A, US EPA 1997 and "Turning a Liability into An Asset: A Landfill Gas-to-Energy Project Development Handbook," US EPA September 1996.
[12] Wind classes are based on average wind speed in the area. Class 6 or greater have the highest average wind speeds, while class 4 has the least average wind speed.
[13] Data provided by Walter Short, National Renewable Energy Laboratory. A similar methodology was also used in "Scenarios for Clean Energy Future," Union of Concerned Scientists.

- Cost Scalar 1.2: Wind capacity meeting 10 percent – 15 percent of region's generation;
- Cost Scalar 1.4: Wind capacity meeting 15% - 20% of region's generation; and
- Cost Scalar 1.6: Remaining wind capacity.

Table 8 presented below summarizes the potential capacity by wind class and cost category for each model region.

Table 8: Potential Wind Capacity by Model Region, Wind Class and Cost Class

(in MW)		Cost Scalars			
Model Region	**Wind Class**	**1**	**1.2**	**1.4**	**1.6**
CNV	Class 6	1,574	4,543		
(California and South-	Class 5		2,775		
West Nevada)	Class 4		4,699	2,145	
CNV Total		1,574	12,017	2,145	-
WSCP	Class 6	678			
(Pacific Northwest)	Class 5		6,088		
	Class 4		962	3,316	17,935
WSCP Total		678	7,050	3,316	17,935
WSCR	Class 6	6,593	3,297	3,297	55,156
(Interior West)	Class 5				32,384
	Class 4				292,468
WSCR Total		6,593	3,297	3,297	380,008

To characterize the cost and performance of wind technologies, the AP2 forum developed four technology vintages that become available for commercial application at different times in the planning horizon. The four vintages reflect expectations of declining costs and technological improvements. Table 9 provides a summary of the cost and performance assumptions for wind technologies.

Table 9: Cost and Performance Assumptions for Wind Technologies[14]

Available Years	Overnight Capital Costs (2001$/kW)	Fixed O&M (2001$/kW-Yr)	Variable O&M (2001 cents/kWh)	Annual Average Capacity Factor
Wind Class 6				
2000-2004	1000	4.00	0.5	40.4
2005-2009	915	4.00	0.2	45.3
2010-2014	800	4.00	0.18	46.4
2015-onward	770	4.00	0.17	47.9
Wind Class 5				
2000-2004	1000	4.00	0.5	35.3
2005-2009	915	4.00	0.2	40.2
2010-2014	855	4.00	0.18	41.3
2015-onward	825	4.00	0.17	42.75
Wind Class 4				
2000-2004	1000	4.00	0.5	30.2
2005-2009	915	4.00	0.2	35.1
2010-2014	910	4.00	0.18	36.2
2015-onward	880	4.00	0.17	37.6
Notes: Does not include Production Tax Credit.				

For this analysis, the generation output from wind plants is based on generation profiles that describe the hourly generation for a typical day in summer and winter. The annual average capacity factor presented in Table 9 above is therefore a summary characteristic of that generation profile. Furthermore, because wind plants are not dispatchable, the capacity credit for wind is restricted to the average generation in the peak 30% of the hours represented by the profile.

Recognizing that wind technologies may encounter problems with transmission bottlenecks, particularly in the interior West where significant resources are located, the AP2 forum decided to include a transmission cost adder of $208 ($2001/kW)[15] for wind resources located in the interior west. While the cost of interconnection to the grid is reflected in the capital costs reported in Table 9 above, the transmission cost adder for the interior West reflects the fact that these resources may also require some upgrades to the existing transmission system in order to deliver the power to the load centers. Connection to the grid alone does not guarantee delivery because there may not be sufficient capacity on the transmission lines to carry the additional power. The forum felt that this cost was particularly warranted for the interior west because much of the wind resource there is located in Wyoming. The forum felt that developing the resources in the interior west would, at a minimum, require some upgrades to the local transmission system to get the power to the demand centers.

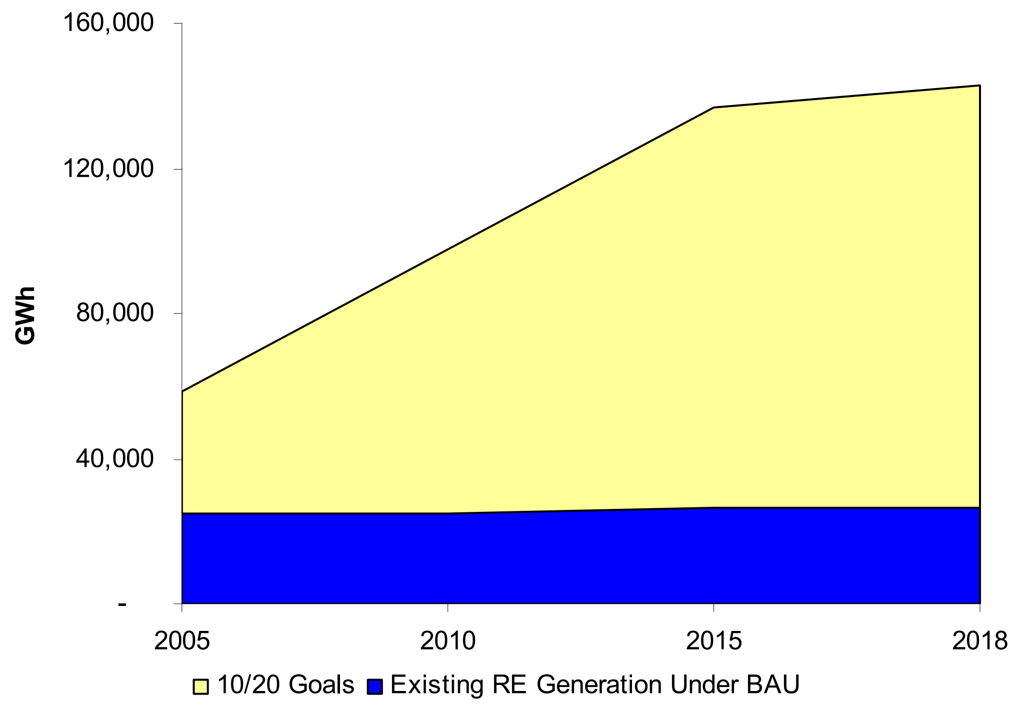
[14] Data provided by Walter Short, National Renewable Energy Laboratory.
[15] Based on “Conceptual Plans for Electricity Transmission in the West,” Report to the Western Governors’ Association, August 2001. Estimated using the incremental cost between the Gas transmission scenario and the Alternative Fuel Scenarios. Consistent with this report, the transmission cost adder is also applied to new coal capacity in the interior west.

The assumptions presented in Table 9 reflect declining technology costs and improved capacity factors over time. In the sensitivity policy scenario that do not allow for those improvements, the 2000-2004 costs and performance are held constant over all time periods.

Assumptions on the 10/20 Renewable Energy Goals

The 10/20 goals were an explicit requirement in many of the policy scenarios and the characterization of that policy goal is based on the recommendations of the GCVTC. The AP2 forum assumed that the minimum renewable energy generation targets for the 10/20 goals would be based on the electricity demand in the nine states and tribal land of the Transport Region. The 10/20 goals, as modeled in this analysis, requires that by 2005 10 percent of the regional electricity demand be met by generation from renewable energy and by 2015 20 percent of the regional electricity demand be met by generation from renewable resources. Existing generation from renewable energy also counts towards that target. Figure 8 presented below provides a summary of the targets and the existing generation from renewable energy under the BAU.

Figure 8: 10/20 Renewable Energy Generation Targets



This analysis assumes that the 10/20 renewable energy targets can be met by generation from wind, solar photovoltaic, solar thermal, biomass gasification combined cycle, biomass direct combustion, landfill gas and geothermal. The analysis did not include options for small hydro (due to data limitations), though small hydro is a potential renewable energy supply option. In addition, the renewable energy targets can be met by generation from renewable technologies located anywhere within the nine states and tribal lands of the Transport Region and also within the state of Washington and Montana[16].

Assumptions on Energy/Capacity Savings and Implementation Costs for Energy Efficiency Recommendations

The AP2 forum commissioned the Tellus Institute to develop the energy savings and implementation cost assumptions for the energy efficiency recommendations. A description of the approach and method used for the energy efficiency analysis along with the detailed results are presented in Appendix II.

The assumptions on the energy savings and implementation costs for the energy efficiency measures were developed outside of IPM, the power-industrial-process sources sectors modeling framework. The energy and peak capacity savings associated with energy efficiency were introduced into IPM to estimate the emissions reductions and cost savings resulting from lower energy demand. The potential emissions reductions were estimated using the change in emissions between the energy efficiency policy scenarios and the BAU scenario. The net production costs impacts were determined based on the following:

(1) The energy efficiency implementation costs estimated outside of IPM;
(2) The avoided investment cost savings in transmission and distribution estimated outside of IPM;
(3) The cost saving from reduced generation estimated using IPM.

The assumptions for the energy efficiency recommendations were specified by model region (CNV – California and Southwest Nevada; WSCP – Pacific Northwest; and WSCR – Interior West) to fit in with the modeling specification for IPM. Though the three model regions encompass more than the nine states and tribal lands of the Transport Region, the saving and cost estimates were based only the states and tribal lands of the Transport Region. Savings were characterized as electricity demand savings, the annual reduction in electricity demand inclusive of loss, and peak savings, the avoided generation capacity associated with the electricity demand savings. Figures 9 and 10 presented below describe the total regional energy and capacity savings. The total savings reflects the sum of savings across the industrial, residential and commercial sectors and represents 1 percent of electricity demand in 2005 and growing to 8 percent by 2018 under BAU conditions.

[16] Renewable generation located in Washington and Montana were allowed to count towards the 10/20 targets because, in the modeling, these states share common electricity markets with many of the states/tribes of the Transport Region.

Figure 9: Annual Electricity Demand Savings Under the Energy Efficiency Recommendations

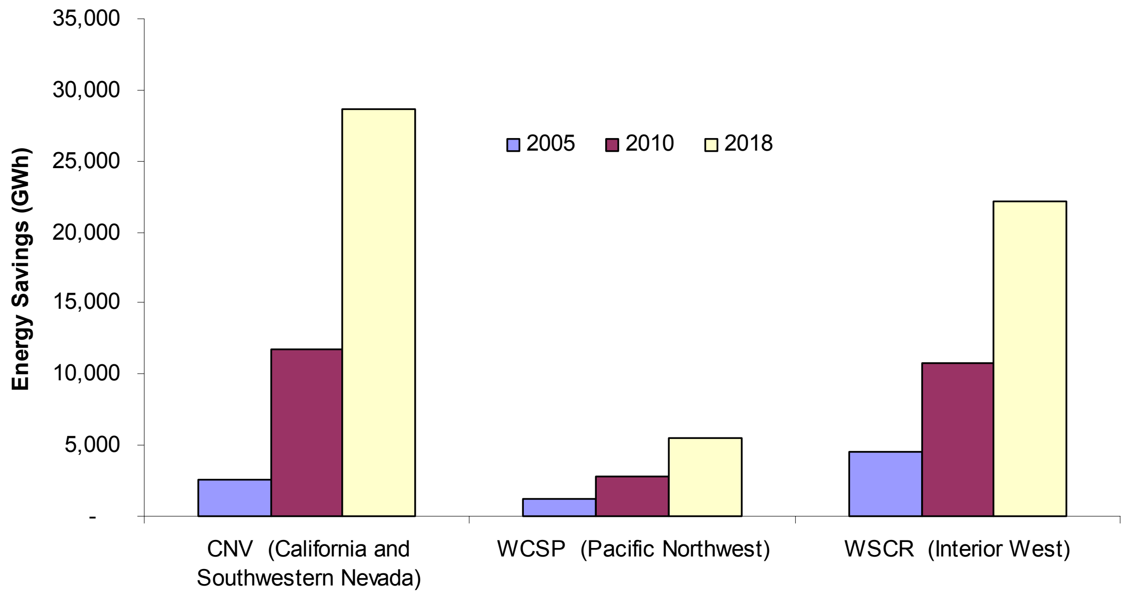
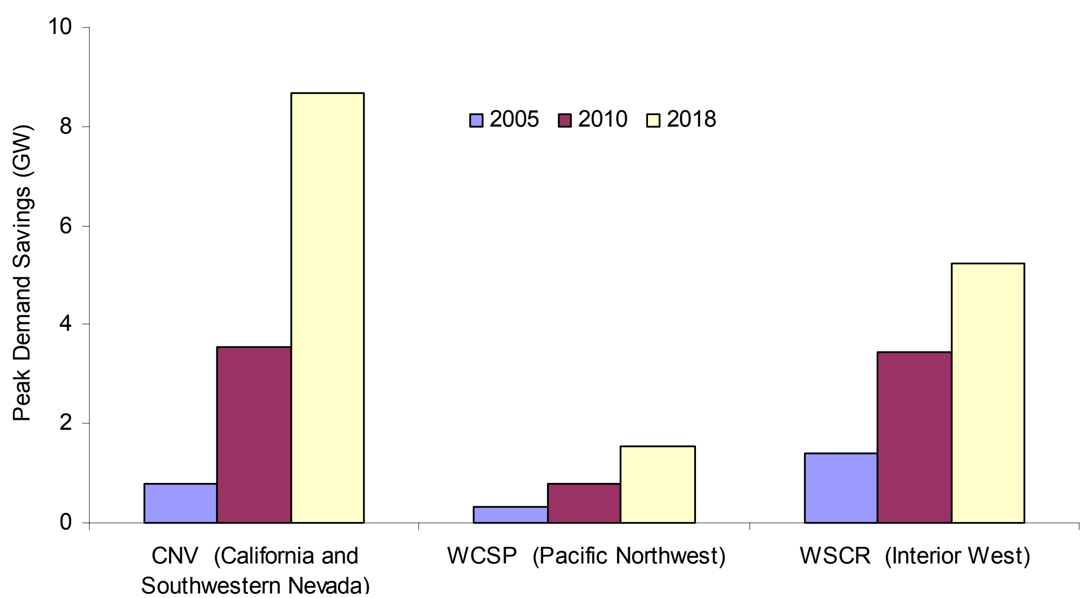
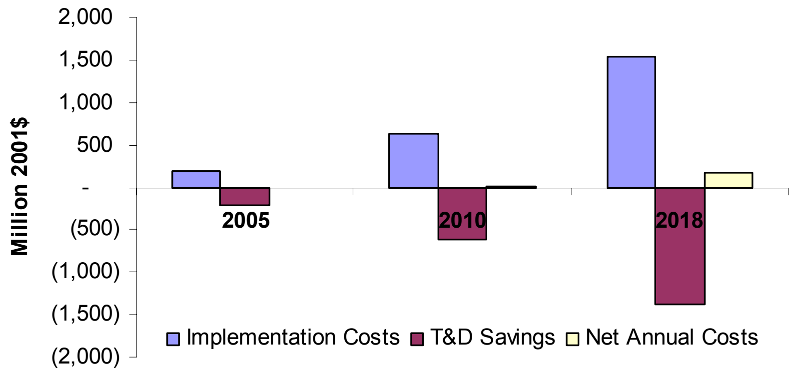


Figure 10: Generation Capacity Savings Under the Energy Efficiency Recommendations



The costs for implementing the energy efficiency recommendations include the costs borne by both the customer and the sponsor and reflect the equipment purchase, fuel, operations, administration and marketing costs. In addition to the implementation costs, the AP2 forum assumed that the energy efficiency measures would lead to avoid investments in the transmission and distribution system at an annual average cost savings of 2.4 cents/kWh (2001 $). Because IPM is a wholesale electricity model that captures cost savings only at the wholesale generation levels, it was necessary to account for these avoided transmission and distribution (T&D) costs outside the model. Figure 11 provides a summary of the assumptions on total implementation costs and avoided T&D investments costs savings for the energy efficiency recommendations. In IPM modeling of the energy efficiency scenarios, the projected production cost savings from IPM are compared against the assumed implementation and avoided T&D costs to estimate net savings.

Figure 11: Annual Implementation Costs and Avoided T&D Cost Savings Under the Energy Efficiency Recommendations



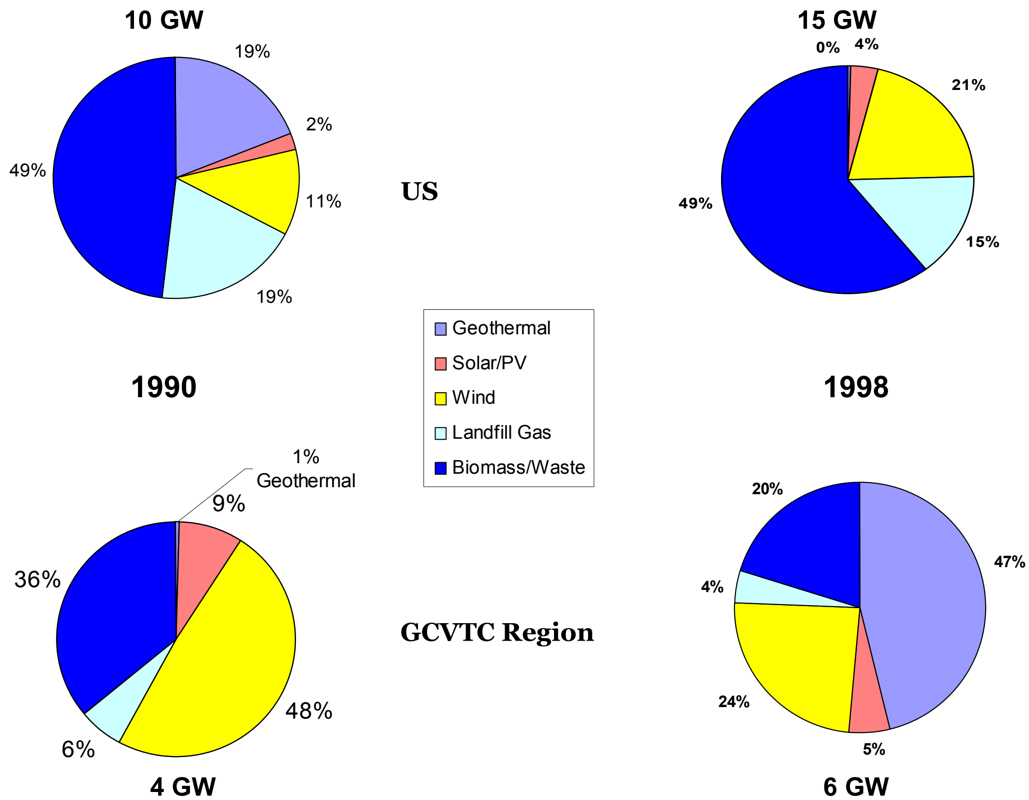
IV. Emissions and Production Costs Impacts

This section describes the emissions and costs impacts on the electricity, industrial and process source sectors under the policy scenarios. The impacts are described in terms of the changes relative to the BAU scenario, thus the first section outlines the notable elements under the BAU scenario.

IV.1 Key Elements Under the Business-As-Usual (BAU) Scenario

The BAU scenario represents a projection of the future without additional efforts to promote renewable energy and energy efficiency in the West. It provides a good reference point for analyzing the impacts of meeting the 10/20 goals and implementing the energy efficiency recommendations. The BAU scenario includes about 1 GW of additional renewable resources that are currently under construction or near the construction phase. However, no additional renewable resources beyond these planned additions are projected in the BAU. As a point of reference, over the last decade about 2 GW of new renewable resources have been brought on line.

Figure 12: Existing Renewable Energy Capacity[17]

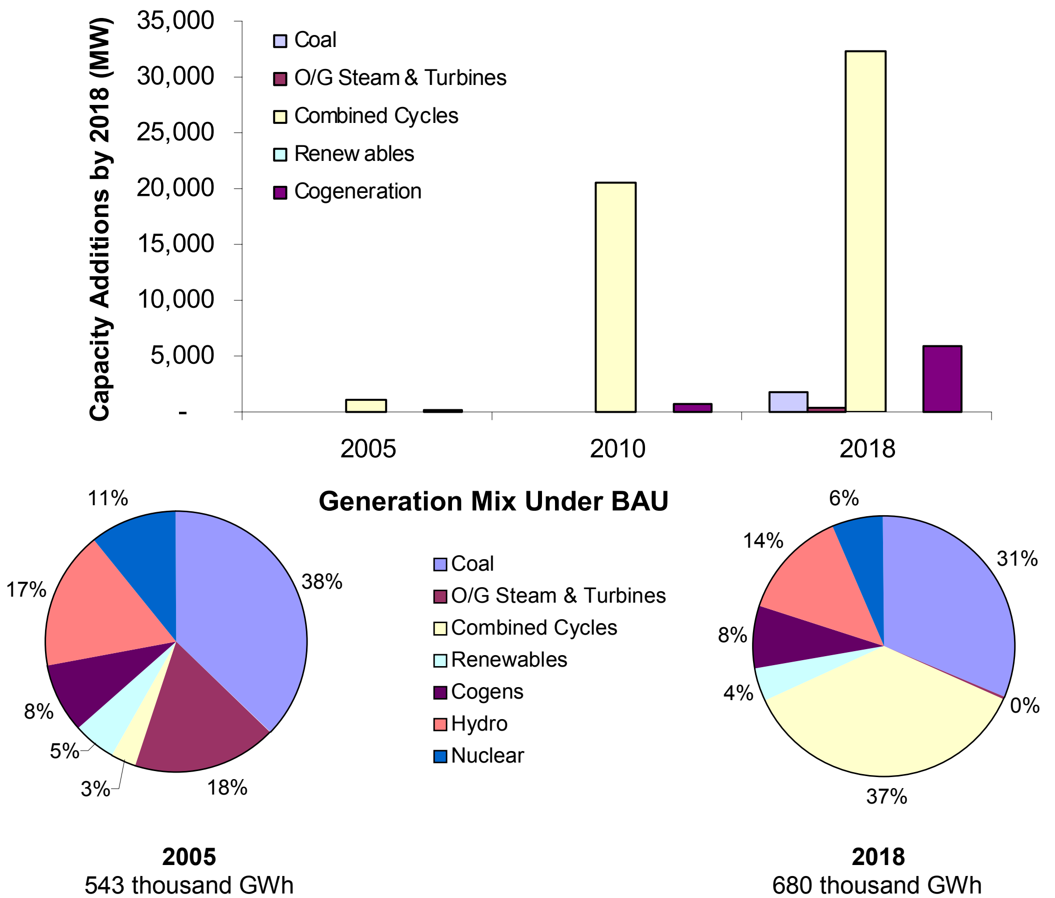


[17] 1990 Data: Energy Information Administration (EIA) Form 860 and EIA Form 867. Some 1990 capacity has been withheld for confidentiality. 1998 Data: EIA Form 860A and EIA Form 860B.

The BAU does not assume any major policy efforts to increase renewable energy or energy efficiency, aside from the indirect benefits afforded clean energy sources by existing air regulations including the Title IV SO_2 program under the Clean Air Act Amendments and the regional SO_2 backstop trading program proposed under the Annex. The growth in renewable capacity under the BAU is limited to the firm capacity additions planned and/or under construction.

Under the BAU scenario, the growth in electricity demand is likely to be met by additions of new gas-fired capacity. By 2018, almost 30 GW of new combined cycle capacity, representing 80 percent of the total growth in new capacity is projected under the BAU. The new combined cycle capacity will likely consist of new combined-cycle and repowering of the older stock of oil/gas steam units to more efficient combined cycle units. As illustrated in Figure 13, by 2018 gas-fired generation from combined cycles represents 37 percent of all generation in the Transport Region up from 21 percent in 2005 (oil/gas steam and combined cycle). The generation from nuclear, hydro and renewable energy remains unchanged between 2005 and 2018, but accounts for a smaller share of the total generation in 2018.

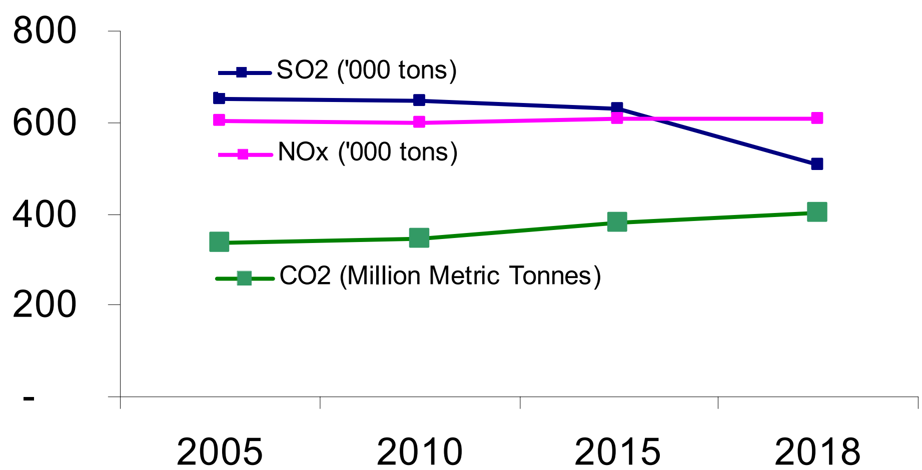
Figure 13: Capacity Growth and Generation Mix Under the BAU



The changes in emissions over time under the BAU scenario reflect the changing mix in capacity and generation. SO_2 emissions under the BAU scenario remain relatively unchanged till 2013, after which the emissions decline as a result of the assumed SO_2

cap and regional trading program. Though NO_x emissions remain relatively unchanged under the BAU scenario between 2005 and 2018, the NO_x emissions *rate* declines significantly as a result of the repowering of existing oil/gas steam units. For CO_2, the change in emissions between 2005 and 2018 mirrors the increase in fossil fuel usage and rises by 19 percent between the two years. Figure 14 presented below provides a summary of projected emissions under the BAU scenario.

Figure 14: Emissions Under the BAU Scenario



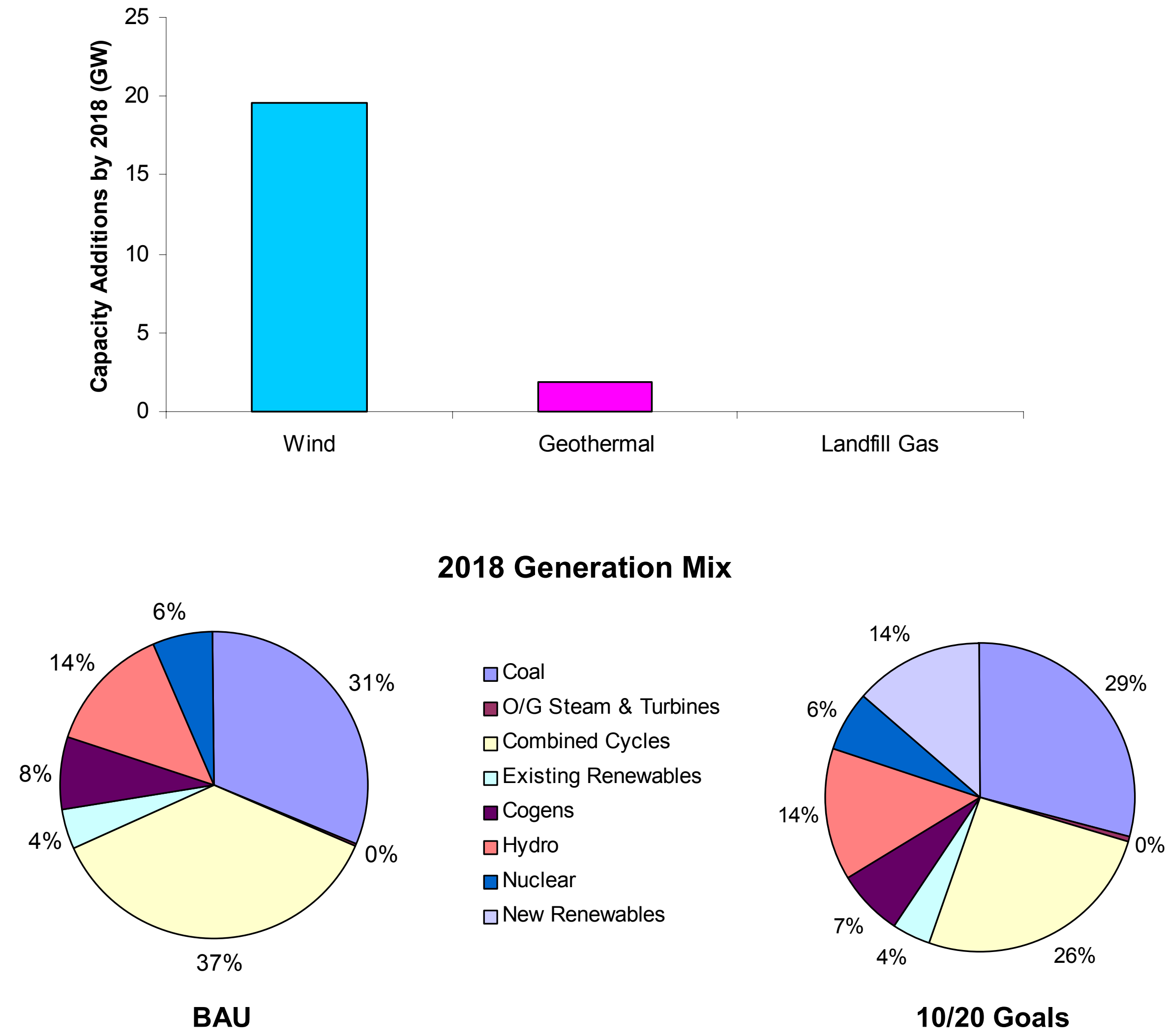
IV.2 Electric System Capacity and Generation Impacts

Implementation of the10/20 goals and energy efficiency recommendations lead to significant increases in renewable energy capacity, totaling nearly 20 GW by 2018. The increase in renewable energy capacity is driven by the combination of two key factors. First, under the policy scenarios that include the 10/20 goals there is an explicit requirement that by 2005 10 percent of the regional electricity demand must be met by renewable resources. By 2015, the requirement increases to 20 percent. Second, the growth in renewable energy capacity is spurred by declining renewable technology cost and performance improvements that the AP2 forum assumed would occur in the policy scenarios.

Under the 10/20 goals policy scenario, as illustrated in Figure 15 below, renewable energy generation in the states and tribal lands of the Transport region expands to 18 percent, up from 4 percent under the BAU scenario[18]. Most of this expansion comes from new wind capacity, which accounts for 65 percent of the renewable energy generation.

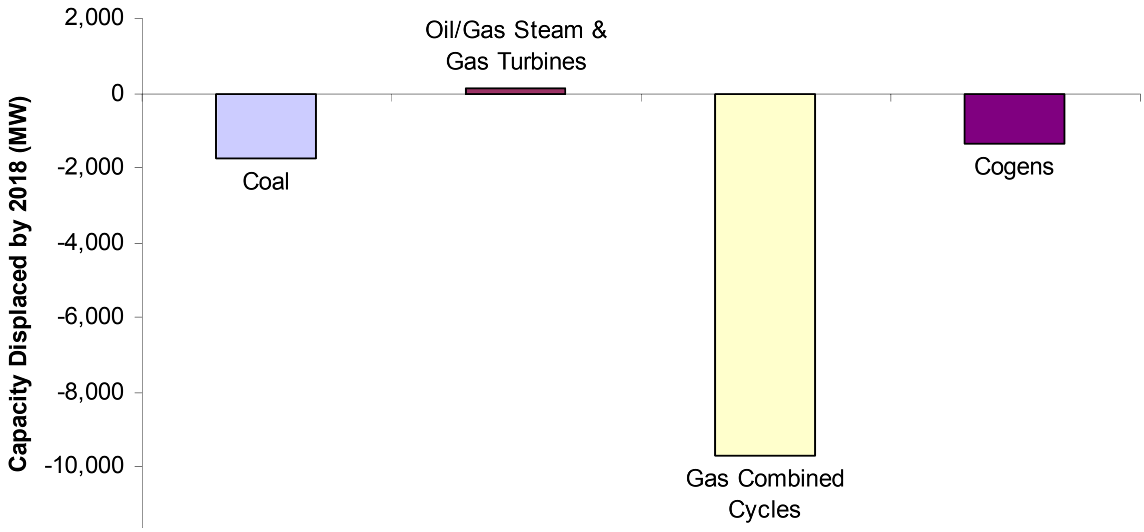
[18] Two percent of the renewable energy generation for the 10/20 goals comes from states and tribal regions outside the Transport Region but that share common electric market with the states/tribes in the Transport Region. The scenario assumes that renewable energy generation from such sources can be used towards the 10/20.

Figure 15: Renewable Energy Capacity and Generation Under the 10/20 Goals



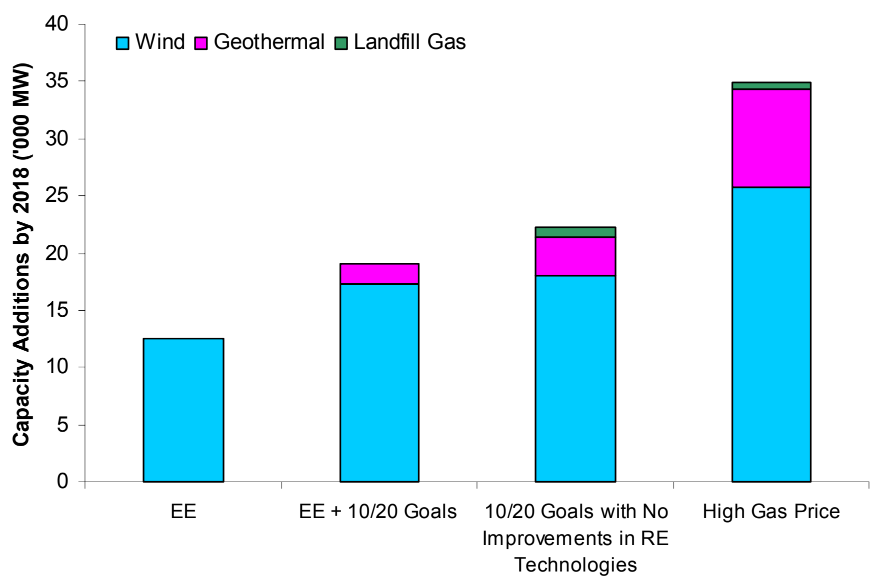
The expansion of renewable energy capacity under the 10/20 goals predominantly displaces new gas-fired capacity. As illustrated in Figure 16 below, by 2018 displaced gas fired combined cycles accounts for almost 80 percent of the 13 GW of the total displaced capacity. The type of displaced capacity (i.e., gas fired combined cycle) reflects the fact that renewable energy capacity will compete against new fossil capacity additions rather than affect the stock of existing units.

Figure 16: Capacity Displaced Under the 10/20 Goals



Results of the analysis indicate that wind will remain the dominant renewable energy technology across a range of different sensitivities and assumptions, particularly when renewable energy generation accounts for 10 percent to 20 percent of regional electricity generation. As illustrated in Figure 16 below, across the other policy scenarios analyzed by the AP2 forum, new wind capacity accounts for at least 75 percent of the additions to renewable energy capacity. In Figure 17 presented below, “EE” refers to the energy efficiency policy scenario, “EE + 10/20” refers to the policy scenario that includes energy efficiency along with the 10/20 goals, “10/20 Goals with No Improvements in RE Technologies” refers to the policy scenario that includes the 10/20 goals but does not allow for improvements in renewable technology cost and performance and “High Gas Prices” refers to the policy scenario with 50% higher gas prices.

Figure 17: Renewable Energy Capacity Additions Under Alternative Policy Scenarios



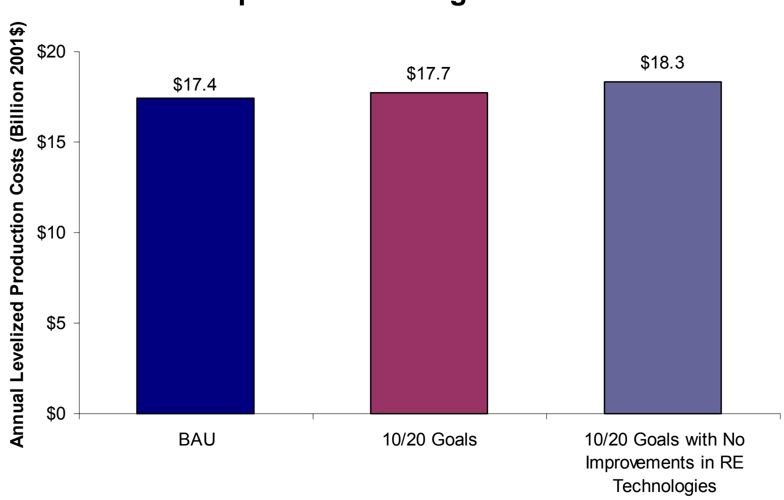
In summary, the changes in electric capacity and generation under the policy scenarios provide some interesting insights. First, the results of the analysis suggest that wind is likely to be the primary choice for renewable energy technology in the West. Even with renewable energy generation providing over 20 percent of the region's electricity generation demand, as in the high gas price scenario, wind appears to be the dominant technology of choice. Second, the penetration of the renewable energy capacity and energy efficiency appears to displace mostly new additions to capacity rather than affecting the existing generation stock. Because most of the new capacity additions under the BAU are gas-fired combined cycle, the results indicate that new gas-fired capacity will be primarily displaced under the policy scenarios. The more important, broader implication is also that renewable energy and energy efficiency compete against new capacity in the supplying electricity.

IV.3 Production Costs Impacts

Implementing the 10/20 renewable energy goals will lead to increased production costs, while the energy efficiency recommendations will result in production costs savings. Production costs, in this case, reflects the incremental or going forward costs [19] associated with producing electricity and industrial steam and includes incremental capital costs, fuel costs and operation and maintenance costs.

As mentioned previously, the AP2 forum considered the production cost impacts of meeting the 10/20 goals under two alternative policy scenarios. In the first policy scenario, the AP2 forum assumed that the cost of developing renewable energy, particularly wind, would improve in the future as a result of the growth in renewable energy capacity. In the second scenario, the AP2 forum wanted to examine the production costs impacts without allowing for any improvements in renewable technology cost and performance. As illustrated in Figure 18 below, the annual levelized production cost impacts under the two policy scenarios could range between $300 million (2001 $) and $900 million (2001 $) or 2 percent to 5 percent of the production costs under the BAU respectively.

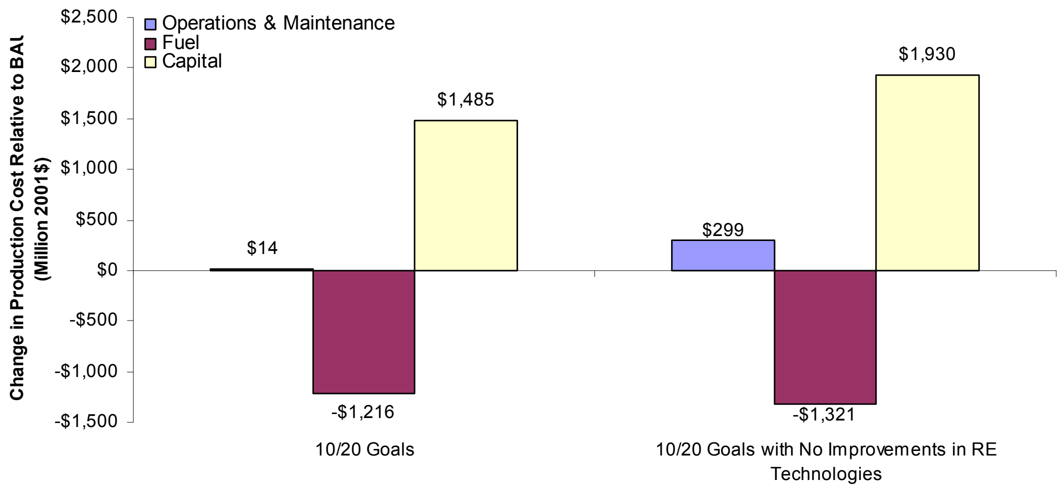
Figure 18: Production Cost Impacts in Meeting the 10/20 Renewable Energy Goals



[19] Embedded cost associated with the capital cost of existing units are not included in modeled production costs.

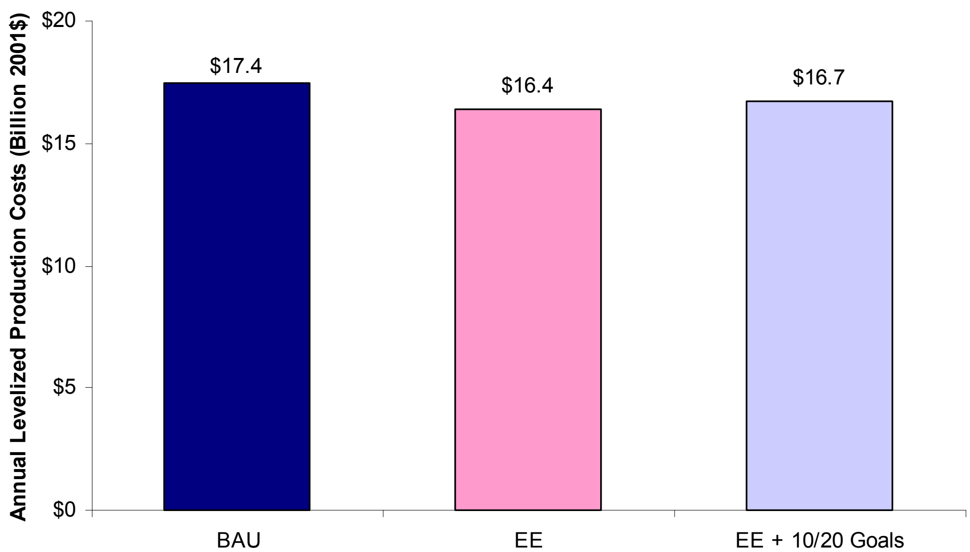
The increase in production costs in meeting the 10/20 goals is largely driven by the capital expenditures required for new renewable energy projects. While the penetration of renewable energy leads to reductions in costs from displaced fossil fuel generation, it is not sufficient to fully offset the increased capital expenditures. Nonetheless, there is a shift in production costs away from fuel and towards capital. Under the 10/20 goals, operation-and-maintenance costs remain relatively unchanged. Figure 19 presented below highlights the composition of the change in annual levelized production costs for 2018.

Figure 19: Composition of Annual Levelized Production Cost Impacts in Meeting the 10/20 Goals



Unlike the 10/20 goals, implementation of the energy efficiency recommendation with and without the 10/20 goals leads to annual levelized production costs *savings* of $730 million to $1 billion (2001 $) respectively. These net savings reflect the cost of implementing the recommendations, the avoided investment costs for transmission and distribution infrastructure and the reduction in electricity production costs from decreased electricity demand. Though the requirements of the 10/20 goals somewhat lowers the savings from energy efficiency, the 10/20 goals and energy efficiency recommendations still result in annual levelized production costs savings of over $700 million. These savings represent 4 percent to 7 percent of the annual levelized production costs of the BAU scenario. Figure 20 presented below contrasts the annual levelized production costs under the BAU and policy scenarios with the energy efficiency recommendations.

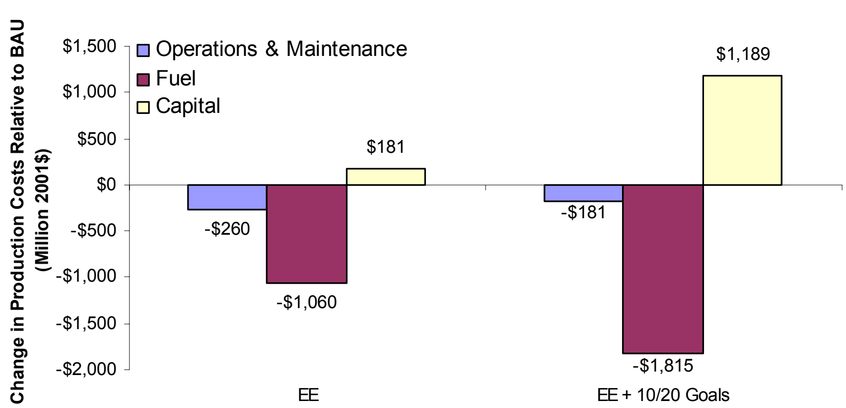
Figure 20: Annual Levelized Production Costs Under the BAU and Policy Scenarios with the Energy Efficiency Recommendations



The projected production costs savings presented in Figure 19 reflects the assumed improvements in renewable energy technology cost and performance. The AP2 forum assumed that the energy efficiency recommendations would occur under a policy regime that would actively promote renewable energy, though without explicit targets, thus leading to enhancements in technology cost and performance.

Much like the policy scenarios with the 10/20 goals, the production cost savings under the policy scenarios with are driven by reductions in fuel expenditures because energy efficiency displaces gas generation. Figure 21 presented below illustrates that by 2018, energy efficiency and energy efficiency with the 10/20 goals leads to almost $ 2 billion in fuel expenditure savings, offset only by increased capital investments in renewable energy capacity.

Figure 21: Composition of Production Cost Impacts Under the Energy Efficiency Policy Scenarios



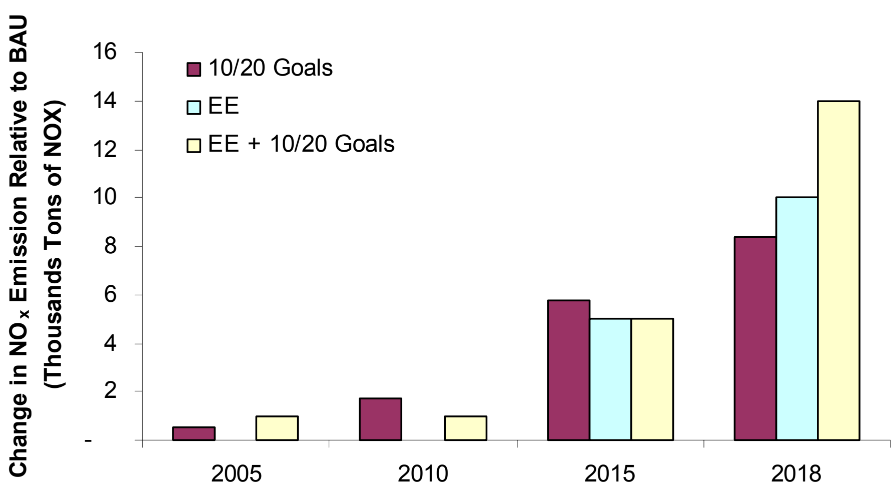
In summary, the production cost impacts of the policy scenarios yield some interesting insights for the 10/20 goals and energy efficiency recommendations. First, the 10/20 goal will results in modest production cost impacts of 2 percent to 5%, while energy efficiency recommendations will achieve production cost *savings* of 5 percent to 7 percent. Second, and perhaps the most notable feature of these policies is that because both the 10/20 goals and energy efficiency recommendations shift production expenditures away from fuel and towards capital, these policy objectives can offer some security against fuel price volatility and fuel supply shocks.

IV.4 Emissions Impacts

Under the 10/20 goals, the emissions reductions occur because conventional fossil fuel generation is replaced with clean or low emissions generation from renewable energy. With energy efficiency, demand savings displaces electricity generation, which in turn creates the opportunities for emissions reductions. The level of associated emissions reductions depends on the pollutant being examined. Fuel based emissions (CO_2) generally follow fuel consumption, while technology/fuel dependent emissions such as NO_x depends on the relative emission rate of displaced technologies.

Under the policy scenarios of the 10/20 and energy efficiency, the change in NO_x emissions relative to the BAU scenario range between 1 percent and 2 percent. As illustrated in Figure 22 below, by 2018 the emissions reduction in NO_x from implementing the 10/20 goals and the energy efficiency will be between 8,000 tons and 14,000 tons annually. Most of the emissions reductions are likely to occur after 2010, when the penetration of renewable energy and energy efficiency is most significant.

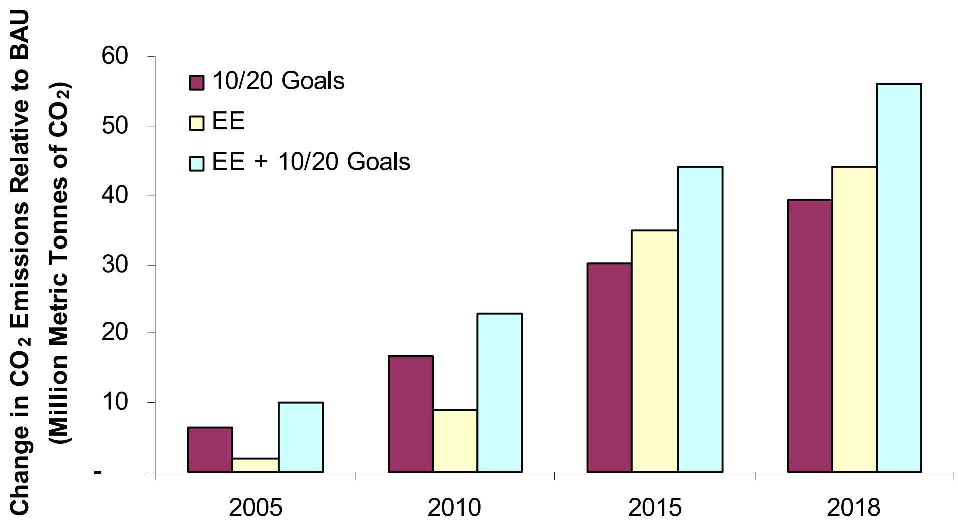
Figure 22: Reductions In NO_x Emissions Under the Policy Scenarios



The modes emissions reductions in NO_x under the 10/20 goals and energy efficiency recommendations reflect that the fact that they largely displaced new gas-fired combined cycles, which are expected to have relatively low NO_x emission rates. However, it is important to recognize that because these reductions come from new generation capacity, renewable energy and energy efficiency will provide a hedge against future NO_x emissions growth.

Estimated emissions reductions in CO_2, on the other hand, are driven largely by reductions in fossil fuel use. As highlighted in Figure 23 below, the reductions in CO_2 emissions range between 10 percent and 14 percent under the various policy scenarios. By 2018, when the penetration of renewable energy and energy efficiency are most significant, the reductions are projected to between 40 million metric tonnes and 55 million metric tones.

Figure 23: Reductions In CO_2 Emissions Under the Policy Scenarios



As was true for NO_x emissions, because CO_2 emissions reductions derive from reductions in fossil fuel use in new capacity additions, the 10/20 goals and energy efficiency will likely provide a hedge against future CO_2 emissions growth.

Unlike NO_x and CO_2 emissions, the analysis projects no reductions in SO_2 emissions reflecting the regional emissions cap and SO_2 trading program as proposed in the Annex and modeled in all scenarios. However, because the SO_2 trading program creates a monetary value for SO_2 emissions, affected sources under the cap and trade program take advantage of reduced fuel use and associated lower emissions to reduce their overall cost of compliance with the cap. Thus, there is an economic benefit to fully offsetting any SO_2 emissions reductions provided by the 10/20 goals and energy efficiency recommendations. This result is not unique to this particular situation but is rather a general outcome under an emissions cap and trading program. Analysis of the extent to which the 10/20 goals might lower the costs of compliance in the regional backstop SO_2 trading program in the Transport Region is discussed below.

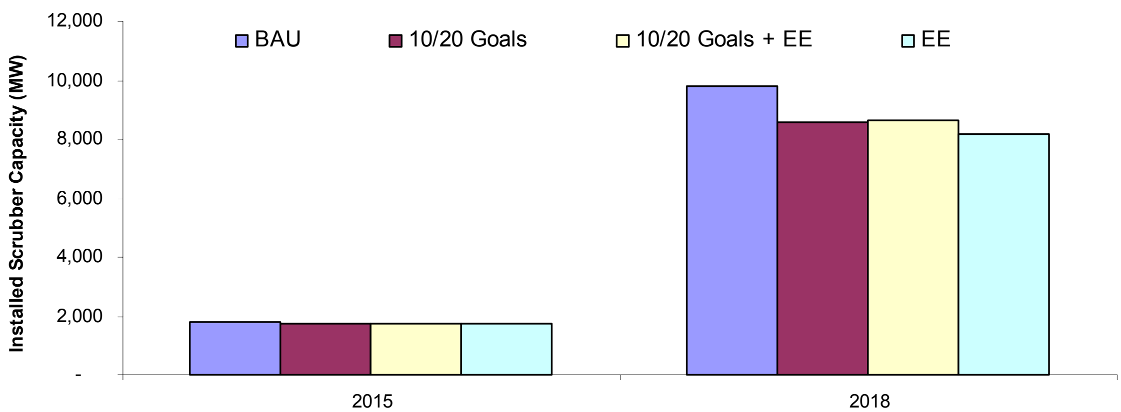
IV.5 Impact on the Regional Backstop SO_2 Trading Program

The compliance cost of the regional trading program such as the Annex depends on the level of reductions required. The 10/20 goals and energy efficiency programs help to lower the compliance cost of the regional backstop SO_2 trading program by lowering the amount of reductions needed to meet the milestone. The penetration of renewable energy under the 10/20 goals displaces fossil fuel generation, which in turn provides the remaining plants in the trading program with more headroom under the emissions cap. The implementation of the energy efficiency recommendations would have the same effect because it also displaces fossil fuel generation.

The results of the analysis indicate that by implementing the 10/20 goals, the compliance cost of meeting the SO_2 reduction requirements through a trading program as proposed in the Annex could decline by approximately $10 million (or 7 percent of the compliance cost without the 10/20 goals[20]) in 2018. This estimate is based on a comparison between two scenarios, one including the 10/20 goals without the regional trading program and the other including the 10/20 goals and the regional trading program (i.e., the 10/20 goals policy scenario).

The fact that the 10/20 goals may make it cheaper to comply with the SO_2 cap and trade program can be illustrated by examining projected amount of SO_2 scrubbers constructed under the scenarios. Scrubber installations (or enhancements to existing scrubbers) are likely to be a key compliance strategy in meeting the SO_2 reduction requirements under the Annex trading program. As illustrated in Figure 24 below, 1,200 MW to 1,700 MW, representing 13 percent to 17 percent, of fewer scrubber installations are projected under the policy scenarios relative to the BAU scenario.

Figure 24: Projected Scrubber Installations Under the Annex SO_2 Trading Program



In summary, the results of the analysis suggest that implementation of the10/20 goals and energy efficiency recommendations will help to reduce the compliance cost of the regional backstop SO_2 trading program by as much as $ 10 million (or 7 percent) in 2018 and displaces 1,200 MW to 1,700 MW of new scrubber installations.

IV.6 Wholesale Electricity Price Impacts

This section discusses the wholesale electricity price impacts and the renewable energy credit price under the policy scenarios of the 10/20 goals and the energy efficiency recommendations. The distinction between the wholesale electricity price and the renewable energy credit price has been maintained for this discussion because the policy design of the 10/20 goals, particularly on how the compliance cost of the 10/20

[20] Ibid., MTF 2000.

goals might be recovered, has not been determined.

In the IPM framework, wholesale electricity prices represent the price at which electricity would be sold by a generator to a retail distributor, assuming competitive generation markets. The model is a wholesale power market model and thus does not model retail markets or project electricity retail prices.[21] In IPM, wholesale electricity prices are based on two separate components, energy price and capacity price, which together reflect the price of simultaneously satisfying electricity and reliability demand.

- Energy prices reflect the variable cost of operation and include fuel cost, variable operating costs and emissions-related costs. Emissions-related costs only exist if an emissions trading program is in place and the allowance price in the trading program is greater than zero.

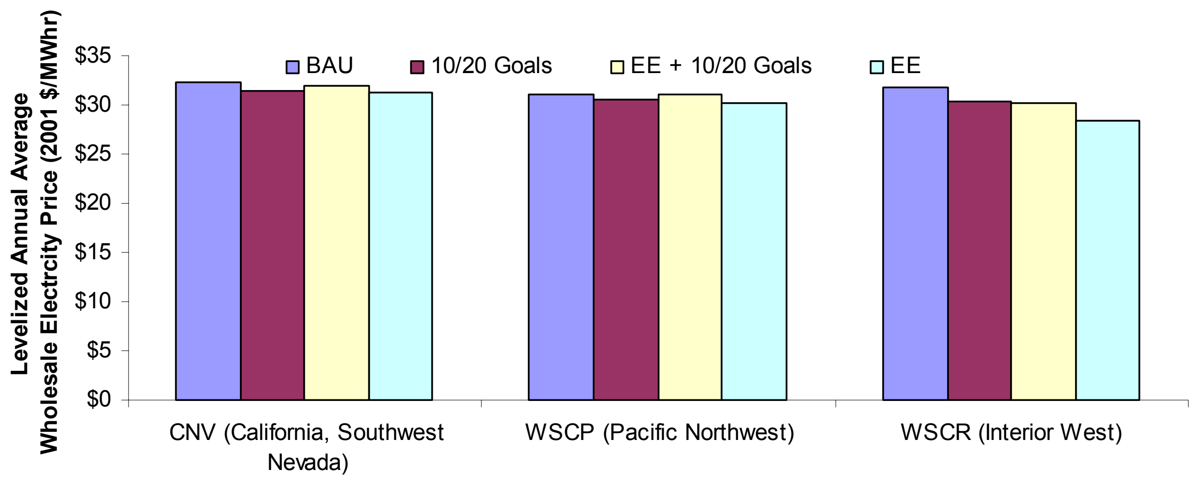
- Capacity prices relate to fixed costs and include the capital and fixed operating costs. Some generating units, such as peaking combustion turbines, often come on-line to serve reliability and only operate a very small fraction of the hours in a year. Such plants often recover their costs through capacity payments. The capacity price can be zero if an electricity market has excess capacity.

The wholesale electricity price is the sum of the energy price and capacity price and both prices reflect the cost of the marginal unit. For energy, the marginal unit is the generating unit that provides the last kWh to satisfy demand and the energy price is based on the variable cost of that marginal unit. All generators, independent of their own cost of generation, receive the same price for the energy sold. Marginal energy prices vary hourly in energy markets. In IPM, marginal energy prices vary by season and load segment (i.e., base, peak, etc). Similarly, the marginal unit in capacity markets is the last unit that has to come on-line to satisfy the peak plus reliability demand and the resulting capacity price is based on the capital and fixed operating costs of that marginal unit.

As illustrated in Figure 24 below, the 10/20 goals and energy efficiency leads to a decline in wholesale electricity prices, of as much as 10 percent under the policy scenario with the 10/20 goals and energy efficiency. The electricity price impacts are differentiated by model region because each of the three regions has separate electricity markets. Though electricity prices often vary within a year and across years, for clarity Figure 25 contrasts the levelized annual average wholesale electricity price between the BAU and policy scenarios.

[21] For purposes of regional economic modeling, where changes in prices (rather than the actual price) serve as modeling inputs, we have included the assumption that end-use electricity customers realize the full benefit (or cost) of the change in wholesale electricity price. In other words, the distribution and/or retailing costs between the Business-As-Usual scenario and the 10/20 goals scenario are assumed to remain constant and the changes in wholesale electricity prices fully flows through to retail rates.

Figure 25: Levelized Annual Average Wholesale Electricity Price



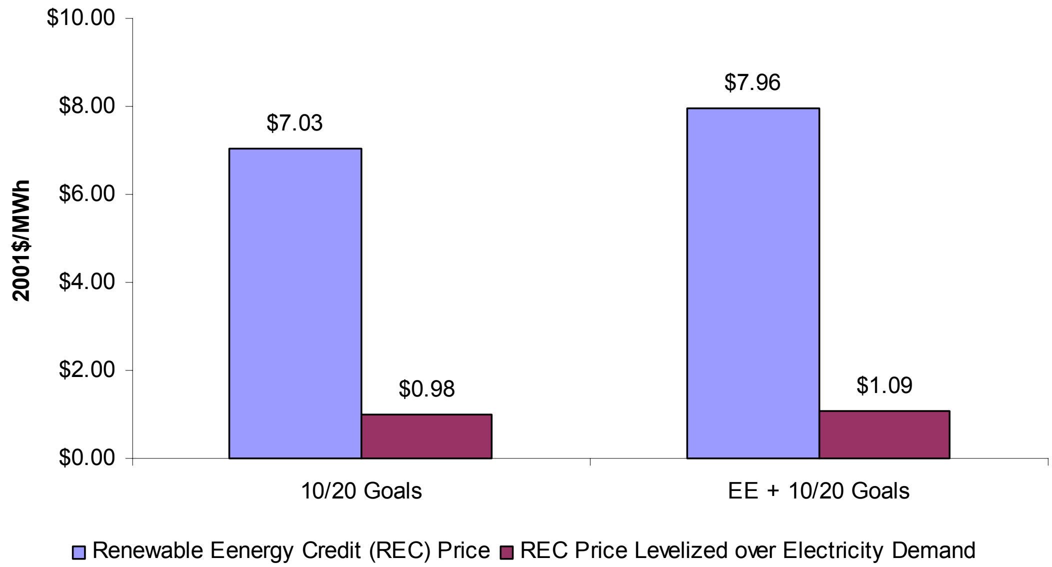
Under the 10/20 goals, the wholesale electricity price declines for two reasons: (1) generation from renewable energy have little or no variable cost of operation and (2) because the 10/20 goals essentially requires the power system to produce the level of generation associated with the targets, in generation markets, wholesale electricity price is determined by the marginal cost in meeting the incremental demand (i.e., the demand left after the generation required by the 10/20 goals have been accounted for). Under energy efficiency, the change in wholesale electricity price results from reduced demand, which eliminates the need for the higher cost units and thus leads to lower prices.

Figure 25 presented above, however, does not account for the "compliance cost" of the 10/20 goals or the implementation costs associated with energy efficiency. The issue of how those costs are recovered is more an issue of policy design but for purposes of this analysis the AP2 forum assumed that the costs of meeting the 10/20 goals and implementing the energy efficiency recommendations would be recovered uniformly through all end-users, as in a Systems Benefit Charge (SBC) type framework.

To achieve the 10/20 goals, developers of renewable energy must earn sufficient revenue to cover their investment costs and earn a reasonable return. These required earnings are reflected in the marginal costs of satisfying the goal – or in the language of renewable portfolio approaches – the renewable energy credit (REC) price. The value of the REC represents the incremental costs over the wholesale energy price that the marginal renewable energy producer must earn – over the commodity energy price – to give him sufficient returns and incentives to construct the renewable capacity. RECs reflect the market price implications of achieving the 10/20 goals while production costs impacts only describe the total production cost implications of meeting the 10/20 targets without describing the price implications (opportunity cost) of the target.

Figure 25 presented below summarizes the annual levelized REC for the policy scenarios with the 10/20 goals. In addition, Figure 26 also describes the value of the REC levelized over the electricity demand of the Transport Region.

Figure 26: Renewable Energy Credit Price for the 10/20 Goals

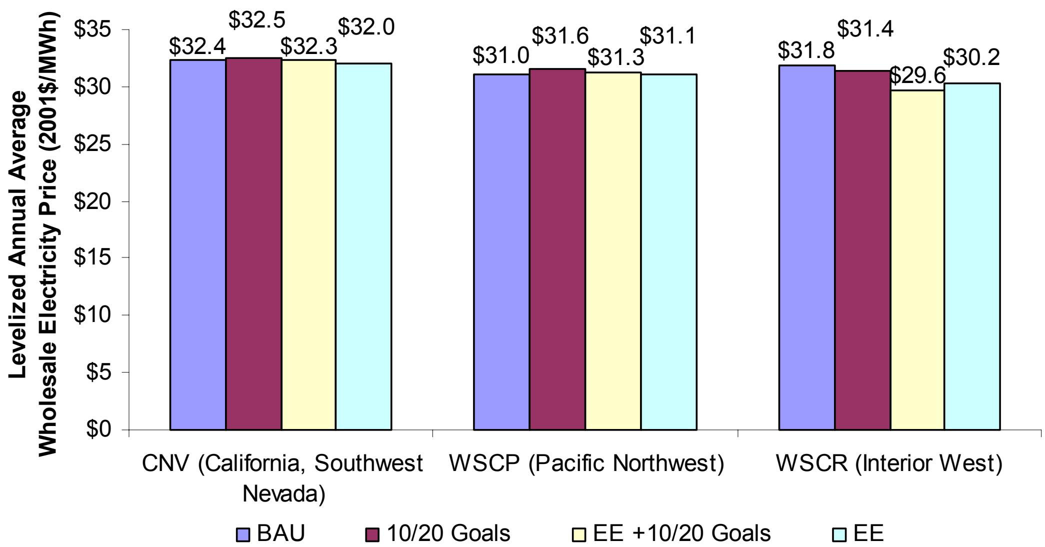


Similarly implementation costs of the energy efficiency recommendations have been translated into price impacts by assuming that the annual levelized implementation costs of $ 45 million[22] will be distributed evenly through all end-users, resulting in an annual levelized cost of $ 0.07/MWh.

The wholesale electricity price along with the renewable energy credit price and the energy efficiency implementation costs provide a better description of electricity price impacts because it explicitly accounts for the compliance cost of the policy objectives. As presented in Figure 27 below, the wholesale electricity price in the Transport Region will increase by 1 percent to 2 percent under the 10/20 goals, decrease by as much as 5 percent with energy efficiency and decrease by as much as 8 percent with energy efficiency and the 10/20 goals. This projected electricity price impact is measured at the wholesale level (the price at which generators will sell to utilities or distribution companies for end-use sales) because it does not account for the distribution and retailing costs. Retail price impacts would be lower in proportion to the share of retail prices that are wholesale price component.

[22] Includes implementation costs and avoided investments costs in transmission & distribution, see Section III.2 above for details.

Figure 27: Wholesale Electricity Price Impacts Under the Policy Scenarios



In summary, the analysis indicates that the 10/20 goals can be achieved with modest price impacts of 1 percent to 2 percent, while energy efficiency could help to reduce the wholesale price by as much as 8 percent in some regions. The largest gains appear to be concentrated in regions that achieve the highest levels of renewable energy and energy efficiency penetration.

V. Secondary Regional Economic Impacts

This section describes the secondary regional economic impacts resulting from the implementation of the 10/20 goals and the energy efficiency recommendations. The AP2 forum selected three policy scenarios for analysis of the regional economic impacts: (1) 10/20 goals; (2) energy efficiency; and (3) 10/20 goals and energy efficiency. Details of the modeling framework and assumptions on regional economic impacts are contained in Section III.2.

Although the REMI model provides estimates on a variety of different impacts, the analysis has been focused around gross regional product (GRP), employment and real disposable personal income. These selected parameters provide a reasonably clear picture of the overall economic impacts of the 10/20 goals and energy efficiency. Gross regional product is analogous to national gross domestic product and describes the final demand or output of the regional economy. It consists of consumption, investment, government expenditures and net exports, while real personal disposable income describes personal income after taxes.

The most informative aspects of the economic impacts are contained in the estimates of the overall regional impacts rather than the state-by-state impacts. While the state-by-state impacts provide a description of how the broader regional impacts may be distributed by state, the state level results may be sensitive to assumption on the distribution of the initial impacts. In particular, the state level results may be sensitive to assumption on how renewable energy investments are allocated across states. IPM projects renewable energy capacity only by model regions and the state level allocations were based on how the renewable energy resources were distribution by state.

On average over the analysis horizon, the 10/20 goals and the EE recommendations have a small impact on GRP, employment and personal income, often less one half of one percent. Most of the impacts are closely aligned with the construction boom that results from capital investment in renewable energy. In addition, the decline in electricity prices from the 10/20 goals and energy efficiency lowers the cost of production in the commercial, industrial and manufacturing sector, which in turns leads to higher income and output. The reduction in electricity prices for the residential sector also leads to higher real income, increased consumption and investments. Table 10 presented below summarizes the change in employment, gross regional product and personal disposable income across the three policy scenarios. State/level details are presented in Appendix I.

Table 10: Annual Average (2005 – 2020) Changes In Key Economic Indicators for the Transport Region Under the Policy Scenarios

	Employment		Gross Regional Product		Personal Disposable Income	
	(Persons)	(% Change)	(Million 2001$)	(% Change)	(Million 2001$)	(% Change)
10/20 Goals	627	0.00%	-312	-0.01%	73	0.00%
Energy Efficiency (EE)	8,415	0.02%	450	0.02%	776	0.04%
10/20 Goals + EE	4,097	0.01%	-58	0.00%	547	0.03%

Under the 10/20 goals, the employment impacts occur mostly in the 2005 to 2015 time period because most of the investment in renewable energy capacity occurs at that time.

Under the scenario that includes only the EE recommendations, the increase in capital investments occur a little later, in the 2011-2015 time period, resulting in an increase in employment over that time period.

The increase in employment also affects gross regional product (or output) through changes in investment and consumption. The increase in employment demand briefly causes wage rates to increase, as labor markets adjust, and this along with the increase in output leads to the increase in personal income. In short, the increase in employment caused by increased investments in renewable energy has the most dominant impact in the regional economy and also leads to related increase in gross regional product and personal income.

The change in employment, though, is temporary and begins to ebb after the 2015 time period as investments in renewable energy decline. The decline in income, which have a less pronounced effect during times of high investments but continue to occur even after the investments have tapered off, add to the regional economic impacts after 2015. The decline in income reflects the drop in profits as a result of the changes in electricity prices and mining revenues from reduced fossil fuel consumption. These income effects are somewhat mitigated by the lower electricity cost faced by the residential, commercial and industrial sector but are not sufficient to offset the decline in income from profits. In addition, wages begins to decline slightly after 2010 as the construction demand begins to taper off and labor markets readjust.

On average over the analysis horizon, the 10/20 goals lead to small increases in employment and personal income and to a minor decline in gross regional product. Energy efficiency leads to increases in employment, personal disposable income and gross regional product over the entire analysis horizon.

In summary, the results of the regional economic analysis indicate that the 10/20 goals and the energy efficiency recommendations will have small or no impacts on the regional economy. The policies may lead to small increases in economic activity in the early years and a small decline in the later years. The impacts in the 2005 to 2015 time period are largely the result of investment in new renewable energy facilities that increase labor demand and have secondary impacts on output and income. Following the investment and construction boom, the region sees some decline in employment, gross regional product and personal disposable income because of the income impacts from lower profits in the electric and mining sector.

VI. Caveats and Uncertainties

The objective of this analysis was to assist the AP2 forum in understanding the potential emissions reductions, costs and secondary regional economic impacts of implementing the 10/20 goals and energy efficiency recommendations. The AP2 forum intends for this report to serve as a technical appendix, providing the analytical support for its recommendation to WRAP. As with any analytical assessment, the findings presented in this report should be understood and applied in the context of which it was developed and recognizing the assumptions, analytical framework, caveats and uncertainties underlying the analysis.

One of the key factors driving the results of the analysis is the assumption on renewable energy technology cost and performance. Existing literature on this subject provide a wide range of estimates, particularly in how the cost and performance might change in future years. The assumptions developed by the AP2 forum for the policy scenarios was based on a variety of different sources, including research of existing literature, data developed by the Energy Information Administration, data developed by the National Renewable Energy Laboratory and stakeholder input. The assumptions represent the forum's best view of renewable energy technologies given the policy climate likely under the 10/20 goals and energy efficiency recommendations.

Outside of the cost and performance assumptions for renewable energy technologies, this analysis was conducted using the data, assumptions and analytical framework developed by the WRAP/MTF in 2000 for the economic analysis of regional trading program in support of the Annex. Those assumptions describe the electric system operation, technology cost and performance including pollution control equipment, fuel prices and economic conditions.[23] In addition, the AP2 forum adopted the WRAP/Annex scenario as the BAU scenario for this analysis with minor modifications to account for the planned additions to renewable energy capacity.

The state level description of the secondary regional economic impacts presented in Appendix I should be used with some caution because the results may be sensitive to the assumptions on how the impacts were allocated by state. A key driver of the regional economic impacts was the capital investments for renewable energy projects. In IPM, which provided inputs for the REMI modeling, the growth in renewable energy capacity is described only by model region and the investments for new capacity were allocated by state based on distribution of renewable resource availability.

Though the modeling and analytical results provide detailed estimates of emissions reductions, cost and secondary regional economic impacts, it is important to recognize that the magnitude of the projected changes are quite small. This is particularly important for analysis of secondary regional economic impacts projected through the REMI model because most of the impacts are less than one half of one percent. Similarly, many of the costs projected from the IPM model are small relative to the total production costs of the sectors modeled. As with any analytical results, small perturbations are difficult to interpret precisely. In instances where the changes appear

[23] MTF 2000.

to be very small, analysis of broader trends, rather than specific numbers, will often be a more robust and meaningful description of the impacts.

VII. Conclusions

The objective of the analysis was to assist the AP2 forum in assessing the potential emissions reduction, costs and secondary regional economic impacts of meeting the 10/20 goals and implementing the energy efficiency recommendations in the states and tribal lands of the Transport Region. The analysis suggests that the 10/20 goals and energy efficiency could both serve as cost-effective air pollution prevention strategies because they provide opportunities for emissions reductions with modest cost or with some cost savings.

The 10/20 goals require that renewable energy resource satisfy 10 percent of the regional energy needs by 2005 and 20 percent of the regional energy needs by 2015. Most of the expansion in renewable energy is likely to come from wind power, where the greatest improvements in technology cost and performance are expected. Additional penetration of geothermal and landfill gas capacity are also projected under the 10/20 goals. The investments required for this expansion is likely to increase annual levelized production costs by $300 million to $900 million, representing a production cost increase of 2 percent to 5 percent relative to the BAU scenario. The increase in wholesale electricity prices from meeting the 10/20 goals are likely to be less than 2 percent.

The energy efficiency recommendations developed by the AP2 forum calls for electricity demand reductions in the Transport Region growing to 8 percent of the electricity demand by 2018. Implementation of the energy efficiency recommendations will lead to annual levelized production cost savings between $700 million and $1 billion in addition to some reductions in wholesale electricity prices. The savings under the energy efficiency policy scenarios accrue from reduced electricity and steam production cost and from avoided investment costs in transmissions and distribution, but are offset by the energy efficiency implementation costs.

Future expansion of renewable energy capacity and increased penetration of energy efficiency is likely to compete against new conventional generation technologies. Analysis of the BAU scenario indicates that in the absence of 10/20 goals or energy efficiency, the growth of conventional capacity will consist mostly of gas-fired combined cycles. The penetration of renewable energy and energy efficiency under the policy scenario is likely to displace new gas-fired combined cycles, which are relatively low emissions technologies.

For 2018, the analysis indicates that annual emissions savings from implementing the 10/20 goals and energy efficiency recommendations will be between 1 percent and 2 percent in NO_x and 10 percent to 14 percent in CO_2. Though the potential for emissions reductions may appear to be modest because renewable energy and energy efficiency compete against new gas fired generation sources, the 10/20 goals and energy efficiency will provide a hedge against future emissions growth.

Though the 10/20 goals and energy efficiency are unlikely to reduce SO_2 emissions in the presence of regional backstop SO_2 trading program proposed in the Annex, they could help reduce the compliance cost of trading program. By meeting the 10/20 goals, the compliance cost of the trading program could decrease the compliance cost by as much as $ 10 million (or 7%) and may displace 1,200 MW to 1,700 MW of new scrubber installations.

The 10/20 goals and energy efficiency are likely to have very small impacts on the regional economy. On average over the analysis horizon, energy efficiency will lead to small gains of less than one half of one percent in employment, gross regional product and personal disposable income. Similarly, on average over the analysis horizon, the 10/20 goals will lead to small increases of less than one half of one percent in employment and personal income along with an equally small decline the gross regional product. The economic impacts under the 10/20 goals and energy efficiency are the result of increased capital investment in renewable technologies and lower electricity prices. In implementing the 10/20 goals and the energy efficiency recommendations, the boom in construction job sparked by the investments along with the lower production costs from lower electricity prices appear to be key reasons for the changes in the regional economy.

Appendix I: Regional Economic Impacts

Economic Impacts by State
10/20 Goals Scenario
Annual Average Change in Employment

	2005-2010		2011-2015		2016-2020		
	Persons	Percent	Persons	Percent	Persons	Percent	Annual Average
AZ	278	0.01%	-768	-0.02%	-1,530	-0.04%	-614
CA	-612	0.00%	-4,123	-0.02%	-6,724	-0.03%	-3,619
CO	651	0.02%	450	0.01%	1,160	0.03%	747
ID	854	0.10%	1,274	0.15%	264	0.03%	801
NM	177	0.02%	-522	-0.04%	-1,372	-0.11%	-525
NV	285	0.02%	451	0.03%	791	0.05%	495
OR	-2,541	-0.11%	-1,351	-0.06%	-1,549	-0.06%	-1,859
UT	720	0.05%	172	0.01%	-391	-0.02%	201
WY	6,271	1.70%	10,380	2.71%	-1,897	-0.48%	5,003
9 States	6,080	0.02%	5,961	0.02%	-11,250	-0.03%	627

Economic Impacts by State
EE Only Scenario
Annual Average Change in Employment

	2005-2010		2011-2015		2016-2020		Annual Average
	Persons	Percent	Persons	Percent	Persons	Percent	
AZ	902	0.03%	3,434	0.10%	1,837	0.05%	1,986
CA	-3,269	-0.01%	5,131	0.02%	-11,315	-0.05%	-3,158
CO	849	0.03%	4,060	0.12%	6,603	0.19%	3,651
ID	925	0.11%	680	0.08%	-193	-0.02%	499
NM	270	0.02%	762	0.06%	-406	-0.03%	212
NV	-81	-0.01%	724	0.05%	252	0.02%	275
OR	1,084	0.05%	1,871	0.08%	997	0.04%	1,303
UT	321	0.02%	1,347	0.08%	-98	-0.01%	511
WY	-27	-0.01%	11,148	2.91%	-1,071	-0.27%	3,139
9 States	975	0.00%	29,156	0.08%	-3,397	-0.01%	8,415

Economic Impacts by State
EE + 10/20 Goals Scenario
Annual Average Change in Employment

	2005-2010		2011-2015		2016-2020		
	Persons	Percent	Persons	Percent	Persons	Percent	Annual Average
AZ	859	0.03%	2,811	0.08%	3,297	0.10%	2,231
CA	-4,828	-0.02%	-6,640	-0.03%	-10,943	-0.05%	-7,305
CO	1,218	0.04%	2,930	0.09%	8,049	0.23%	3,888
ID	986	0.12%	2,573	0.29%	-297	-0.03%	1,081
NM	307	0.03%	230	0.02%	-274	-0.02%	101
NV	302	0.02%	481	0.03%	543	0.03%	433
OR	-923	-0.04%	167	0.01%	-1,131	-0.05%	-647
UT	959	0.06%	1,048	0.06%	422	0.03%	819
WY	6,169	1.67%	4,843	1.27%	-1,055	-0.27%	3,497
9 States	5,050	0.01%	8,441	0.02%	-1,389	0.00%	4,097

Economic Impacts by State
10/20 Goals Scenario
Annual Average Changes in Gross Regional Product

	2005-2010		2011-2015		2016-2020		
	Million $ (F	Percent	Million $ (F	Percent	Million $ (F	Percent	Annual Levelized (million 2001$)
AZ	26	0.01%	-46	-0.02%	-129	-0.05%	-29
CA	-135	-0.01%	-554	-0.03%	-958	-0.04%	-423
CO	42	0.02%	36	0.01%	90	0.03%	49
ID	31	0.06%	49	0.08%	-14	-0.02%	27
NM	4	0.01%	-35	-0.04%	-98	-0.11%	-30
NV	15	0.02%	25	0.02%	56	0.05%	27
OR	-148	-0.10%	-95	-0.06%	-138	-0.07%	-129
UT	36	0.04%	7	0.01%	-35	-0.03%	12
WY	242	0.95%	392	1.39%	-172	-0.54%	185
9 States	112	0.00%	-221	-0.01%	-1399	-0.04%	-312

Economic Impacts by State
EE Only Scenario
Annual Average Changes in Gross Regional Product

	2005-2010		2011-2015		2016-2020		
	Million $ (F	Percent	Million $ (F	Percent	Million $ (F	Percent	Annual Levelized (million 2001$)
AZ	57	0.02%	249	0.10%	141	0.05%	129
CA	-200	-0.01%	293	0.01%	-1108	-0.05%	-233
CO	63	0.03%	318	0.13%	613	0.22%	251
ID	41	0.07%	42	0.07%	-17	-0.02%	27
NM	12	0.02%	40	0.05%	-21	-0.02%	13
NV	-4	0.00%	53	0.05%	26	0.02%	18
OR	67	0.04%	146	0.08%	77	0.04%	91
UT	22	0.02%	100	0.09%	31	0.03%	46
WY	-5	-0.02%	451	1.60%	-100	-0.32%	109
9 States	52	0.00%	1,692	0.05%	-359	-0.01%	450

Economic Impacts by State
EE + 10/20 Goals Scenario
Annual Average Changes in Gross Regional Product

	2005-2010		2011-2015		2016-2020		
	Million $ (F	Percent	Million $ (F	Percent	Million $ (F	Percent	Annual Levelized (million 2001$)
AZ	61	0.03%	194	0.08%	230	0.08%	133
CA	-409	-0.02%	-720	-0.03%	-1232	-0.05%	-650
CO	85	0.04%	236	0.09%	712	0.25%	258
ID	38	0.07%	113	0.18%	-36	-0.05%	43
NM	8	0.01%	1	0.00%	-33	-0.04%	-3
NV	16	0.02%	30	0.03%	40	0.03%	24
OR	-57	-0.04%	16	0.01%	-91	-0.05%	-44
UT	52	0.05%	74	0.07%	51	0.04%	57
WY	235	0.92%	156	0.56%	-115	-0.36%	125
9 States	30	0.00%	100	0.00%	-475	-0.01%	-58

Economic Impacts by State
10/20 Goals Scenario
Annual Average Changes in Real Disposable Income

	2005-2010		2011-2015		2016-2020		
	Million $ (F	Percent	Million $ (F	Percent	Million $ (F	Percent	Annual Levelized (million 2001$)
AZ	31	0.02%	13	0.01%	-35	-0.02%	11
CA	-77	-0.01%	-221	-0.02%	-373	-0.03%	-175
CO	42	0.03%	97	0.06%	125	0.07%	75
ID	18	0.05%	36	0.08%	6	0.01%	21
NM	11	0.02%	-8	-0.01%	-46	-0.07%	-7
NV	16	0.02%	45	0.05%	52	0.05%	33
OR	-110	-0.10%	-85	-0.07%	-80	-0.06%	-95
UT	29	0.05%	19	0.03%	-8	-0.01%	18
WY	183	1.06%	379	2.01%	3	0.02%	193
9 States	143	0.01%	277	0.01%	-357	-0.02%	73

Economic Impacts by State
EE Only Scenario
Annual Average Changes in Real Disposable Income

	2005-2010		2011-2015		2016-2020		
	Million $ (F	Percent	Million $ (F	Percent	Million $ (F	Percent	Annual Levelized (million 2001$)
AZ	72	0.05%	331	0.19%	245	0.13%	182
CA	-55	0.00%	217	0.02%	-401	-0.03%	-40
CO	67	0.04%	382	0.22%	612	0.32%	272
ID	33	0.08%	45	0.10%	-3	-0.01%	28
NM	22	0.04%	88	0.14%	32	0.05%	42
NV	9	0.01%	96	0.11%	83	0.09%	50
OR	54	0.05%	110	0.09%	92	0.07%	78
UT	21	0.03%	99	0.14%	48	0.06%	49
WY	2	0.01%	371	1.97%	23	0.11%	115
9 States	224	0.01%	1,741	0.09%	731	0.03%	776

Economic Impacts by State
EE + 10/20 Goals Scenario
Annual Average Changes in Real Disposable Income

	2005-2010		2011-2015		2016-2020		
	Million $ (F	Percent	Million $ (F	Percent	Million $ (F	Percent	Annual Levelized (million 2001$)
AZ	69	0.04%	285	0.16%	414	0.22%	204
CA	-140	-0.01%	-352	-0.03%	-599	-0.04%	-285
CO	76	0.05%	325	0.19%	747	0.39%	288
ID	31	0.08%	90	0.20%	4	0.01%	42
NM	21	0.04%	62	0.10%	70	0.10%	43
NV	24	0.03%	80	0.09%	109	0.11%	58
OR	-27	-0.03%	6	0.00%	1	0.00%	-12
UT	42	0.07%	83	0.11%	87	0.11%	63
WY	180	1.05%	209	1.11%	21	0.10%	146
9 States	278	0.02%	788	0.04%	854	0.04%	547

Appendix II: Energy Efficiency Analysis and Methodology

ESTIMATION OF POTENTIAL ENERGY EFFICIENCY SAVINGS FOR THE WESTERN REGIONAL AIR PARTNERSHIP BY THE AIR POLLUTION PREVENTION FORUM

Approach, Methods and Summary Results

David Von Hippel and David Nichols
Tellus Institute
(Revised draft, June 26, 2002)

Introduction

Tellus Institute was asked by the Air Pollution Prevention Forum (the AP2 Forum) to prepare estimates of electric energy efficiency savings in order to determine the potential impact of energy efficiency programs on air pollutant emissions from the electricity generation sector in the West. The Forum asked the Tellus team to estimate the achievable potential for electricity savings through energy efficiency programs in three air pollutant modeling regions: the Interior West (the "WSCR" region including Utah, Colorado, Arizona, New Mexico, Wyoming, Eastern Idaho, and Nevada excluding the Las Vegas area), part of the Pacific Northwest (the "WSCP" region, including Oregon and Western Idaho), and California/Las Vegas (the "CNV" region). Energy efficiency programs for the three areas were modeled over the period from 2002 through 2018, with impacts of measures installed under the programs counted through 2026. Only a limited set of energy efficiency measures were included in the program, so the estimates prepared were not, nor were they intended to be, fully comprehensive assessments of all potential electricity savings. The electricity savings (energy and peak) and the incremental costs of the programs were provided for use in ICF's IPM modeling system, and were used to generate air pollution scenario results as described in the Draft Final Report on Energy Efficiency and Renewable Energy, to which this document is a supplement.

The sections below describe the overall approach used to estimate the potential impacts of energy efficiency programs, present a brief summary of the overall results of the estimation process, and indicate what next steps might be undertaken to elaborate the assessment of energy efficiency opportunities in the West.

Overall Approach

The key steps in the estimation of energy efficiency opportunities in the Interior West and Oregon/Western Idaho regions were as follows:

- **Identification of energy efficiency measures**, by Forum group members and the Tellus team
- **Measure evaluation**, to determine the basic cost-effectiveness of individual measure installations.

- **Program evaluation**, including assembly of illustrative energy efficiency programs (application of measures to markets) and estimation of program impacts and costs, by year.

Each of these steps is described briefly below. A different, more aggregate approach was used for the California/Las Vegas region.

Identification of Measures

The Forum group, based on their knowledge of electricity demand in the West, prepared a preliminary list of energy efficiency measures for the Tellus team to evaluate. The measures spanned all customer categories (including residential, commercial/institutional, industrial, and agricultural consumers), and ranged widely in scope and applicability. Measures designed strictly to reduce or displace load (load response and load management programs), but not save energy, were not included, nor were major uses of renewable energy in end-use settings (such as solar water heating). Likewise distributed generation technologies without heat production, gas energy efficiency measures, and transportation sector measures were also excluded from the study.

The Tellus team performed an initial, qualitative screening of the suggested measures, eliminating (in a relatively few cases) measures from the list, and adding other measures that the team felt merited consideration. The final list of measures considered in the Interior West is presented in Table 1, below. The same list of measures was considered in the Oregon/Western Idaho region, except that two measures for application in the aluminum industry (aluminum production cell retrofit and advanced forming processes) were investigated in the latter region. Summary descriptions of these measures are provided in **Attachment 1** to this document.

Table 1: Energy Efficiency Measures Evaluated, Interior West Region

Residential Sector Measures	Commercial Sector Measures	Industrial Sector Measures
Efficient Central Air Conditioning	Lighting, Advanced Measures	Motor Downsizing
Efficient Room Air Conditioning	Lighting, Efficient Fluorescent	Premium Motors versus Rewinding
Evaporative Cooling	Refrigeration, High-cost Measures	Premium Motors (versus standard new motors)
Indirect-direct Evaporative Cooling	Refrigeration, Low-cost Measures	Air Compressor System Measures
Appliance Recycling (refrigerators)	Air Conditioning Improvement Residential-type Central AC	Fan System Measures
Compact Fluorescent Torchieres	Air Conditioning Improvement Residential-type Room-type AC	Pump System Measures
CFL Fixtures--Indoor	Air Conditioning Improvement, Small Heat Pumps	CHP[24], 10 MW Combustion Turbine (replacing gas boiler)
CFL Fixtures--Outdoor	Air Conditioning Improvement, 20-ton Package Units	CHP, 3000 kW diesel-type (replacing gas boiler)
CFL Bulbs	Air Conditioning Improvement, 350-ton Centrifugal Units	CHP, 40 MW Combustion Turbine (replacing gas boiler)
Duct Test and Seal--Homes with Central AC	Air Conditioning, IDDEC[25], 20, 150, and 350-ton Equivalent Units	Industrial CHP, 800 kW diesel-type (replacing gas boiler)
Duct Test and Seal--Homes with Electric Space Heat	Ground-source Heat Pumps, 1000 to 3000 operating hours/yr	High-efficiency Transformers
Energy Star (Vertical Axis) Clothes Washer	Efficient Clothes Washers	
SEHA (Horizontal Axis) Clothes Washer	LED Exit Signs	
Appliance Standby Loss Reduction, Incentive Approach	LED Traffic Signals	
Appliance Standby Loss Reduction--Standards Approach	Retrocommissioning of Buildings	
Home Weatherization	Space Heat High Efficiency Gas Boiler	
New Home Building Envelope Improvement to IECC 2000 levels	Space Heat, Standard Gas Boiler	
New Home Building Envelope Improvement--Enhanced levels	Space Heat, Gas Unit Heater	
	Water Heat Gas Boiler Fuel Switch	
	Water Heater Fuel Switching	
	Water Heating, Heat Pump Unit	

[24] CHP = Combined Heat and Power (or Cogeneration)
[25] IDDEC = Indirect-direct Evaporative Cooling

Table 1 (Continued): Energy Efficiency Measures Evaluated, Interior West Region

Additional Commercial Sector Measures
Gas Air Conditioning (with heat recovery displacing Electric WH[26])
Gas Air Conditioning (with heat recovery displacing Gas WH)
Gas Air Conditioning (w/o heat recovery)
Building Envelope--Improvements to ASHRAE Standards
Building Envelope--Improvements to Enhanced Level
Cooling Tower VSD[27] (CA Central Valley-type Climate)
Cooling Tower VSD (CA Desert-type Climate)
High-efficiency Transformers
CHP, 100 kW diesel-type replacing Electric WH
CHP, 100 kW diesel-type replacing Gas WH
CHP, 30 kW Micro-turbine replacing Electric WH
CHP, 30 kW Micro-turbine replacing Gas WH
CHP, 800 kW diesel-type replacing Electric WH
CHP, 800 kW diesel-type replacing Gas Boiler

Measure Evaluation

For each measure listed in Table 1, plus several other measures[28], MS Excel™ workbook tools were used to evaluate the measure cost-effectiveness. For each measure, cost-effectiveness was calculated relative to standard technologies, that is, technologies providing the same energy service but with efficiencies just meeting existing or planned standards, or technologies that correspond to standard practice for the end-use.

Inputs to the measure cost-effectiveness calculation included:

- **Measure cost information**, including incremental or total measure capital cost (of both the energy-efficient and standard measure) per unit, and incremental or total non-fuel annual operating and maintenance (O&M) costs.
- **Energy use impacts**, including annual energy and peak power savings or usage, and annual gas use, if applicable, expressed on the same unit basis as the costs.
- An assumed **discount rate** (4.88 percent per year on a real basis).
- Real levelized **avoided capacity and energy costs**, in this case, estimates based on "proxy" gas-fired combustion turbine or combined-cycle units, using gas prices as defined by the Forum for use in the IPM modeling process. Note that these costs were used for rough screening purposed only, and are not the same as the costs used in the IPM modeling work to derive the impacts of energy efficiency programs on overall power system costs.
- Estimated **electricity rates**, calculated very roughly as the weighted averages of year 2000 electricity rates in the regions being studied, by sector, escalated at 1 percent annually (on a real basis).
- **Gas avoided costs** based on the costs used in the IPM modeling work.

The data elements above were derived from a wide variety of national and regional publications. Additional inputs were developed through consultation with experts in the energy-efficiency field. In cases where electricity usage in a measure was

[26] WH = Water Heating
[27] VSD = Variable Speed Drive
[28] Including fuel cell-based and other types/sizes of combined heat and power equipment, as well as several energy-efficiency measures that proved less than cost-effective.

likely to be weather-sensitive (space cooling, for example), adjustments to national or regional values were made based on conditions in the region (Interior West or Oregon/W. Idaho) modeled. **Attachment 2** to this document provides a tabular summary of key measure cost and savings figures, as well as key program-related inputs to the energy efficiency analysis.

The outputs of the measure cost analyses included life-cycle costs, for those measures where standard units were compared directly with higher-than-standard-efficiency measures, and in all cases benefit-cost ratios for energy-efficiency measures relative to standard practice were calculated. The resulting ratios thus represent “incremental” measure costs and savings, relative to standard equipment. Benefit-cost ratios calculated from a total resource cost perspective were the primary yardstick used to assess whether measures should be included in programs, but in some cases participant cost measures were used to (roughly) inform the level of incentives that might be required.

Program Evaluation

Increasing the market penetration of energy-efficiency measures in an aggressive manner generally implies the provision of financial incentives to customers. As a consequence, the program evaluation phase of the development of energy-efficiency estimates for use by the AP2 Forum focused on estimating the sponsor costs of reaching a broader market for energy efficiency measures[29]. The estimation of energy-efficiency program costs and benefits involved the following steps:

- **Grouping of measures** into "programs" based, typically, on the end-uses and sectors addressed by the measures.
- Estimating the **program market** by consideration of the electricity demand in the sector and end-use addressed by the program, and of the nature and current market for the measure to be implemented. Sources for information on markets for energy-efficiency measures included national end-use surveys, statistics on electricity use by sector, State, and utility area, and a host of specific studies on particular markets from the national and regional literature.
- Estimating program penetration rates based on a combination of penetration rates historically achieved by utilities mounting aggressive energy efficiency efforts, and on program targets that were felt to be "aggressive but achievable" in the markets studied.
- Estimating **expenditures for administering** energy-efficiency programs, including both start-up and ongoing costs, based on consideration of the types of activities and interactions with customers that would be required to initiate the energy efficiency programs considered and to carry them out on an ongoing basis.

In a few cases, program impacts were based on the assumption that mandatory standards would be implemented in the future (for example, in 2008), which would raise

[29] The AP2 Forum wished to leave open the question of what types of agencies might organize and offer energy-efficiency programs of the types implied in the work described here. Accordingly, the organizations offering the programs are referred to as "sponsors", which could include government agencies, energy-efficiency program administrators retained to coordinate the use of funds collected through systems benefit charges, or, as in the past, distribution utilities.

effective program participation to near 100 percent (and reduce sponsor measure costs to zero).

The ECO2™ DSM analysis software package, developed at Tellus Institute, was used to evaluate the candidate energy-efficiency programs. Key program inputs—such as the number of participants annually per measure, program administrative costs, and shares of measure costs assumed paid by the sponsor and by customers—were developed and documented in the same set of workbooks used to develop measure data. Program results from the ECO2 runs included annual energy savings, peak power savings (summer and winter peak), customer measure costs, sponsor measure costs, administration costs, customer O&M costs, net fuel (gas) and water costs (if any), estimated energy and capacity costs avoided by the program (from the perspectives of customers and society), and end-use pollutant emissions for the years 2002 through 2026. Net present values of program costs (and estimated benefits), as well as costs of saved energy, were calculated in a set of Excel workbooks that compiled ECO2 results for each region. Specific examples, for several of the measures and programs evaluated, of the overall analytical approach used to estimate energy efficiency costs and impacts for the WSCR and WSCP regions, are provided in Attachment 3 to this document.

Approach Used in the CNV Modeling Region

Savings and costs for energy efficiency in the CNV (California/Las Vegas) region were estimated based on a parameterization of a national (American Council for an Energy Efficient Economy or ACEEE) study. Based on its national analysis, ACEEE provided Tellus with estimated electricity reductions by sector for a number of policies. The Tellus team used results of some of these policies ("Appliance Standards", "Public Benefits Funds", and "Tax Credits") as a base for a rough estimate of potential electricity savings in the CNV modeling region. National electricity reductions through application of energy efficiency measures were allocated to the region based on the base case level of electricity consumption from NEMS (National Energy Modeling System) runs for each sector. From NEMS output, the Tellus team determined the region's electricity sales by sector as a fraction of national sales by sector. This fraction was applied to the national estimate of electricity use reductions from ACEEE to determine CNV reductions. A similar approach was used to estimate program costs[30].

Once estimates based on ACEEE results were obtained, these estimates were "trued-up" for consistency with end-use based energy efficiency costs and savings as estimated by the Tellus team for the Interior West and Oregon/W. Idaho regions. In the process, ACEEE savings estimates were reduced by nearly two-thirds[31]. The results of this "true-up" procedure should be considered only a rough approximation of the probable results if an end-use method were applied for the California/Las Vegas region.

[30] The ACEEE source document for which the original ACEEE estimates were prepared is Nadel, S. and H. Geller with the Tellus Institute (2001), Smart Energy Policies: Savings Money and Reducing Pollutant Emissions Through Greater Energy Efficiency. American Council for an Energy-Efficient Economy, Report No. E012, September, 2001.
[31] Note that this "true-up" also implicitly excludes savings due to free-riders, since the WSCR savings used to accomplish the true-up exclude savings from free-riders.

Selection of Measures and Programs for Use in IPM Emissions Modeling Effort

The AP2 Forum reviewed the results of the energy-efficiency analyses described above in order to decide which results to carry forward for use in the IPM emission modeling effort. In addition to deciding to exclude the results of the combined heat and power analyses (see discussion below), the Forum felt that it would be prudent to remove the costs and savings for those measures with higher costs of saved energy from the packages of energy-efficiency programs modeled in each region. A threshold of 5.4 cents (2001 dollars) per kWh saved (on a levelized basis) was set, based very roughly on current average avoided costs for electricity generation in the West regions, and measures with costs higher than the threshold level were accordingly excluded from the final packages of energy-efficiency programs for which energy/power savings and costs were included in the IPM modeling effort. The cost and savings of the resulting packages of energy-efficiency programs are described below.

Summary Results

The summary results provided below present energy and peak power savings, as well as costs, estimated for the energy-efficiency programs and measures included in the final package of programs used in the IPM modeling effort. Results are presented by region, and on an overall basis.

Energy Savings

Figures 1 through 3 show annual GWh electricity savings for the years 2002 through 2018 in the WSCR (Interior West), WSCP (Oregon/W. Idaho), and CNV (California/Las Vegas) regions, respectively. Results are shown by sector, and indicate that commercial sector savings dominate the package of programs (though the suite of industrial measures examined was relatively limited), followed by residential sector savings. By 2018, annual electricity savings from the package of energy efficiency programs in the Interior West totals about 20,000 GWh, versus about 5,200 GWh in the Oregon/W. Idaho region, and about 28,000 in California/Las Vegas[32].

[32] Note that these figures do <u>not</u> include credit for avoided transmission and distribution losses, so the net effect on required generation will be higher than the end-use savings indicated here.

Figure 1:

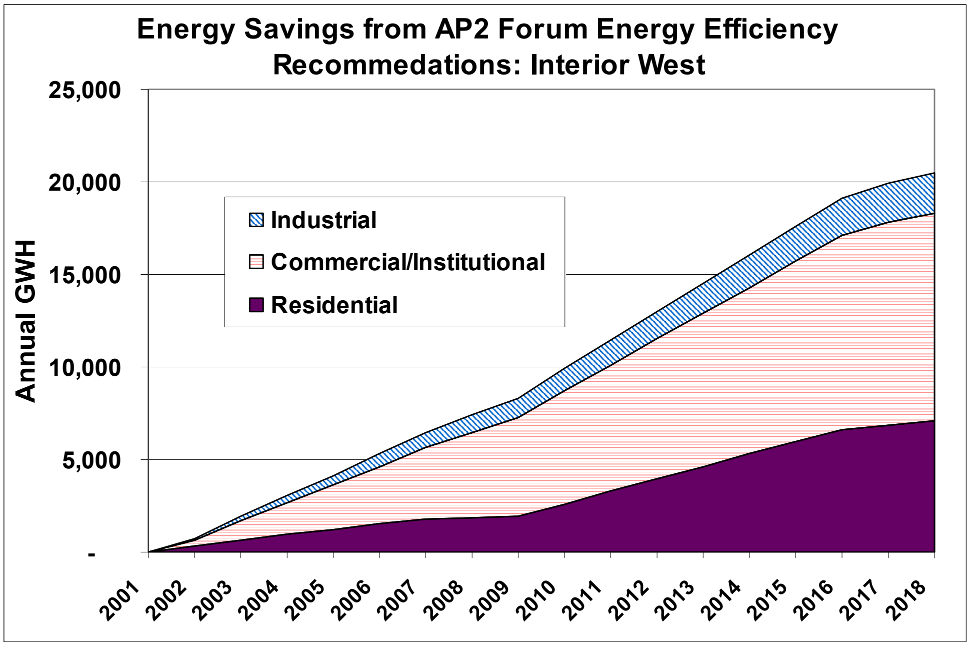


Figure 2:

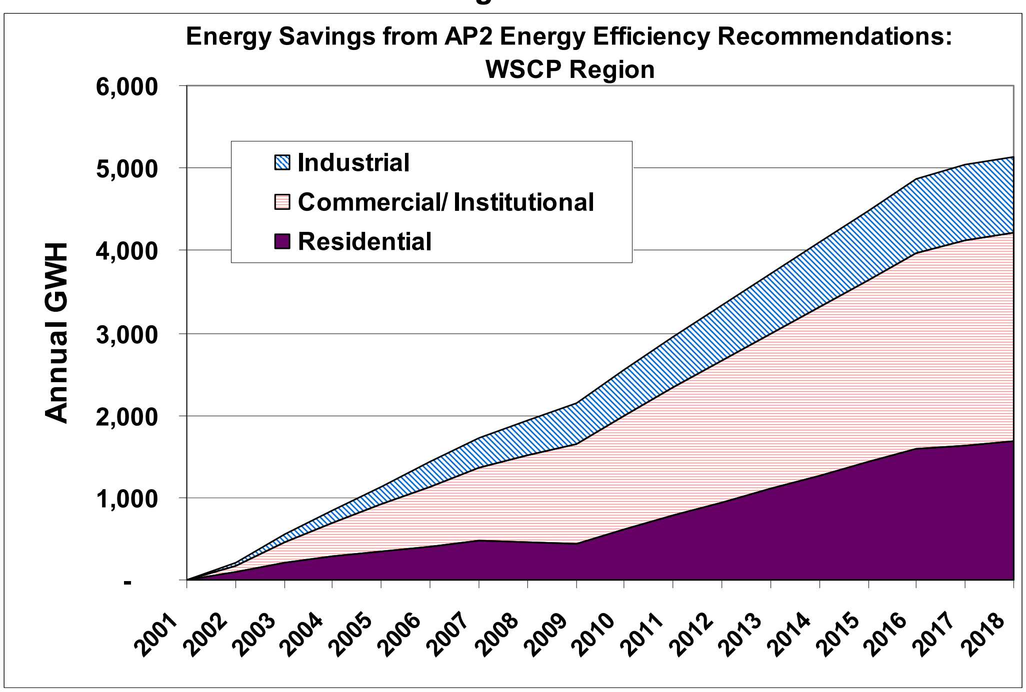


Figure 3:

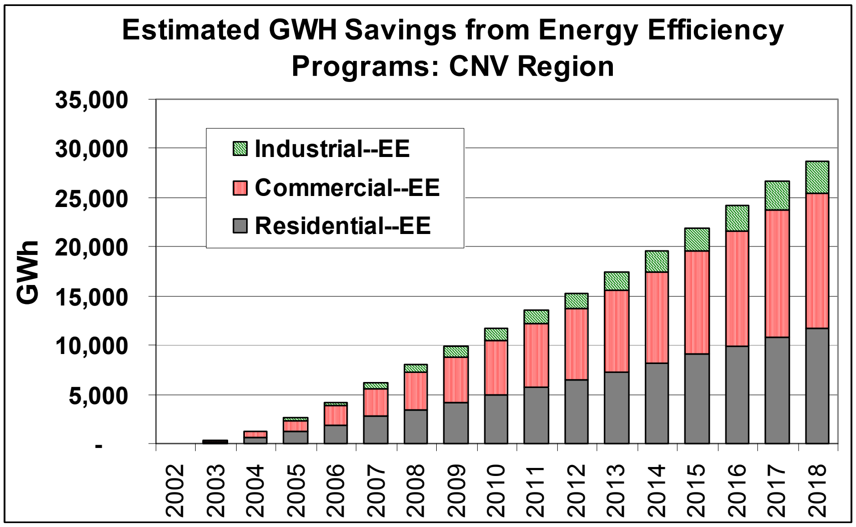
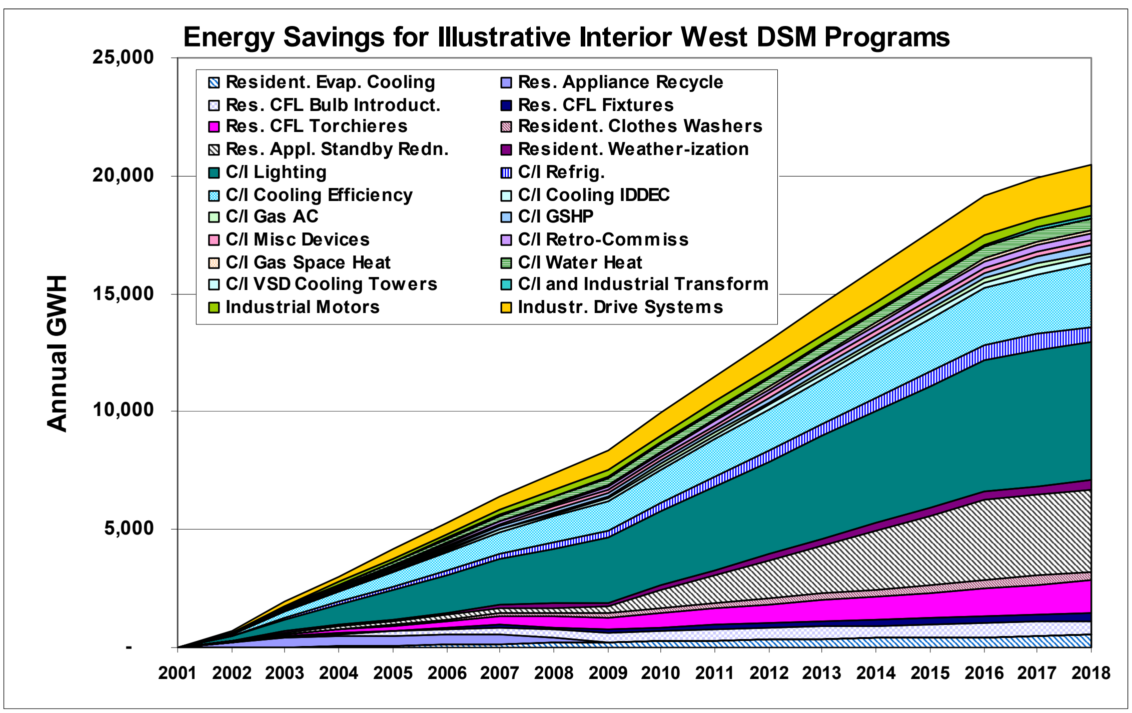


Figure 4 indicates the magnitude of energy savings for each of the programs included in the energy-efficiency package for the Interior West.

Figure 4:



Peak Power Savings

Figures 5 and 6 present annual summer peak power savings, by region and by sector, for the Interior West and Oregon/W. Idaho regions. By 2018, summer peak savings in the Interior West are over 6,000 MW, and savings in the Oregon/W. Idaho region are over 1,400 MW. Total summer peak power savings for the California/Las

Vegas region from the energy-efficiency package were estimated at approximately 780 MW in 2005, 3,500 MW in 2010, 6,600 MW in 2015, and 8,700 MW in 2018. Figure 7 shows summer peak savings by sector for the period 2002 to 2018 in the Interior West.

Figure 5:

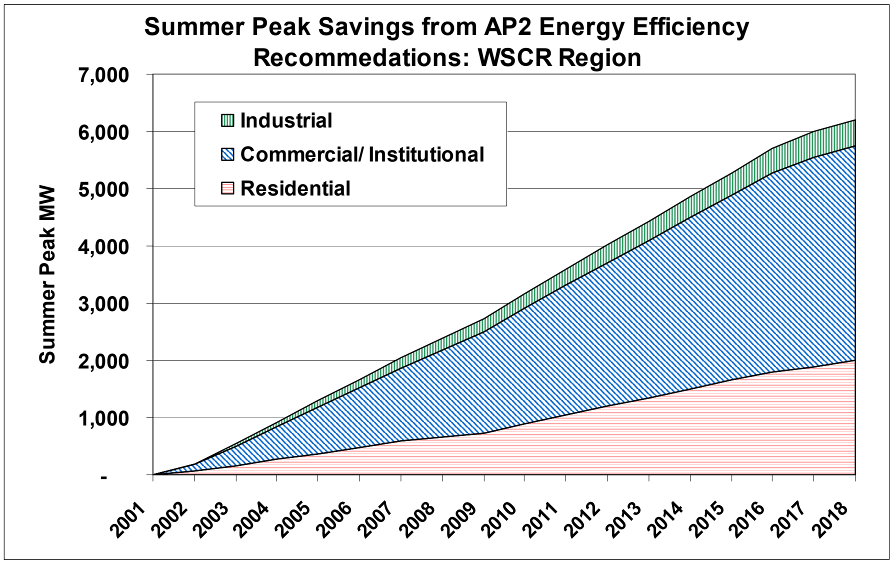


Figure 6:

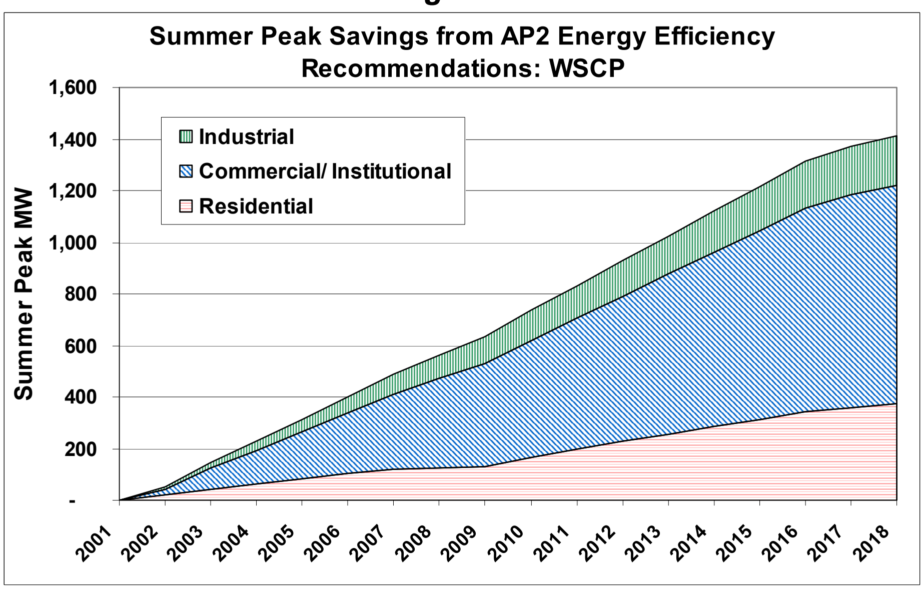
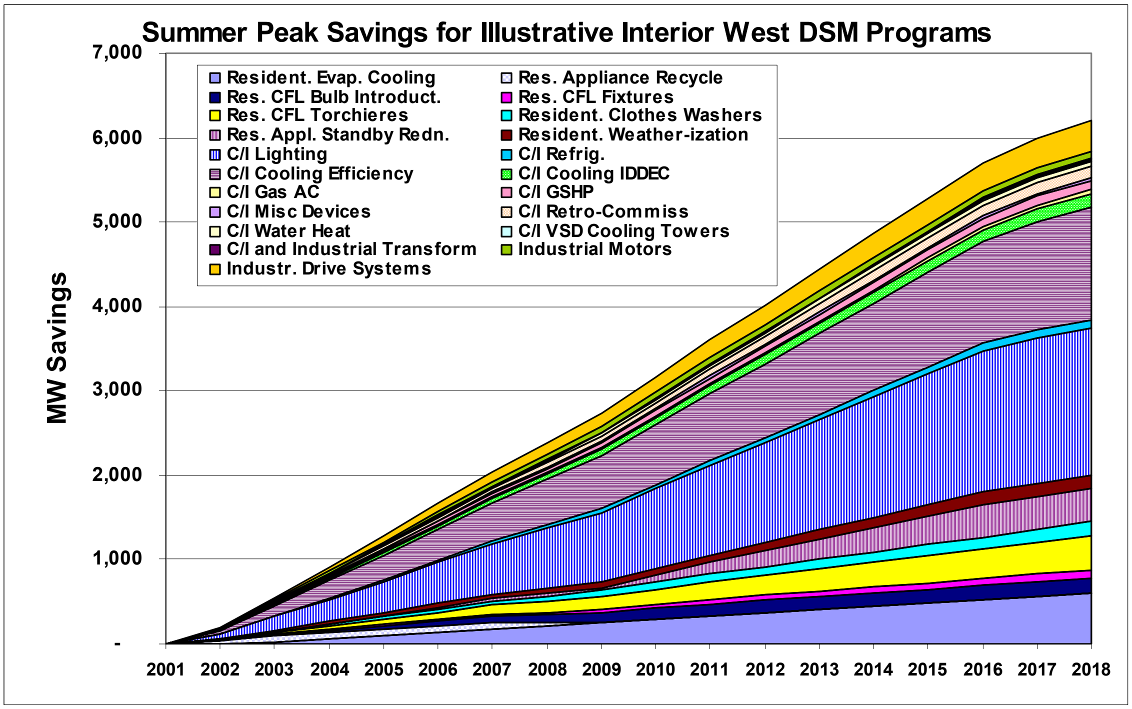


Figure 7:



Program Costs

The total incremental costs of the packages of energy-efficiency programs for each region are presented in Figures 8 through 10 for the three regions modeled. These costs are presented as annualized costs, that is, incremental capital costs for purchase of measures are levelized so that a portion of those costs are ascribed to each year in which a given device installed under the program is in operation. By 2018, total annualized costs in the Interior West region reach about $550 million and costs in the Oregon/W. Idaho region reach $130 million, both in year 2018 dollars (or about $340 and $80 million 2001 dollars, respectively), while total annualized costs in the California/Las Vegas region reach approximately $1,100 million 2001 dollars.

Figure 8:

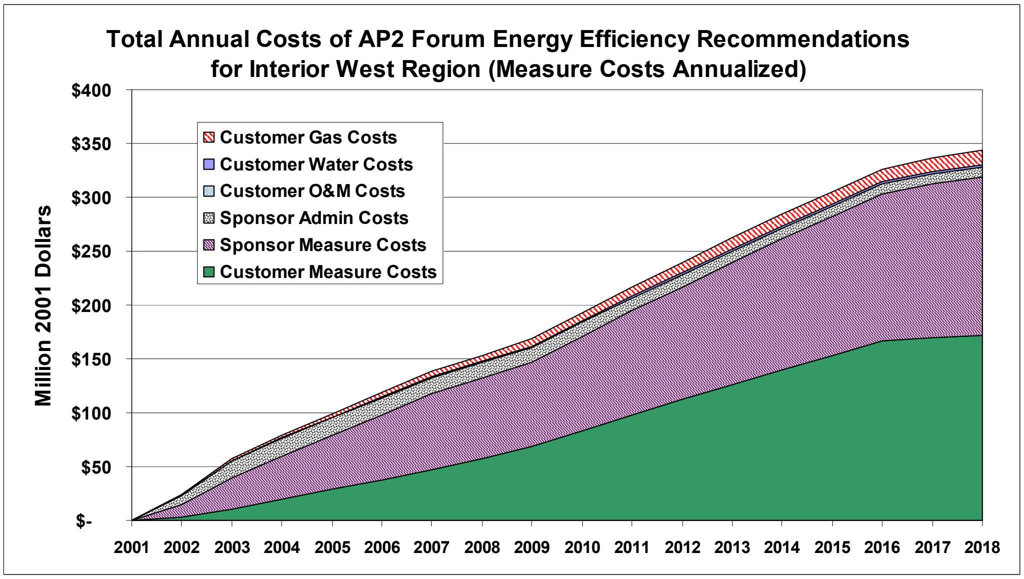


Figure 9:

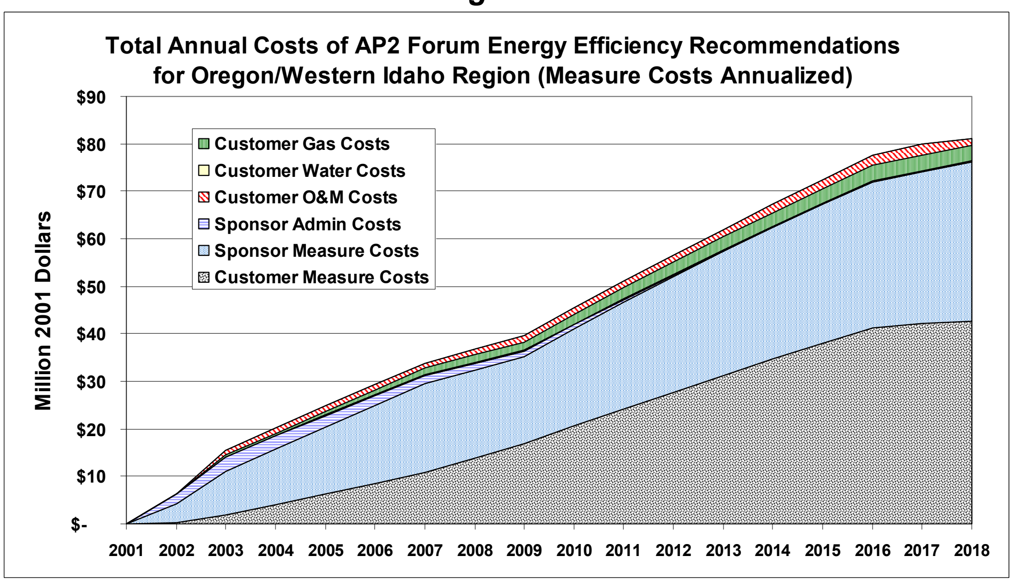
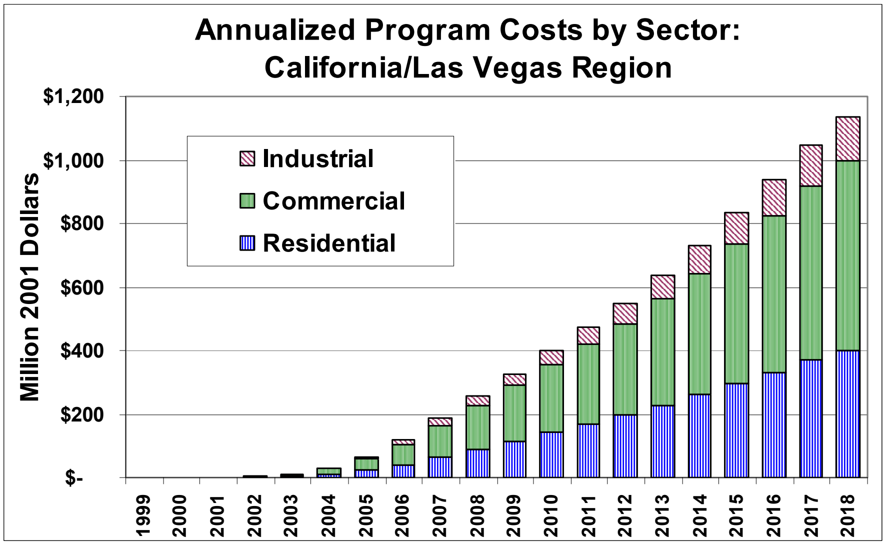


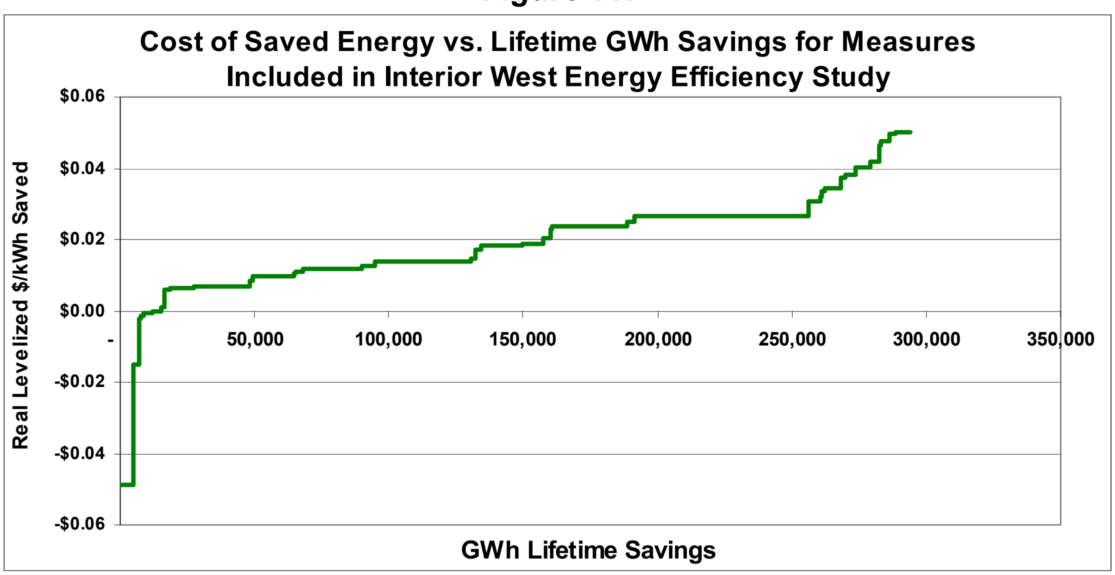
Figure 10:



Costs of Saved Energy

Figure 11 show the curve of the cost of saved energy for the measures ultimately included in the Interior West energy efficiency package. Table 2 presents the same information in a tabular format that identifies the measures at each cost level. Note that the costs shown in Table 2 are discounted total incremental program costs for the period 2002 to 2026[33]. Cost curve results for the Oregon/W. Idaho region are not shown here, but are similar.

Figure 11:



[33] Note that the discounting formulae used to prepare the values in Table 2 incorporate zero cost values for 2001, so the values shown are effectively in year 2001 dollars.

Table 2: Cost Of Saved Energy Results Sorted By Cost Per kWh:

Measure	Discounted TRC Cost ($1000)	MWh Savings Through 2026	Real Levelized Cost of Saved Energy ($/kWh)	Percent of Total Cummul. Package Savings	Cummulative MWh Savings through 2026	Percent of Total Cummul. Package Costs	Cummulative Discounted TRC Cost
Residential Evaporative Cooling	$ (111,017)	5,007,946	$ (0.0489)	1.7%	5,007,946	-4.4%	$ (111,017)
Residential IDDEC Cooling	$ (15,554)	2,305,001	$ (0.0151)	2.5%	7,312,947	-5.0%	$ (126,571)
Comml/Instit. Space Heat Std. Gas Boiler	$ (458)	465,659	$ (0.0022)	2.6%	7,778,606	-5.0%	$ (127,029)
Comml/Instit. Space Heat High Eff. Gas Boiler	$ (565)	962,327	$ (0.0013)	3.0%	8,740,933	-5.1%	$ (127,594)
Comml/Instit. Water Heat Gas Boiler Fuel Switch	$ (1,145)	3,325,686	$ (0.0008)	4.1%	12,066,619	-5.1%	$ (128,739)
Comml/Instit. Water Heater Fuel Switching	$ (505)	3,484,222	$ (0.0003)	5.3%	15,550,841	-5.1%	$ (129,244)
Comml/Instit. Space Heat Gas Unit Heater	$ 422	803,719	$ 0.0011	5.6%	16,354,560	-5.1%	$ (128,821)
Industrial Fan System Measures	$ 7,041	2,473,382	$ 0.0062	6.4%	18,827,942	-4.8%	$ (121,780)
Industrial Air Compressor System Measures	$ 23,789	8,347,664	$ 0.0062	9.2%	27,175,606	-3.9%	$ (97,991)
Residential CFL Torchiere	$ 62,045	21,232,172	$ 0.0067	16.5%	48,407,778	-1.4%	$ (35,946)
Industrial Motor Downsizing	$ 3,416	865,684	$ 0.0086	16.8%	49,273,462	-1.3%	$ (32,531)
Comml/Instit. Refrigeration, Low-cost Measures	$ 29,224	6,446,877	$ 0.0098	19.0%	55,720,339	-0.1%	$ (3,307)
Residential CFL Bulbs	$ 49,797	8,999,064	$ 0.0099	22.0%	64,719,403	1.8%	$ 46,490
Comml/Instit. Water Heating, Heat Pump Unit	$ 4,169	833,390	$ 0.0106	22.3%	65,552,793	2.0%	$ 50,659
Comml/Instit. LED Exit Signs	$ 10,551	2,212,350	$ 0.0109	23.1%	67,765,143	2.4%	$ 61,210
Comml/Instit. Lighting, Efficient Fluorescent	$ 120,842	22,406,144	$ 0.0117	30.7%	90,171,287	7.2%	$ 182,052
Residential CFL Fixtures--Indoor	$ 24,370	4,477,776	$ 0.0124	32.2%	94,649,063	8.2%	$ 206,422
Industrial Premium Motors	$ 32,469	4,640,110	$ 0.0137	33.8%	99,289,173	9.5%	$ 238,891
Residential Appl. Standby Loss Red.--Mandatory	$ 186,808	31,092,432	$ 0.0138	44.4%	130,381,605	16.9%	$ 425,699
Residential Appl. Standby Loss Red.--Incentive	$ 19,091	2,018,494	$ 0.0148	45.1%	132,400,099	17.7%	$ 444,789
Comml/Instit/Industrial Transformers (C/I)	$ 14,260	1,903,312	$ 0.0172	45.7%	134,303,411	18.2%	$ 459,050
Industrial Pump System Measures	$ 130,051	15,459,078	$ 0.0183	51.0%	149,762,489	23.4%	$ 589,101
Comml/Instit. Retrocommissioning	$ 35,765	4,203,554	$ 0.0186	52.4%	153,966,043	24.8%	$ 624,866
Comml/Instit. Refrigeration, High-cost Measures	$ 30,151	3,487,028	$ 0.0188	53.6%	157,453,071	26.0%	$ 655,018
Residential Appliance Recycling	$ 40,598	2,593,122	$ 0.0204	54.5%	160,046,193	27.6%	$ 695,616
Comml/Instit/Industrial Transformers (Industrial)	$ 2,150	223,428	$ 0.0220	54.6%	160,269,621	27.7%	$ 697,766
Residential CFL Fixtures--Outdoor	$ 5,562	515,112	$ 0.0228	54.7%	160,784,733	27.9%	$ 703,328
Comml/Instit. AC Impr., 20-ton Package Units	$ 296,085	28,046,667	$ 0.0236	64.3%	188,831,400	39.7%	$ 999,414
Comml/Instit. Ground-source HP, 3000 hrs/yr	$ 30,955	2,745,355	$ 0.0249	65.2%	191,576,755	40.9%	$ 1,030,369
Comml/Instit. Lighting, Advanced Measures	$ 795,012	64,744,193	$ 0.0266	87.2%	256,320,948	72.4%	$ 1,825,380
Comml/Instit. AC Impr., Residential-type CAC	$ 57,876	4,042,410	$ 0.0307	88.6%	260,363,358	74.7%	$ 1,883,257
Comml/Instit. LED Traffic Signals	$ 13,697	931,600	$ 0.0322	88.9%	261,294,958	75.3%	$ 1,896,954
Comml/Instit. Efficient Clothes Washers	$ 15,511	914,946	$ 0.0335	89.2%	262,209,904	75.9%	$ 1,912,465
Comml/Instit. AC Impr., Small Heat Pump	$ 93,753	5,867,466	$ 0.0343	91.2%	268,077,370	79.6%	$ 2,006,218
Comml/Instit. Ground-source HP, 2000 hrs/yr	$ 30,955	1,830,237	$ 0.0373	91.9%	269,907,607	80.9%	$ 2,037,173
Comml/Instit. AC Impr., Res. Room-type AC	$ 66,814	3,738,494	$ 0.0383	93.1%	273,646,101	83.5%	$ 2,103,987
Residential Weatherization	$ 109,264	5,824,614	$ 0.0402	95.1%	279,470,715	87.8%	$ 2,213,251
Comml/Instit. Gas AC, w/ heat recov. (EWH)	$ 53,763	2,896,170	$ 0.0420	96.1%	282,366,885	90.0%	$ 2,267,014
Comml/Instit. Cooling Tower VSD--Desert Climate	$ 6,408	336,718	$ 0.0431	96.2%	282,703,603	90.2%	$ 2,273,422
Industrial Prem. Motor vs. Rewind	$ 10,383	436,716	$ 0.0464	96.4%	283,140,319	90.6%	$ 2,283,805
Residential SEHA Clothes Washer	$ 66,392	3,052,546	$ 0.0476	97.4%	286,192,865	93.3%	$ 2,350,197
Residential Energy Star Clothes Washer	$ 57,518	2,527,540	$ 0.0498	98.3%	288,720,405	95.6%	$ 2,407,715
Comml/Instit. AC, IDDEC, 150-ton Equiv. Units	$ 111,958	5,072,414	$ 0.0501	100.0%	293,792,819	100.0%	$ 2,519,673
ALL MEASURES/ALL PROGRAMS	$ 2,519,673	293,792,819	$ 0.0186				

Combined Heat and Power

Based on the results of two national studies, the Tellus team identified a considerable achievable potential for the application of combined heat and power (CHP) in all three of the modeled regions. Implementation of CHP could result in significant cost savings, displacement of capacity (about 7.5 GW at the end-use level), and overall fuel (gas) savings relative to separate production of power and heat, and would also help, in many instances, to ease transmission constraints by providing distributed generation. Gas-fired CHP systems do, however, produce emissions of nitrogen oxides (NO_x) that might, depending on the type of CHP used and the type and extent of emissions control equipment with which it is fitted, result in an increase of NO_x emissions relative to separate heat production and power generation. This result is far from certain, as it depends on the average emission factors for CHP systems meeting current standards in major air sheds in the West. Though any increase in NO_x emissions from the implementation of modern, regulations-compliant CHP system is likely to be modest relative to overall NO_x emissions from power generation in the West, Forum members were sufficiently concerned about the potential impact of CHP systems on local and regional air quality, as well as about the ultimate "marketability" of CHP systems, that a consensus decision was made to leave savings (and costs) of CHP programs out of the total energy-efficiency savings figure passed on to the IPM modeling effort.

Summary Results, All Regions

Figures 12, 13, and 14 show, respectively the energy savings, summer peak savings, and annualized costs of the sum of all three regional energy efficiency packages modeled for the AP2 Forum. Together, the energy efficiency packages save approximately 54,000 GWh of electricity annually by 2018, with peak savings in that year of about 16,000 MW, at an annualized cost in 2018 of about \$1.6 billion (2001 dollars). The savings, both energy and peak power, from the energy efficiency packages in the three regions combined are shown by sector (residential, commercial/institutional, and industrial) in Figures 15 and 16 (peak results are not available by sector for the CNV region).

Figure 12:

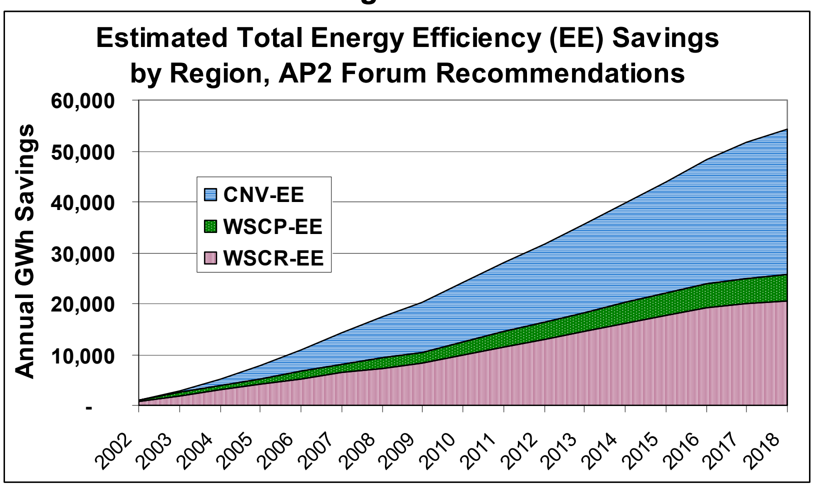


Figure 13:

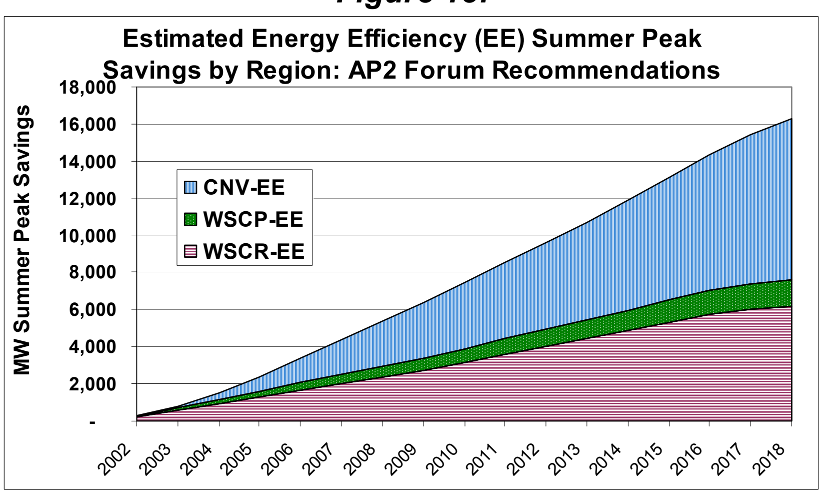


Figure 14:

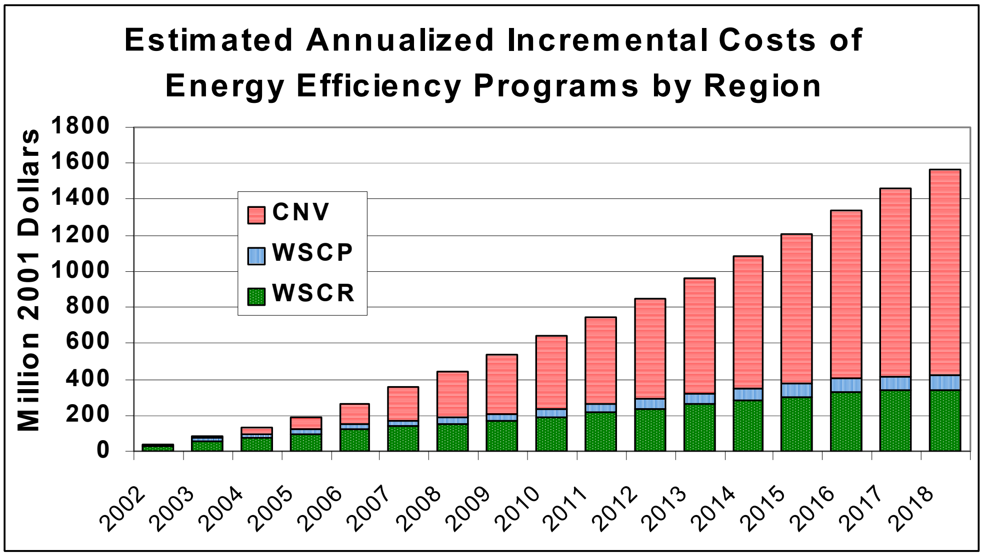


Figure 15:

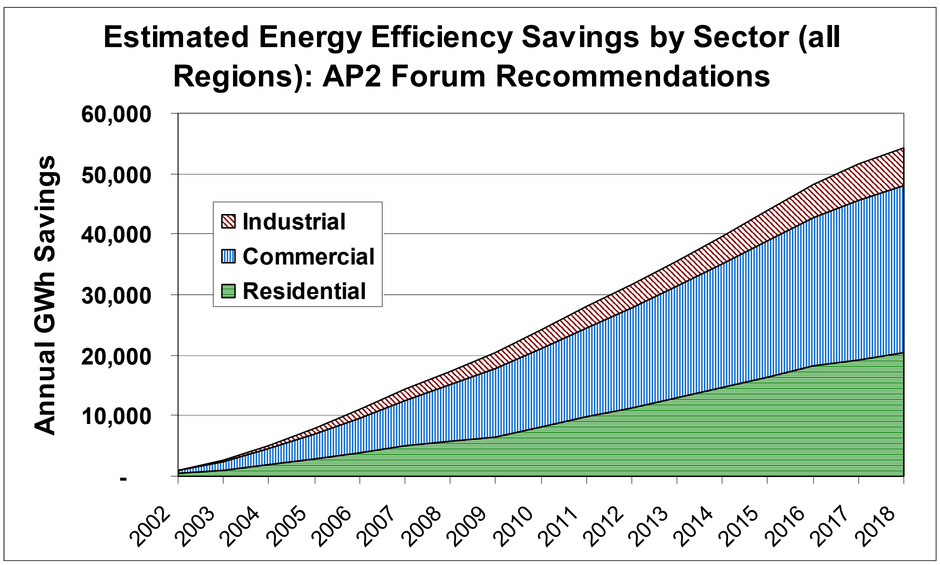
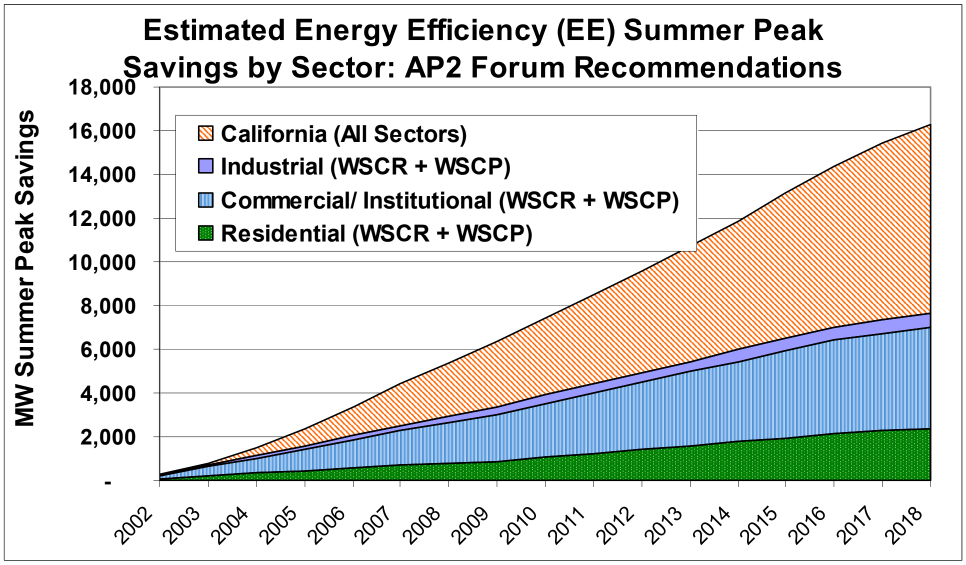


Figure 16:



Potential "Next Steps" in Energy Efficiency Analysis for the West

The analysis described above has identified a number of significant energy efficiency opportunities in the West. As with most energy-efficiency analyses of this type, the reliability and accuracy of the work done for the Forum might, given time and resources, be broadened, deepened, and followed-up in a number of ways. Possible "next steps" in identifying, evaluating, and implementing energy-efficiency programs in the West include:

- Obtain additional expert review of the assumptions and other inputs used in the energy-efficiency analysis.
- Preparing a measure-by-measure estimate of energy-efficiency potential, similar to that done for the other two regions, for the California/Las Vegas region.
- Review the air pollutant emissions (especially NO_x) impacts of potential combined heat and power systems, factoring in local regulations on new emissions sources and the types of pollution control used on new CHP systems.
- Deepen the overall analysis by evaluating additional measures, and by incorporating more region-, state-, tribe- and utility-area-specific information into the estimates wherever possible.
- Provide the energy-efficiency analysis on a State-by-State or Tribal level and/or work with state- or tribe-level teams (for example, from State Energy Offices or Tribal groups) to develop individual state- or tribal-level analyses.
- Identify and tailor approaches for implementation of energy-efficiency programs on regional, statewide, or tribal area bases.

ATTACHMENT 1: BRIEF DESCRIPTIONS OF MEASURES CONSIDERED IN THE WESTERN REGIONAL AIR PARTNERSHIP (WRAP) ENERGY EFFICIENCY ANALYSES

Background

Several members of the Air Pollution Partnership (AP2) Forum have requested, on behalf of their constituents, a listing with brief definitions of the energy efficiency measures considered during the WRAP energy efficiency analyses carried out for the WSCR (Interior West) and WSCP (Northwest—Oregon and Western Idaho) regions. The listing below is divided into residential, commercial/institutional, industrial, and combined heat and power (CHP) measures. This listing is intended to supplement the document Estimation of Potential Energy Efficiency Savings for the Western Regional Air Partnership by the Air Pollution Prevention Forum: Approach, Methods and Summary Results, itself an annex to Final Report on Energy Efficiency and Renewable Energy, which reports on the overall pollution impacts modeling effort overseen by the AP2 Forum.

The descriptions that follow cover all of the energy efficiency measures evaluated, including some measures (higher cost and CHP measures) ultimately not included in the package of energy efficiency measures used in pollutant emissions modeling. For each of the descriptions, names in italics and parentheses (for example "*Residential Efficient CAC*") correspond to the short measure names found in tables of "Cost of Saved Energy Results" presented in Estimation of Potential Energy Efficiency Savings for the Western Regional Air Partnership by the Air Pollution Prevention Forum: Approach, Methods and Summary Results (to which these descriptions are attached) and used by the AP2 Forum to review the energy efficiency analyses.

RESIDENTIAL SECTOR MEASURES

Residential Appliance Recycling: The appliance recycling program approach provides incentives to customers to allow their operable refrigerators or freezers to be disposed of. Appliance recycling has been operated successfully in several regions. A recycling company is contracted to collect the appliances and dispose of them in an environmentally responsible way. The electricity savings result from the fact that the average stock of refrigerators and freezers now in use consumes more than twice the electricity of the new units available on the market today ("*Residential Appliance Recycling*").

Residential Air Conditioning—High-efficiency Units: Compressor, control, fan, heat-exchanger, seal, and other improvements in central and room air conditioners make the most efficient residential units available substantially more efficient than those just meeting standards ("*Residential Efficient CAC*", "*Residential Efficient Room AC*").

Residential Air Conditioning—Evaporative Cooling: In contrast to typical compressor-driven air conditioners, evaporative coolers lower indoor temperatures by evaporating a mist of water, which carries away heat. Evaporative or "swamp" coolers are effective in low-humidity areas, and use only a small fraction of the electricity used by compressor-driven air conditioners ("*Residential Evaporative Cooling*").

Residential Air Conditioning—IDDEC: A variant of residential evaporative cooling called indirect/direct evaporative cooling, or IDDEC, is under development that will provide reliable cooling with significantly less electricity input than typical compressor-driven air conditioning, and is useful in applications where standard evaporative cooling might not be appropriate ("*Residential IDDEC Cooling*").

Residential Heating and Cooling—System and Duct Service and Repair: Many existing heating systems can be made significantly more efficient by applying a package of system and duct repair measures, including tune-ups for heat-pump condenser and evaporator units, cleaning, sealing and insulating duct work, or re-routing duct work to make the flow of heat from the furnace to living areas more efficient (evaluated as two measures: "*Residential Duct Test and Seal--CAC*", and "*Residential Duct Test and Seal--ESH*").

Residential Heating and Cooling—Weatherization Retrofits: The thermal performance of a dwelling—the degree to which a heated house stays warm and a cooled house stays cool, is a function of many factors, including how well insulated the house is, the integrity of its windows and doors, whether it has been well-sealed to control the incursion of outside air, its overall design, its orientation relative to sun and wind, and its proximity to nearby vegetation. Of these factors, the first three are usually addressed by measures installed during a weatherization retrofit of an existing dwelling ("*Residential Weatherization*").

Residential Heating and Cooling—Better-than-Code Building Envelopes for New Homes: Although some parts of the West already have state (and sometime local) residential building codes that mandate quite high residential building performance, there are opportunities to exceed code levels. There are also opportunities to ensure that more buildings are actually built to code, through improved code enforcement, and to strengthen building codes to other states. For the WRAP energy efficiency analysis, incentives were assumed used until 2009 to bring homes to IECC 2000 (International Energy Conservation Code) levels ("*Residential Building Envelope Impr.--IECC 2000*"), and that thereafter code changes mandate enhancements in performance beyond the IECC 2000 level ("*Residential Building Envelope Impr.--Enhanced*").

Residential Lighting—Compact Fluorescent (CFL) Bulbs: Over the last decade or so, compact fluorescent light bulbs (CFLs) designed for use in incandescent fixtures – and lamps and fixtures specifically designed to use CFL technology – have been making inroads in the U.S. market. CFLs use roughly one-quarter of the electricity to produce the same amount of light as incandescent bulbs, and last up to 10 times longer ("*Residential CFL Bulbs*").

Residential Lighting—Indoor CFL Fixtures: CFLs work best when used in fixtures specifically designed for them ("*Residential CFL Fixtures--Indoor*").

Residential Lighting—Outdoor CFL Fixtures: Using CFLs in outdoor fixtures presents an attractive way to save both money and electricity, as long-lived CFL bulbs are used for many hours per day when installed for outdoor security lighting. In addition, as many outdoor incandescent bulbs designed for outdoor use are both expensive and short-lived, there are significant operation and maintenance savings from using outdoor CFL-based fixtures ("*Residential CFL Fixtures--Outdoor*").

Residential Lighting—CFL Torchieres: The "torchiere" style of tall floor lamp gained tremendous popularity in recent years as inexpensive units have become widely available.

Most units use bright, but inefficient, halogen bulbs, while some use incandescent bulbs. Their high electricity use and the fire hazards created by high temperature halogen units have prompted the development of the CFL torchiere. The CFL torchiere produces the same light output as the halogen and incandescent units, using 20-30 percent of the electricity and eliminating an important fire risk ("*Residential CFL Torchiere*").

Residential Appliance Standby Loss Reduction: Even when turned off, many household electronic devices consume small amounts of electricity. While insignificant on an individual device basis, the total energy consumed by standby equipment adds up to about 5 percent of current residential electricity use, due to the multitude of devices and their steady power drain. The EPA *Energy Star* program already includes an initiative to encourage the reduction in average standby consumption from 4.4 to 1 watt per device, a drop of over 75 percent. For WRAP, introduction of measures for standby loss reduction were modeled as an incentive program through 2009 ("*Residential Appl. Standby Loss Red.--Incentive*"), and as a mandatory standard thereafter ("*Residential Appl. Standby Loss Red.--Mandatory*").

Residential Clothes Washing: Improvements in clothes washers allow clothes to be cleaned with less hot water use, and often "spin" clothes faster so that less energy is required to dry them. Two types of higher-than-standard-efficiency clothes washers were included in the WRAP analysis: vertical-axis *Energy Star*-qualified machines ("*Residential Energy Star Clothes Washer*"), and horizontal-axis washers ("*Residential SEHA Clothes Washer*", where SEHA is "Super-Efficient Home Appliance").

COMMERCIAL/INSTITUTIONAL SECTOR MEASURES

Commercial/Institutional Cooling—"Package" AC and Chillers: Use of higher-than-standard efficiency "package" air conditioning (AC) units and centrifugal chillers for small-to-medium-sized and large commercial/institutional buildings produce more cold air (or chilled water) per unit of electricity input than standard models ("*Comml/Instit. AC Impr., 20-ton Package Units*" and "*Comml/Instit. AC Impr., 350-ton Centrif. Units*").

Commercial/Institutional Cooling—Residential-type Units: Many smaller commercial buildings use units that are the same as, or larger but similar to, the AC systems used in homes. For the WRAP study, models of room-type air conditioners, central air conditioners, and heat pumps with energy efficiency ratings significantly higher than standard units were evaluated ("*Comml/Instit. AC Impr., Res. Room-type AC*", "*Comml/Instit. AC Impr., Residential-type CAC*", "*Comml/Instit. AC Impr., Small Heat Pump*").

Commercial/Institutional Cooling—Evaporative Cooling: Evaporative cooling technologies use the latent heat of vaporization of water to cool air. One of the most promising configurations, indirect-direct evaporative cooling (IDDEC) can substantially reduce electricity requirements relative to conventional cooling systems and operate well in the relatively low humidity conditions that prevail during Western summers. For WRAP measures in three size classes were modeled for use in different types of commercial/institutional buildings, based on the size of conventional AC equipment that would otherwise be used ("*Comml/Instit. AC, IDDEC, 20-ton Equiv. Units*", "*Comml/Instit. AC, IDDEC, 150-ton Equiv. Units*", and "*Comml/Instit. AC, IDDEC, 350-ton Equiv. Units*").

Commercial/Institutional Cooling—Gas-fired Air Conditioning: Electricity use can be reduced by replacing electric air conditioners with gas-fired air conditioners. Gas-fired air conditioners use either an absorption cooling cycle or a gas-fired internal-combustion engine that turns an air conditioning compressor. Additional energy is saved by using waste heat from the gas-fired engine to heat water. Three gas-fired AC configurations were evaluated: without heat recovery ("*Comml/Instit. Gas AC, w/o heat recovery*"), with heat recovery and with the recovered heat avoiding the use of a gas-fired water heater ("*Comml/Instit. Gas AC, w/ heat recov. (GWH)*"), and with the recovered heat displacing an electric water heater ("*Comml/Instit. Gas AC, w/ heat recov. (EWH)*").

Commercial/Institutional Cooling—Cooling Tower Variable-Speed Drives: Cooling systems for large buildings often have cooling towers, where waste heat is exhausted using fans. Variable-speed drives for the fan motors on cooling tower allow the speed of the fans to be adjusted to cooling needs, and thus save electricity. Efficiency savings were estimated for WRAP using data from different regions of California. For example, for the WSCP (Oregon/Western Idaho) region, "*Comml/Instit. Cooling Tower VSD--Valley Climate*" denotes an installation in a climate similar to that of the Central Valley in California, while "*Comml/Instit. Cooling Tower VSD--N. Coast Clim.*" Uses a California North Coast climate as an analog.

Commercial/Institutional Space Heat: Electricity, and energy overall, can be saved by switching from electric resistance heating to gas-fired heating systems, preferably gas-fired systems of higher than standard efficiency. In some cases, gas-fired heaters and boilers are less expensive to buy (as well as operate) than electric ones of equivalent capacity. Three measures were evaluated for WRAP: High efficiency and standard gas boilers replacing electric resistance boilers ("*Comml/Instit. Space Heat High Eff. Gas Boiler*" and "*Comml/Instit. Space Heat Std. Gas Boiler*"), and gas "unit heaters" (stand-alone or ceiling-mounted, fan-forced heaters often used in spaces such as warehouses or workshops; ("*Comml/Instit. Space Heat Gas Unit Heater*").

Commercial/Institutional Ground-Source Heat Pumps: Ground-source heat pumps (sometimes called "geothermal" heat pumps) are used for both heating and cooling, and differ from typical heat pumps in that they use buried "loops" of piping with water or other fluid running through it to extract heat from (or, in cooling mode, exhaust heat to) the earth below ground level. The relatively constant temperature of the earth allows the heat pump to run more efficiently, under some conditions, than a typical air-source heat pump. As the number of hours a ground-source heat pump will need to run depends on climate, installations with running times (both heating and cooling) of 1000, 2000, and 3000 hours per year were assumed ("*Comml/Instit. Ground-source HP, 1000 hrs/yr*", "*Comml/Instit. Ground-source HP, 2000 hrs/yr*", and "*Comml/Instit. Ground-source HP, 3000 hrs/yr*").

Commercial/Institutional Water Heat: Water heating electricity use can be reduced substantially by switching from standard electric resistance-type water heaters to heat-pump-type water heaters ("*Comml/Instit. Water Heating, Heat Pump Unit*"). Switching from electric water heating to natural gas-fired water heating, using both boilers and tank-type water heaters, can also reduce both electricity use and overall energy requirements after losses in electricity generation are accounted for ("*Comml/Instit. Water Heater Fuel Switching*", "*Comml/Instit. Water Heat Gas Boiler Fuel Switch*").

Commercial/Institutional Building "Retrocommissioning": Retrocommissioning is defined as "a process of thoroughly identifying the current needs for services within a building, assessing the functionality and appropriateness of the equipment now serving the building, devising and implementing a systematic plan for repairing, rejuvenating or replacing the existing systems, and finally creating operations and maintenance practices to assure continued functionality of the systems". It is therefore the process of reviewing all of the energy uses in an existing building, and making changes to maintenance and operation, and in some cases in equipment, to make sure that the building operates as efficiently as possible ("*Comml/Instit. Retrocommissioning*"). Retrocommissioning usually is designed to reduce a building's need for heating, cooling, and/or lighting.
Commercial/Institutional Building Standards: Higher standards for insulation, window performance, thermal seals, and other building components help reduce heating and cooling energy use. Two levels of building standards, one meeting ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) 90.1.99 building guidelines ("*Comml/Instit. Building Envelope--ASHRAE Stds.*"), and one exceeding ASRAE guidelines by about 20 percent ("*Comml/Instit. Building Envelope--Enhanced Level*").
Commercial/Institutional Refrigeration: Commercial sector refrigeration ranges from large refrigerators not much different from residential units to walk-in or building-sized cold storage rooms or freezers. Options for improving the energy efficiency of refrigeration systems in the commercial sector include improving door seals, compressors, insulation, and controls. The WRAP analysis included two sets of measures, one of which includes measures having payback times of less than two years ("lower-cost measures", "*Comml/Instit. Refrigeration, Low-cost Measures*") and the other having offering paybacks of between two and five years ("*Comml/Instit. Refrigeration, High-cost Measures*").
Commercial/Institutional Lighting—Fluorescent Bulbs and Ballasts: Replacing standard bulbs and ballasts in the four-foot fluorescent fixtures that are most common in office and other applications with high-efficiency bulbs and ballasts produces significant savings ("*Comml/Instit. Lighting, Efficient Fluorescent*".
Commercial/Institutional Lighting—Advanced Lighting Measures: This measure includes a "package" of "emerging" lighting measures, ranging from use of daylighting to lighting controls to the use of advanced bulbs and fixtures, offering average energy savings over standard practice of more than 50 percent ("*Comml/Instit. Lighting, Advanced Measures*").
Commercial/Institutional Lighting—LED Exit Signs: LEDs are also increasingly used in commercial and institutional exit signs in place of incandescent or fluorescent bulbs. LED exit signs save a considerable amount of energy, and may not need to be replaced for a decade or more, significantly reducing maintenance ("*Comml/Instit. LED Exit Signs*").
Commercial/Institutional Clothes Washers: Upgrades in commercial clothes washers, as with residential washers, can yield significant energy savings in water heating and clothes drying, as well in the washer itself ("*Comml/Instit. Efficient Clothes Washers*").
LED Traffic Signals ("*Comml/Instit. LED Traffic Signals*"): Light emitting diodes (LEDs) have been widely used in electronics for years, are now starting to find new lighting applications. As with LED exit signs, long-lasting LED traffic signals, though

they cost more per bulb than incandescent signals, dramatically reduce energy use (by 90%) as well as O&M costs. Although LED traffic signals do not produce the same amount of overall light as incandescent signals, the focused points of bright light produced by LEDs make them easy for the eye to pick out, and thus ideal for traffic lights and other signage.

Commercial/Institutional/Industrial Electrical Transformers: In larger commercial buildings and in industrial installations, transformers are used to "step down" high-voltage power from the electrical grid to usable lower voltages. Transformer losses are not substantial, but as each kWh of electricity used in a building typically must pass through a transformer, even a small reduction in losses improves the energy-efficiency of the entire building. The measures "*Comml/Instit/Industrial Transformers (C/I)*" and "*Comml/Instit/Industrial Transformers (Industrial)*" model the purchase of higher-efficiency "TP-1" transformers instead of standard units.

INDUSTRIAL SECTOR MEASURES

Industrial Motors Efficiency Improvements: The efficiency of industrial motors can be improved in several ways: by replacing failed motors with premium (highest efficiency) instead of standard models ("*Industrial Premium Motors*"), by substituting premium motors where motors would otherwise be rewound ("*Industrial Prem. Motor vs. Rewind*"), and by downsizing motors to appropriate capacity for the systems they power ("*Industrial Motor Downsizing*"). These types of improvements typically save only 1-4 percent of motor electricity requirements, but when applied across the large number of industrial motors, the savings can be considerable.

Industrial Motor System Improvements: Even greater savings of motor electricity use can be achieved by modifying the design and operation of systems that motors drive: air compressors, pumps and valves, fans, and other systems (such as conveyors). For the WRAP energy efficiency analysis, the potential savings for improving each of three types of motor systems ("*Industrial Air Compressor System Measures*", "*Industrial Fan System Measures*", and "*Industrial Pump System Measures*") were evaluated. Savings for these measures can range, on average, from 5 percent for fans to nearly 20 percent for pumps and air compressors.

Industrial—Aluminum Production Process Improvements: Primary aluminum production – as opposed to secondary production from recycled aluminum feedstocks -- is a very energy-intensive process. One of the key options for reducing electricity consumption per unit of aluminum produced is to retrofit aluminum production cells for higher electrolytic efficiency and lower heat loss ("*Industrial Aluminum Process Impr.: Cell Retrofit*"). Other technological advances are possible, such as advanced forming and near net-shape casting. These advances are designed to save energy by producing aluminum in shapes that are close to their final form, can provide considerable O&M and thermal energy (typically gas energy) savings, though typically small electricity savings ("*Industrial Aluminum Process Impr.: Adv. Forming*").

Industrial Electrical Transformers: (see listing under Commercial/Institutional sector, above)

COMBINED HEAT AND POWER

From half to two-thirds of the energy used for fuel-based electricity generation is typically lost as waste heat. Combined heat and power (CHP) systems effectively capture this waste heat and supply it to a facility's process or building heat requirements, and can thereby approximately double the overall efficiency of fuel use to 80 percent or so.

We included in our analysis several types of natural gas-fired CHP systems in several size classes:

- **Internal Combustion Engines**: Internal combustion (IC) engines have been used in stationary power generation applications for a century or more, and are a very mature technology. Heat from gas-fired water-cooled IC engines can be captured from the engine's coolant system via a radiator, and used to heat or pre-heat air or water to help provide space or water heat.
- **Combustion Turbines**: Conventional combustion turbines (CT) are a newer, but still quite mature, electric generation option, having been in wide use for decades. Here heat can be captured from the hot exhaust gases of the turbine via a heat exchange unit, and used for space or water heat, or (more likely) for process heat in industrial plants. We incorporated 10 and 40 MW combustion turbines into the industrial sector CHP initiative that we evaluated.
- **"Micro" Turbines**: Micro-turbines (MT) are self-contained CHP devices that are new on the market. These units, the size of a large household refrigerator (in the 30 kW size) produce heat and electricity using a high-speed but very reliable miniature turbine coupled to a generator. These units, recently commercialized, will be available in size classes other than 30 kW soon, but only the 30 kW units are included in our analysis.

The types of CHP systems included in the commercial/institutional and industrial sector WRAP energy efficiency analyses are as follows:

- **Commercial CHP**: CHP measures in the commercial sector included 30 kW MT units, 100 kW IC units, and 800 kW IC units, with some of the units displacing grid electricity and heat from electric resistance boilers or water heaters ("*Comml/Instit. CHP, 30 kW MT repl. Elect. WH*", "*Comml/Instit. CHP, 100 kW IC repl. Elect. WH*", and "*Comml/Instit. CHP, 800 kW IC repl. Elect. WH*"), and other units displacing grid electricity and heat from gas-fired boilers or water heaters ("*Comml/Instit. CHP, 30 kW MT repl. Gas WH*", "*Comml/Instit. CHP, 100 kW IC repl. Gas WH*", and "*Comml/Instit. CHP, 800 kW IC repl. Gas Blr.*")
- **Industrial CHP**: For the industrial sector, our estimate included 800 and 3000 kW IC units, and 10 and 40 MW CT units. All co-generated heat from these units was assumed to displace gas-fired boilers or process heating equipment ("*Industrial CHP, 800 kW IC repl. Gas Blr.*", "*Industrial CHP, 3000 kW IC repl. Gas Blr.*", "*Industrial CHP, 10 MW CT repl. Gas Blr.*", and "*Industrial CHP, 40 MW CT repl. Gas Blr.*")

ATTACHMENT 2:
TABULAR SUMMARY OF DSM MEASURE AND PROGRAM INPUTS AND ASSUMPTIONS

WSCR, Residential Sector

SUMMARY OF DSM MEASURE AND PROGRAM ASSUMPTIONS USED IN EVALUATING AN ENERGY EFFICIENCY PORTFOLIO FOR THE INTERIOR WEST (WSCR) REGION

PROGRAM **/MEASURE**	Units of Measure Application	Measure Lifetime (years)	Annual kWh Savings per Unit	Summer Peak Savings: kW/Unit	Incremental Installed Cost ($/unit)	Incremental Annual O&M Cost ($/unit)	Program Incentives	Ongoing Admin. Costs	Start-up Admin. Costs
Residential Efficient Cooling Equipment								6.5% of spon. Costs	$1,000,000
High-efficiency Central AC	AC Units	15	863	0.98	$550	$0	70% of incr. cost		
High-efficiency Room AC	AC Units	15	121	0.21	$150	$0	70% of incr. cost		
Residential Evaporative Cooling								10% of spon. Costs	$1,000,000
Direct Evaporative Cooling	AC Units	15	1,870	2.14	$ (1,000)	$ 63	$550		
Indirect/Direct Evaporative Cooling	AC Units	15	1,578	1.80	$ (300)	$ 63	$550		
Residential Lighting--CFL Bulbs								50% of spon. Costs	$500,000
Compact Fluorescent Lamps (CFL)	Bulbs	9	60.2	0.0181	$2.50	$0	$3.75		
Residential Lighting--CFL Fixtures								65% of spon. Costs	$1,000,000
CFL Fixtures--Indoor	Fixtures	19	167	0.050	$14.21	$1.10	100% of incr. cost		
CFL Fixtures--Outdoor	Fixtures	11	143	0.0128	$17.14	($10.60)	100% of incr. cost		
Residential Lighting--Torchieres								20% of spon. Costs	$500,000
CFL Torchieres	Lamps	20	599	0.1797	$40.00	($4.88)	75% of incr. cost		
Residential Appliance Recycling									$500,000
Second Refrigerator Pickup	Appliances	6	1,149	0.196	$125	$0	$75/unit	*(see note)*	
Residential Clothes Washers								15% of spon. Costs	$500,000
EnergyStar Vertical Axis Washers	Appliances	15	674	0.280	$324	$0	50% of incr. cost		
SEHA Horizontal Axis Washers	Appliances	15	814	0.339	$374	$0	50% of incr. cost		
Residential Electronics Standby Loss Reduction									
EnergyStar Devices, Incentive Program	Devices	7	29.8	0.0034	$2.50	$0	50% of incr. cost	15% of spon. Costs	$500,000
EnergyStar Devices, Mandatory Program	Devices	7	29.8	0.0034	$2.50	$0	none	none	$500,000
Residential "Weatherization"								6.6% of spon. Costs	$500,000
Weatherization of Elect. Heated Homes	Homes	15	1,344	1.02	$529	$0	20% of incr. cost		
Residential Duct Testing and Sealing				0.242				16% of spon. Costs	$500,000
Duct Measures, Space Heating Savings	Homes	10	212	0.242	$309	$0	70% of incr. cost		
Duct Measures, Space Cooling Savings	Homes	10	153	0.175	$309	$0	70% of incr. cost		
Residential New Construction Building Shell Improvements								8.6% of spon. Costs	
Improvements to IECC 2000 Level	Homes	50	230	0.096	$1,161	$0	50% of incr. cost		$1,000,000
Enhancements beyong IECC 2000	Homes	50	491	0.205	$2,253	$0	none		$3,000,000

ICF CONSULTING

PROGRAM/MEASURE	Units of Measure Application	Annual Program Participation (in measure units) Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Notes
Residential Efficient Cooling Equipment								
High-efficiency Central AC	AC Units	10,666	21,412	36,058	37,187	37,064	37,239	SEER 13.5 vs. 10.5
High-efficiency Room AC	AC Units	4,646	9,316	15,639	15,978	15,941	15,993	SEER 10 vs. 8.5
Residential Evaporative Cooling								
Direct Evaporative Cooling	AC Units	3,555	7,137	14,423	14,875	14,826	14,895	Evaporative vs. direct cooling
Indirect/Direct Evaporative Cooling	AC Units	178	1,784	7,212	7,437	7,413	7,448	IDDEC vs. direct cooling
Residential Lighting--CFL Bulbs								
Compact Fluorescent Lamps (CFL)	Bulbs	237,961	729,749	994,749	1,018,306	1,041,666	1,065,305	
Residential Lighting--CFL Fixtures								
CFL Fixtures--Indoor	Fixtures	20,450	62,713	106,859	109,389	111,899	114,438	
CFL Fixtures--Outdoor	Fixtures	3,870	11,869	20,223	20,702	21,177	21,658	
Residential Lighting--Torchieres								
CFL Torchieres	Lamps	26,812	63,952	140,102	143,420	146,710	150,040	Compares CFL torchiere with std halogen or incand. lamp
Residential Appliance Recycling								
Second Refrigerator Pickup	Appliances	186,004	190,138	0	0	0	0	Measure cost includes pickup cost and administrative costs
Residential Clothes Washers								
EnergyStar Vertical Axis Washers	Appliances	5,463	10,954	18,389	18,790	18,744	18,800	
SEHA Horizontal Axis Washers	Appliances	5,463	10,954	18,389	18,790	18,744	18,800	
Residential Electronics Standby Loss Reduction								
EnergyStar Devices, Incentive Program	Devices	518,428	1,038,328	1,737,351	1,758,052	1,755,797	1,758,995	Incentive program ends in 2009
EnergyStar Devices, Mandatory Program	Devices	20,105,881	20,173,792	20,265,715	20,489,221	20,484,333	20,522,500	Mandatory program starts in 2010
Residential "Weatherization"								Includes savings of both
Weatherization of Elect. Heated Homes	Homes	16,739	16,944	17,157	17,400	17,637	17,876	heating and cooling energy.
Residential Duct Testing and Sealing								
Duct Measures, Space Heating Savings	Homes	16,848	17,075	17,292	17,511	17,738	17,997	Winter peak savings
Duct Measures, Space Cooling Savings	Homes	15,996	16,211	16,417	16,625	16,841	17,087	Summer peak savings
Residential New Construction Building Shell Improvements								
Improvements to IECC 2000 Level	Homes	24,458	24,592	24,963	26,093	25,970	26,144	Incentive program ends in 2009
Enhancements beyong IECC 2000	Homes	241,068	243,198	244,371	245,181	246,049	246,352	Mandatory program starts in 2010

ATTACHMENT 3:
EXAMPLES OF ENERGY EFFICIENCY MEASURE AND PROGRAM EVALUATIONS PERFORMED FOR THE WESTERN REGIONAL AIR PARTNERSHIP (WRAP)

The three "text boxes" that follow provide example of the procedures used in the evaluation of energy efficiency measures for the Air Pollution Partnership Forum of WRAP. The examples shown—for Commercial/Institutional/Industrial Transformers, Residential Air Conditioning, and Commercial Refrigeration—illustrate the process used in the "bottom-up" (end-use based) energy efficiency analysis carried out for the Interior West and Oregon/Western Idaho regions, and provide examples of some of the data sources and assumptions used. Each example documents three analytical "steps" for the measures and programs considered. The first two steps, compilation of measure costs and performance data and measure benefit/cost analysis, and estimation of program markets and participation, are carried out and documented in MS Excel™ workbooks. The third step, estimation of program costs and savings, was accomplished using the ECO energy-efficiency program analysis software tool, developed by Tellus Institute.

Commercial/Institutional/Industrial Transformers

Step 1: Compilation of Measure Cost and Performance Data, and Measures Benefit/Cost Analysis:

Incremental costs for commercial-sized units were taken to be $4.42 per kVA, and for industrial-sized transformers, $1.81 per kVA (where "kVA" is thousand volt-amps, a measure of transformer capacity). These high-efficiency "TP-1" transformers save, for commercial and industrial applications, respectively, an average of 23.3 and 7.4 kWh per kVA of transformer capacity, relative to standard new transformers[34]. In order to estimate peak savings, a "peak factor" of 0.156 kW per MWh of energy savings was used, along with a transformer lifetime of 30 years[35].

The measure cost and savings data described above were used, along with rough estimates of avoided energy and capacity costs for electricity generation, to estimate benefit/cost ratios for the two transformer measures. Both proved very cost-effective (with benefit/cost ratios of about 3.3 for commercial transformers and 2.6 for industrial units), and were thus included in the WRAP energy efficiency package.

[34] Data on incremental costs and savings for high-efficiency transformers were derived based on Tables 5.4, 5.7, and 5.8 of Supplement to the "Determination Analysis" (ORNL-6847) and Analysis of the NEMA Efficiency Standard for Distribution Transformers, by P. R. Barnes, S. Das, B. W. McConnell, and J. W. Van Dyke. This Oak Ridge National Laboratory Report No. ORNL-6925, dated September 1997, was received as ORNL6925.pdf from Jan Berry of ORNL, 10/24/01. The designation "TP-1" refers to a USEPA EnergyStar program standard for transformers. An ORNL expert on transformer technology (Mr. Lance McCord) was consulted regarding estimates for other parameters needed to estimate average transformer costs and savings.

[35] The peak factor used, 0.000156 kW per kWh saved, is taken from the "National" worksheet of the workbook "neep1017.xls", prepared by various researchers for the NEEP (Northeast Energy Efficiency Partnerships, Inc.) energy efficiency analyses, and summarizing national energy savings potential for a variety of energy efficiency improvements, most related to appliance or equipment standards. The average lifetime of transformers is also from this source.

Step 2: Program Market and Participation Estimation, and Estimation of Administration Costs

The markets for commercial and industrial transformers in the Interior West (WSCR) region were estimated starting with an estimate that of nationwide annual sales of "dry-type" transformers in 2000 totaled 22 million kVA[36]. In order to estimate the fraction of these transformers that were sold in each sector, average commercial-sector and industrial-sector load factors of 20 and 40 percent, respectively, were applied[37]. Using these load factors, the implied distribution of transformer sales nationally was calculated as 14.7 million kVA in the commercial sector, and 7.3 million kVA in the industrial sector. Based on WSCR region commercial and industrial electricity sales in 2000 (61,615 and 54,858 GWh, respectively) and analogous figures for the U.S. as a whole, estimated year-2000 sales of transformers in the WSCR were calculated as 870,654 kVA in the commercial sector, and 375,684 kVA in the industrial sector[38]. These year-2000 sales by sector were then extrapolated through 2018 using the rates of growth in commercial and industrial electricity sales included in National Energy Modeling System (NEMS) projections for the Mountain Census Region, yielding estimates of the markets for transformer sales during the 2002 to 2018 program period.

Program participation was assumed to be 15 percent of transformer sales in the first program year, and 30 percent in subsequent years. This participation rate was based on judgment as to what a well-advertised, aggressive program might accomplish, and included the assumption of a budget of $500,000 to start up the program (the equivalent of perhaps 5 full-time staff, plus funds for developing program marketing materials), and a sponsor incentive equal to 50 percent of the incremental cost of the transformers. Administrative costs equal to 15 percent of sponsor measure costs were assumed, based on consideration of the effort likely to be required to process incentive payments and for ongoing program marketing, and the "free- rider" fraction was taken to be 15 percent[39].

Step 3: Program Costs and Savings Estimates

Measure cost, savings, and lifetime estimates prepared as described in Step 1, above, together with estimates of annual program participation for each measure, administrative cost factors, sponsor cost fractions, and free-ridership estimates estimated as described in Step 2, were entered into the ECO software tool, together with estimates of parameters such as discount rates (4.88 percent annually, on a real basis) capital recovery factors (based on device lifetimes and the assumed discount rate), and the future inflation rate (2.8 percent annually)[40]. ECO was then used to calculate streams of annual costs (on

[36] From the 1997 ORNL report cited earlier.

[37] See, for example, The Cadmus Group, Inc (1999), Metered Load Factors for Low-Voltage, Dry-Type Transformers in Commercial, Industrial, and Public Buildings. File 120799_cadmus.pdf, downloaded 10/23/01 from www.neep.org.

[38] National and state-level electricity sales data from the Energy Information Administration (EIA) of the US Department of Energy (USDOE).

[39] "Free-riders" are program participants that would have adopted the measure even in the absence of the sponsor's incentive program. In practice, "free-ridership" is sometimes measured by post-program evaluation surveys or by market studies, but in many instances, for planning of DSM programs, values in the range of 10 to 20 percent are assumed.

[40] The discount rate used here is similar to real discount rates used by large utilities operating in the West.

both "expensed" and annualized bases) and savings (electrical energy and peak power) for each of the two measures (commercial and industrial transformers) in the program, as well as for the program as a whole. Cost data from ECO (presented as customer and sponsor measure costs, and sponsor administrative costs) and savings data were aggregated with costs from other programs, and savings data were likewise aggregated, and the "package" of annual costs and savings results was summarized for consideration by the Air Pollution Prevention Forum and for inclusion in air pollution and economic impacts modeling using ICF, Inc.'s IPM software tool.

APPENDIX A-13. OTHER GCVTC OPTIONS

This appendix contains work products and references relied upon by Arizona in the development of Chapter 13 of the Regional Haze SIP.

Appendix A-13a. Arizona's Assessment of Other Recommendations Of The Grand Canyon Visibility Transport Commission

ARIZONA'S ASSESSMENT OF
OTHER RECOMMENDATIONS
OF THE
GRAND CANYON VISIBILITY TRANSPORT COMMISSION

To Satisfy the Requirements of 40 CFR 51.309(d)(9)

Arizona Department of Environmental Quality
October 2003

Regulatory History and Requirements

The recommendations of the GCVTC are presented throughout the June 1996 final report with varying degrees of specificity. Not all are included in the Regional Haze Rule. However, some of the recommendations were intended as a menu of options, with no expectation that any geographic area would implement all of them. The GCVTC pointed out in its final report that:

> “Some of the Commission's recommendations ask the EPA to take specific **actions** or institute particular **programs**, in cooperation with the tribes, states and federal agencies as implementing bodies. Other recommendations provide a range of potential policy or strategy **options for consideration** by the EPA and implementing entities. As the EPA develops policies and takes actions based on this report, this distinction between "actions" and "options" should be maintained with diligence. That is, recommendations intended as policy options should not become mandated actions or regulatory programs.”
> [**bold** emphasis in original.][1]

The EPA acknowledged the discretion that should be afforded by states, and the need to report on what measures in the preamble to the rule (64 FR 35755):

> “9. Implementation of Additional Requirements. In section 51.309(d)(9), EPA requires SIPs to provide for implementation of other GCVTC Report policy and strategy options that can be practicably included as enforceable emissions limits, schedules of compliance or other enforceable measures to make reasonable progress toward the national visibility goal for the 16 Class I areas. The GCVTC’s recommendations included items that are not appropriate to directly translate to SIP requirements for every State. The EPA supports State choice of appropriate actions on other options and measures identified by the GCVTC and has, therefore, established a general provision for SIPs calling for them to consider and adopt additional measures as necessary and appropriate. The rule further requires States to report to EPA in 2003, 2008, 2013 and 2018 on what measures have been adopted and the status of implementation of those measures.”

(a) Evaluation of additional Grand Canyon Visibility Transport Commission recommendations. Pursuant to 40 CFR 51.309(d)(9), Arizona has evaluated the “additional” recommendations of the Grand Canyon Visibility Transport Commission, to determine those recommendations have be, or may be, implemented based on national, regional, state, and or local initiatives. Arizona reviewed the GCVTC’s 1996 report, *Recommendations for Improving Western Vistas,* to identify those recommendations that were not incorporated into Section 309 of the Regional Haze Rule as specific requirements. Arizona has concluded that many of the can not be practicably included in this SIP at this time. Arizona will review the status of implementation of these recommendation in future SIP plan revisions required under 40 CFR 51.309(d)(10).

(b) Implementation of Additional Recommendations. Based on the evaluation made by the State of Arizona, the following are actions and programs that have been adopted that support the

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[1] *Recommendations for Improving Western Vistas.* Grand Canyon Visibility Transport Commission, Western Governors' Association. Denver CO, June 1996. Page i.

additional recommendations of the GCVTC described in 309(d)(9). As is noted, the majority of these programs are related to mobile sources although a limited number of programs in other areas have been performed.

GCVTC Options/ Recommendations	Status of Implementation National Strategies for Mobile Sources	Modeled by WRAP (see WRAP TSD for details)
1. Adopt 49-state LEV standards	The National Low Emission Vehicle Program (NLEV) program is a voluntary program to introduce cleaner cars and light trucks in all parts of the country. The NLEV program will continue to exist until the cleaner Federal Tier 2 emission standards become effective in the 2004 model year. Regulated by EPA. Effective from model year 1996. 62 FR 31192, June 6, 1997 Although A.R.S 49-556 allows Arizona to adopt the NLEV program it also provides the state an opportunity to adopt the federal Clean Fuel Fleet program in lieu of the federal LEV program. The federal Clean Fuel Fleet program was, however, replaced by the Cleaner Burning Gasoline program. A.R.S 49-556	Yes Yes
2. Support development of heavy duty vehicle (HDDV) standards	New PM standards for Urban Buses for 1996 and later model years (0.5 g/mile) Regulated by EPA. Effective from model year 1996. 61FR 6949, Feb. 23, 1996.	Yes
	New stringent emission standards and test procedures for all heavy duty diesel vehicles (HDDV) >8,500 lbs Gross Vehicle Weight Rating (GVWR) Regulated by EPA 66 FR 5002, Jan. 18, 2001	Yes
3. Negotiate and adopt off-road standards	Off-road standards for construction and other equipment phased in three stages - Tier 1 through Tier 3. Regulated by EPA. Effective from model year 1996 through 2008. 61 FR 58102, November 12, 1996.	Yes
	Proposed off-road standards for construction equipment, industrial, agriculture, etc (comment period ended Aug 2003). Regulated by EPA. Effective from model year 2008.	No
4. Promote broader application of cleaner fuels	Federal low sulfur diesel (15 ppm) standard for highway HDDV. Developed as part of the new heavy duty engine and vehicle standards and to treat the engine and fuel as one system. Regulated by EPA. Effective from 2007. 66 FR 5002, Jan. 18, 2001	Yes
	Federal Tier II gasoline standard requires refiners to produce gasoline with average sulfur standard of 120 ppm (300 ppm cap) beginning in 2004 and by 2006, average standard to be reduced to 30 ppm (80 ppm cap). Regulated by EPA. Phase in beginning 2004. 65 FR 6698, February 10, 2000	Yes

GCVTC Options/ Recommendations	Status of Implementation National Strategies for Mobile Sources	Modeled by WRAP (see WRAP TSD for details)
5. Pursue strategies for diesel locomotives, boats, airplanes and federal vehicles	Locomotives: Standards phased in three stages - Tier 0, Tier 1 and Tier 2 Regulated by EPA. Effective from model year 2001 through model year 2005. 63 FR 18978, April 16, 1998 * Model by WRAP note: modeled for a diesel sulfur content of 500 ppm.	Yes
	Recreational marine diesel engines vessels greater than 50 hp, used in pleasure craft and yachts, and cruisers. (Less than 50 hp marine vessels are regulated under the Tier 2 and Tier 3 federal off-road engine standards). Regulated by EPA. Phased-in beginning model year 2006. 67 FR 68242, November 8, 2002.	No
	Commercial marine diesel engines vessels Regulated by EPA. Phased-in beginning model year 2004. 67 FR 68242, November 8, 2002.	No
	Aircraft gas turbine engines with rated thrust greater than 26.7 kilo newtons. New standards align with International Civil Aviation Organization . 62 FR 25355, May 8, 1997	Yes
	All federal executive agencies are required to provide information to the Office of Management and Budget, regarding improvements made to federal facilities and activities aimed towards reducing pollution. Exec. Order #12088, 1978	No
	EPA's Partnership Plan includes measures such as Transit, Telecommute, rideshare and alt fueled fleet vehicles to reduce pollution from mobile sources.	No
7. Support improved control of evaporative emissions	On-board refueling vapor recovery system reduces evaporative emission during refueling in cars. Regulated by EPA. Phased-in from 1998- 40%, 1999-80%, 2000-100% 59 FR 16262, April 6, 1994 Stage II vapor recovery systems are to be used in gas refueling stations in ozone nonattainment areas. In Arizona, regulated by ADWM. Effective from 1993	Yes

GCVTC Options / Recommendations	Status of Implementation Mobile Sources – Regional/Local Strategies	Modeled by WRAP (see WRAP TSD for details)
1. Establish Clean Fuel Demonstration Zones	Fuel-based programs in the state Area A: 1. Reformulated gasoline (Arizona Cleaner Burning Gasoline) 2. Vehicle emissions inspection programs 3. Stage II vapor recovery systems 4. Vehicle Fleet Alternative Fuel Vehicle conversion requirement Area B: 1. Oxygenated gasoline 2. Vehicle emissions inspection program	Yes
2. Analyze Pricing and Incentive Approaches	Nothing at this time	
3. Explore Inspection Programs for Heavy Duty Vehicles	Since 1975, ADEQ has implemented a program for heavy duty on-road diesel vehicles in Area A and Area B.	Yes (as existed in 1996)
3. Explore Inspection Programs for Heavy Duty Vehicles (cont.)	Emissions inspections for diesel vehicles in Area A and Area B.	Yes
3. Explore Inspection Programs for Heavy Duty Vehicles (cont.)	All pre-1988 engines operated in Area A to meet 1988 or newer standards (GVWR ≥ 26,000 lbs.)[1] Effective from January 1, 2004; Regulated by ADEQ A.R.S 49-542(f)(7)	No
	Sulfur content of diesel fuel limited to 500 ppm in Area A. Effective from 1993. Regulated by ADWM. A.R.S. § 41-2083	Yes
4. Promote vehicle maintenance	Since 1975, the State of Arizona has implemented a vehicle emissions inspection program. Regulated by ADEQ. Arizona Administrative Code, R18-2-1001 through R18-2-1013	Yes

GCVTC Options/ Recommendations	Status of Implementation Other Recommendations	Modeled by WRAP
1. Develop emission fees programs.	Fees for emissions are charged in the Operating Permits program, as required under 40 CFR Part 70.	No
2. Develop comprehensive emissions inventory for Mexican sources	WRAP has acquired emission inventory information for Mexican sources; see the WRAP Technical Support Document for regional haze SIPs for a complete description.	Yes
	In addition, EPA has funded various entities including the Western Governors' Association to work with Mexican to improve the quality of the information.	No

Appendix A-13b. Summary of Discussions with Federal Land Managers on Emissions In-and-Near the Four Arizona GCVTC Class I Areas

Appendix A-13b. Table 1: Summary of Reported Information Regarding Dust Emissions: Grand Canyon National Park		
Source Category	**Activities Within the Class I Area**	**Activities Near the Class I Area (within 50 km)**
Paved and unpaved roads	There are approximately 30-40 miles of scenic paved drives along each rim of the canyon and about 60 miles of unpaved roads (and additional residential and service roads, especially in Grand Canyon Village). Unpaved roads are reported to receive very little traffic and carry less than five percent of the 41 million vehicle miles traveled annually (for comparison, 71 million vehicle miles are traveled in Maricopa County each day). Visitors to the South Rim of the Canyon can use a shuttle bus system (4.8 million boardings in 2001). Road dust mitigation measures include wet sweeping.	Paved and unpaved dirt roads exist, especially south and east of the canyon. Use of unpaved dirt roads is reported to have increased recently in the south.
Mining activity	No activity reported.	A limestone mine is located approximately 30 km south of the Park near Peach Springs. Newly established national monuments to the northwest of the Park will most likely restrict mining activities. There are numerous uranium claims in the area, but no mining at present.
Agriculture activity	No activity reported.	No activity reported.
Grazing activity	Some wildlife grazing is reported.	Some livestock and wildlife grazing is reported. Commercial cattle grazing occurs south and north of the Grand Canyon (USFS, BLM, and private lands), and family livestock operations (mostly sheep and horse, some cattle) on the Navajo Nation to the east.

Appendix A-13b. Table 1: Summary of Reported Information Regarding Dust Emissions: Grand Canyon National Park		
Source Category	**Activities Within the Class I Area**	**Activities Near the Class I Area (within 50 km)**
Wind generated emissions	Several dry lake beds and beaches are potentially sources of wind generated dust but are only a few acres in size.	Sparsely vegetated areas and increasing activities do exist. The largest is the Red Lake dry lakebed north of Kingman and 40 km south of the Canyon. Sparse vegetation on grazed lands of the Coconino Plateau south of the Park may also be a source of wind-blown dust in the Spring. The Colorado River delta in Lake Mead area appears to be rapidly colonized by tamarisk, minimizing it as a dust source.
Off-highway vehicles (OHV)	There is no off-highway vehicle (OHV) activity	Minimal off-highway vehicle activity is reported. An Off Highway Vehicle Management Plan under development for the 7 National Forests in the state including the Kaibab National Forest near the Grand Canyon. When implemented the proposed plan will help restrict OHV use to specific areas and times of the year when soil and vegetation impacts will be minimized and potentially reduce the amount of bare soil exposed to wind erosion.
Logging activity	No significant activity reported. Limited thinning occurs adjacent to developed areas for wildfire protection and forest restoration.	No significant activity reported. Limited thinning occurs adjacent to developed areas for wildfire protection and forest restoration
Construction activity	Various construction projects occur, but are of limited scope (a few new buildings, repaving projects, etc.)	Unknown at this time
Other area dust sources	Foot and pack animal (mule) traffic occurs within the Park	Unknown at this time
Residential wood burning	Approximately 55 woodstoves are used in the Park. Estimated fuel use is 3 cords/year.	Some residential wood-burning activity occurs
Prescribed burning and Wildfires	Wildfires have occurred with noticeable smoke emissions. Prescribed fires also occur.	Occasional wildfires are reported with noticeable smoke emissions. Prescribed fires also occur.
Point sources	No activity reported.	Coal fired power plant 20 km east of the Park

Appendix A-13b. Table 2: Summary of Reported Information Regarding Dust Emissions: Mt. Baldy Wilderness Area		
Source Category	**Activities Within the Class I Area**	**Activities Near the Class I Area (within 50 km)**
Paved and unpaved roads	No paved or unpaved roads are reported within the Wilderness area.	More than 3,000 miles of roads surfaced in native or unspecified materials and over 400 miles of paved or gravel roads are reported on Forest Service lands. Road dust is reported to be the most common type of dust observed in the area. Observed emissions are reported primarily due to unimproved roads or high-speed dirt roads and are broadly dependant on road use and climate. Road access and use is seasonal, normally from May through October. Dust emissions are generally reduced from July through mid September, due to an increase in monsoonal rainfall. Road maintenance and paving projects are under development for selected routes. Plans include a paving project for a stretch of State Route 377, a high recreational use gravel road north of the Wilderness. The Apache-Sitgreaves National Forests Land Management Plan includes a goal to reduce open road density to a maximum of 2.5 miles per square mile by 2020. Fort Apache Reservation road density (west of the Wilderness area) is reported to be similar to Forest Service areas but may have less vehicular traffic.
Mining activity	No activity reported.	Areas of material mining (cinder and gravel pits) exist. Materials from these operations are used for road maintenance.
Agriculture activity	No activity reported.	Common agricultural activities are related to meadow hay and alfalfa. These activities are generally downwind of the Wilderness area.
Grazing activity	No activity reported. Livestock grazing has not been allowed within the wilderness area for 10 years.	Livestock grazing is a common activity. Historic grazing practices are reported to have impacted plant coverage and increased soil loss from wind erosion in isolated locations. Grazing is generally downwind of Mt. Baldy. The Forest Management Plan includes a goal to balance permitted

Appendix A-13b. Table 2: Summary of Reported Information Regarding Dust Emissions: Mt. Baldy Wilderness Area		
Source Category	**Activities Within the Class I Area**	**Activities Near the Class I Area (within 50 km)**
		numbers of livestock with estimated land capacities. A reported potential source of dust emissions are seasonally fed stock tanks and irrigation reservoirs. These earthen structures can dry out in early summer and fall, exposing sediments to wind erosion.
Wind generated emissions	No activity reported.	Area winds show a diurnal pattern with prevailing flow from the southwest. Some localized areas of open (low vegetation density and low precipitation, particularly to the northeast) or disturbed land subject to wind erosion occur in the area but are generally downwind of the wilderness.
Off-highway vehicles (OHV)	No activity reported.	Frequent OHV activity is reported in Forest lands east of the wilderness. An OHV Management Plan under development for the 7 national forests in the State, including the Apache-Sitgreaves National Forest near Mt. Baldy. When implemented, the plan will help restrict OHV use to specific areas and times of the year when soil and vegetation impacts will be minimized and potentially reduce the amount of bare soil exposed to wind erosion. To date, a hardened trail system has been constructed east of the wilderness to provide managed ATV use (near Springerville and south of Eager).
Logging activity	No activity reported.	Logging is currently minimal in the Forest area (east). Emissions generation during logging activities are reported primarily due to log trucks operating on haul roads. Current logging activity on the White Mountain Fort Apache Reservation (west) is reported to be limited to salvage operations in recently burned-over areas.
Construction activity	No activity reported.	Some development is reported to the northeast and northwest though limited private land is available near the wilderness.
Other area dust sources	No activity reported.	Recreational trails are used primarily by hikers and backpackers.

Appendix A-13b. Table 2: Summary of Reported Information Regarding Dust Emissions: Mt. Baldy Wilderness Area		
Source Category	**Activities Within the Class I Area**	**Activities Near the Class I Area (within 50 km)**
		Area ski slopes have good ground cover and little activity in the summer.
Residential wood burning	No activity reported.	A small number of wood stove activity is reported approximately six miles northeast, and downwind of the Wilderness. This activity is not likely to affect the Wilderness area, though may affect a nearby IMPROVE monitoring site.
Prescribed burning and Wildfires	No prescribed fires are planned. Wildfires are reported with noticeable smoke emissions.	Occasional wildfires are reported with noticeable smoke emissions. Prescribed fires also occur to the southwest.
Point sources	No activity reported.	Point sources include a power plant and a co-generation plant located northeast of the Wilderness area that uses forest product fue. A lumber mill is reported to the southwest. A power plant is also located northeast beyond 50 km from the Wilderness.
Other defined sources	No activity reported.	No activity reported.

Appendix A-13b. Table 3: Summary of Reported Information Regarding Dust Emissions: Petrified Forest National Park		
Source Category	**Activities Within the Class I Area**	**Activities Near the Class I Area (within 50 km)**
Paved and unpaved roads	There are approximately 40 miles of two-lane paved road in the Park. A 4.5 mile portion of Interstate 40 passes through the northern portion of the park. In addition there are an unknown number of miles of unpaved roads. However, about half of the unpaved roads are closed and the remainder are used only by Park personnel.	Paved roads and unpaved dirt roads exist, some of which access the park boundary. Unpaved road use is primarily residential and truck traffic going to a natural gas depot From I-40 to the Adamana gas plant which borders the park.
Mining activity	No mines are in operation within the Park.	An aggregate mine is in operation approximately 15km southwest of the Park.
Agriculture activity	No agricultural activities are reported within the Park.	Some agricultural activities (general farming) are reported within 50km south of the Park boundaries and hay farming activities within 50km northwest of the Park.
Grazing activity	There is grazing of native animals only within the Park.	Livestock grazing occurs near the Park. Historic grazing practices may have impacted coverage and increased soil loss from wind erosion in certain locations.
Wind generated emissions	Some localized areas of naturally occurring open (low vegetation density and low precipitation), disturbed land, and dry riverbeds may result in fugitive dust. Wind generated dust is reported to be the most common type observed in the area and is most common in spring.	Some localized areas of naturally occurring open (low vegetation density and low precipitation) or disturbed land may result in fugitive dust. Wind generated dust is reported to be the most common type observed in the area and is most common in spring.
Off-highway vehicles (OHV)	OHV activity is not allowed.	Recreational or OHV activity is reported near the Park, although it is unrestricted, and the extent of the activity is not known.
Logging activity	No activity reported.	No activity reported.
Construction activity	No activity reported.	Some population growth and development is occurring in the area.
Other area dust sources	There are approximately 10 miles of trails that are used only for hiking.	No activity reported.

Appendix A-13b. Table 3: Summary of Reported Information Regarding Dust Emissions: Petrified Forest National Park		
Source Category	**Activities Within the Class I Area**	**Activities Near the Class I Area (within 50 km)**
Residential wood burning	There appears to be some residential word-burning stoves.	There appears to be some residential word-burning stoves.
Prescribed burning and Wildfires	Vegetation in the park is shrub and grassland, with few trees. No prescribed fires are currently conducted in or within 50 km of the Park. Wildfires are not common in the area.	No prescribed fires are currently conducted in or within 50 km of the Park. Wildfires are not common in the area.
Point sources	No activity reported.	Coal fired utility power plants are located 35 km west of the Park and 52 km southeast of the Park.

Appendix A-13d. Table 4: Summary of Reported Information Regarding Dust Emissions: Sycamore Canyon Wilderness Area		
Source Category	**Activities Within the Class I Area**	**Activities Near the Class I Area (within 50 km)**
Paved and unpaved roads	There are no paved roads or unpaved roads within the wilderness area.	Paved roads exist near the wilderness area and are reported to be increasing in number. The number of unpaved roads is reported to be stable or declining in number, although use of existing roads is increasing.
Mining activity	No activity reported.	There are currently no mines in operation. Inactive mining facilities have the potential to cause an impact if they reopen.
Agriculture activity	No activity reported.	Some agricultural activity occurs in the Verde Valley/Camp Verde areas, south/southwest of the Wilderness area.
Grazing activity	There is some grazing of domestic animals, however wildlife are reported to be the most common grazers in the wilderness.	There is very little grazing and occurs primarily on the Mogollon Rim and Colorado plateau areas.
Wind generated emissions	No activity reported.	Winds in the area show a diurnal pattern. Prevailing winds are generally from the south/southwest and may be gusty during the day, with lighter down-canyon winds at night. Wind generated dust is reported to be the most common type of localized source of observed dust and is most prevalent in April-July timeframe, and with front-driven weather events in the fall. Areas of bare soil at the mouth of Sycamore Canyon and in the Sedona area are sheltered and are not considered to be frequent emission sources.
Off-highway vehicles (OHV)	No activity reported.	OHV use is observed to be increasing but is seasonal (fall/winter/spring). This activity appears to be concentrated to the east of the Wilderness area and any emissions are generally transported away from the area on prevailing westerly winds.
Logging activity	No activity reported.	Historically, logging activity (dust emissions from logging

Appendix A-13d. Table 4: Summary of Reported Information Regarding Dust Emissions: Sycamore Canyon Wilderness Area		
Source Category	**Activities Within the Class I Area**	**Activities Near the Class I Area (within 50 km)**
		trucks) has occurred primarily east of the wilderness. No current activity is reported.
Construction activity	No activity reported.	Growth and development is occurring in the Cottonwood/Verde Valley and Prescott Valley areas to the south and southwest of the Wilderness Area.
Other area dust sources	Recreational use has increased within the Wilderness, such as hiking, backpacking, and some horseback riding.	No activity reported.
Residential wood burning	No activity reported.	Some residential wood-burning activity occurs.
Prescribed burning and Wildfires	There have been no prescribed burns reported within the wilderness area.. Occasional wildfires are reported with noticeable smoke emissions.	Occasional wildfires are reported with noticeable smoke emissions. Prescribed fire adjacent to the wilderness is planned and occurs in the fall through late spring.
Point sources	No sources reported.	A cement facility is located to the southwest near Perkinsville and is permitted to operate.
Other	No activity reported.	There is agricultural burning in the Verde Valley/Camp Verde areas (south/southwest of the Wilderness Area).

APPENDIX A-14. PROJECTION OF VISIBILITY

This appendix contains work products and references relied upon by Arizona in the development of Chapter 14 of the Regional Haze SIP.

December 2, 2002

Ms. Alice Edwards
Air Non-Point & Mobile Sources Program
Alaska Department of Environmental Conservation
410 Willoughby Avenue, Suite 303
Juneau, AK 99801-1795

Mr. Dennis Schwehr
Strategic Issues Management Group Inc.
P.O. Box 2166
Thompson Falls, MT 59873

Mr. Bobby Ramirez
Salt River Pima-Maricopa Indian Community
10005 E. Osborn Road
Scottsdale, AZ 85256

Dear Ms. Edwards, Mr. Schwehr, and Mr. Ramirez:

The Arizona Regional Haze Emissions Inventory Workgroup (EIWG) would like to provide the WRAP Emissions Forum with the results of our review of the 1996 WRAP Emissions Inventory. While the EIWG understands that it is not possible to change WRAP's 1996 emissions inventory, we are requesting that the WRAP Emissions Forum consider the recommendations.

The enclosed report, "Review of 1996 WRAP Emissions Inventory For Use in Arizona's Regional Haze State Implementation Plan," summarizes EIWG's review and recommendations to enhance the inventories for certain emission source categories. An overview of this report will be presented by me at ADEQ's December 5, 2002, Regional Haze public workshop. The EIWG also requests that issues in the Report related to fire and dust emissions inventories be referred to the appropriate WRAP Forums.

We appreciate the WRAP's hard work and diligence in developing an initial comprehensive emissions inventory for the western states. ADEQ and its stakeholders are committed to working with the Emissions Forum in its future work. For additional information on this report, please contact Randy Sedlacek, ADEQ, at 602-771-2352 or rfs@ev.state.az.us.

Sincerely,

Steven E. Peplau
EIWG Chair,
Maricopa County Air Quality Division Manager

encl: 1

cc: Tom Moore, WRAP
Lee Gribovicz, Wyoming DEQ

Review of 1996 WRAP Emissions Inventory
For Use in Arizona's Regional Haze State Implementation Plan

Emissions Inventory Workgroup

November 25, 2002

EXECUTIVE SUMMARY

The Emissions Inventory Work Group (EIWG) reviewed the 1996 Western Regional Air Partnership's (WRAP) Emissions Inventory (EI) for use in Arizona's Regional Haze SIPs submitted after Year 2003. The majority of the review was based on comparisons between the WRAP EI and local emissions inventories developed by Maricopa County, Maricopa Association of Governments, Pima County, Pima Association of Governments, and Pinal County. Following is a summary of the EIWG's review and recommendations to ADEQ for working with WRAP to enhance WRAP emission source categories:

1. **Onroad Emissions** - The vehicle miles traveled (VMT) data in the 1996 WRAP EI were larger than the VMT data in local emissions inventories and did not match the seasonal allocation of VMT. The EIWG suggests that local VMT data be used for developing the mobile onroad emissions for Arizona Regional Haze SIPs submitted after Year 2003, with particular attention to allocating VMT by season, because Arizona does not follow the national pattern for maximum VMT occurring during the summer season.

2. **Nonroad Emissions** - Generally, the nonroad emissions data in the 1996 WRAP EI were higher than the nonroad emissions data in local emissions inventories. Since the temporal pattern of nonroad equipment activity in Arizona can be quite different from the national average, the EIWG recommends that local Arizona nonroad emissions data be used in the Arizona Regional Haze SIPs submitted after Year 2003.

3. **Point Sources** - Emissions data for point sources, greater than 100 tons per year, in the 1996 WRAP EI were larger than the emissions data for Maricopa County, and much larger than the point source emissions data in Pima County and Pinal County emissions inventories (e.g., as much as an order of magnitude for PM10 emissions from point sources in Pima County). In July 2002, both Maricopa and Pima Counties submitted corrected point source emissions data to WRAP's contractor. The EIWG recommends that emissions data from the state, local governments, and tribal entities be used instead of national surrogates for Arizona Regional Haze SIPs submitted after Year 2003. The EIWG also recommends that a decision be made whether fugitive dust emissions should be included as part of the point source inventory for Arizona Regional Haze SIPs submitted after Year 2003.

4. **Area Sources** - Emissions data for area sources in the 1996 WRAP EI were in relatively good agreement with the emissions data in Maricopa County (except for certain subcategories such as NOx from stationary source fuel combustion, which were grossly overestimated), but were not in good agreement with the emissions data for area sources in Pima County. The EIWG suggests that area source emissions in the WRAP EI be reviewed for accuracy before these data are used in Arizona Regional Haze SIPs submitted after Year 2003.

5. **Forest Fires** - The WRAP EI and the Arizona Smoke Management Program may use different emission factors (but use the same activity data) to estimate emissions from forest fires. The EIWG suggests that forest fire emissions from the WRAP EI be compared to the Arizona Smoke Management Program's and for WRAP to lobby USEPA to use the most current emission factors for estimating emissions from forest fires (currently WRAP is using AP-42 emission factors).

6. **Agricultural / Rangeland Burning** - Emissions data on agricultural / rangeland burning are planned to be included in the WRAP's Year 2018 Fire EI. The EIWG suggests that the WRAP's emissions estimates for this category be used, since little data are collected on agricultural / rangeland burning in Arizona. In the future, a statewide tracking system for the location, size, fuel type, fuel loading, and time of burning would greatly benefit the understanding of the contribution of this emission source to regional haze.

7. **Biogenics** - The WRAP biogenic emission estimates for Maricopa County are much smaller than those calculated by the Maricopa Association of Governments (MAG) estimates. The EIWG plans to investigate this discrepancy further after receiving biogenic emissions data grouped by counties from the WRAP Modeling Center at the University of California - Riverside.

8. **Wind Erosion** - This emission category is scheduled to be added to the WRAP EI after completion of a WRAP research contract. Estimating emissions from wind erosion entails accounting for a number of factors including local variations in soil type, wind patterns, precipitation patterns, vegetation growth, and topography. Due to the inherent complexity of developing wind erosion estimates for a region as large as Arizona, the EIWG suggests that the wind erosion data produced by the WRAP's contractor be used in Arizona Regional Haze SIPs submitted after Year 2003.

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ACRONYMS AND ABBREVIATIONS

ADEQ	Arizona Department of Environmental Quality
ATR	Automated Traffic Recorders
CO	Carbon Monoxide
EI	Emissions Inventory
EIWG	Emissions Inventory Work Group
EPA	United States Environmental Protection Agency
GCVTC	Grand Canyon Visibility Transport Commission
GIS	Geographic Information System
HPMS	Highway Performance Monitoring System
MAG	Maricopa Association of Governments
MCESD	Maricopa County Environmental Services Division
NEI	National Emissions Inventory
NH3	Ammonia
NOx	Nitrogen Oxides
PAG	Pima Association of Governments
PM10	Particulate Matter Less Than Or Equal To 10 Microns
PM2.5	Particulate Matter Less Than or Equal to 2.5 Microns
SIP	State Implementation Plan
SO2	Sulfur Dioxide
U.S.	United States
USEPA	United States Environmental Protection Agency
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
WRAP	Western Regional Air Partnership

BACKGROUND

Federal Mandate

As part of the Clean Air Act Amendments in 1977, Congress set a national goal of remedying existing visibility impairment, and preventing future impairment, from manmade pollution at the 156 national parks and wilderness areas across the United States (see Figure 1 for map of Arizona Class I Areas). Section 169 A was added to the Clean Air Act to address visibility impairment from existing stationary sources operating in and near national parks or wilderness areas. In this case, the visibility impairment could be found directly associated with or caused by the stationary source (i.e., reasonably attributable). Section 169B was added to address visibility impairment due to regional haze. Regional haze is defined as, "visibility impairment that is caused by the emission of air pollutants from numerous sources located over a wide geographic area. Such sources include, but are not limited to, major and minor stationary sources, mobile sources, and area sources." (40 CFR § 51.301). The Regional Haze Rule, adopted July 1, 1999, requires states to develop programs to assure reasonable progress toward meeting the national visibility goal. The way in which states develop and implement programs to address air pollution is through a state implementation plan (SIP) [1].

History - ADEQ

The state of Arizona has been actively involved in visibility and regional haze issues, beginning with the Grand Canyon Visibility Transport Commission (GCVTC) and continuing with the Western Regional Air Partnership (WRAP), the successor organization to the GCVTC. Each Arizona work group has a designated person to monitor the WRAP process and report items of interest and concern to the relevant group. The WRAP forums are expected to produce many work products that will be available for Arizona's consideration as it develops its Regional Haze SIP.

Beginning in August 2001, ADEQ launched Phase 1 of a stakeholder process to determine which schedule to follow in its development of a Regional Haze SIP. The federal Regional Haze Rule provides two choices for states and Indian tribes in the nine state GCVTC region. States submitting SIPs in 2003 will be implementing GCVTC recommendations per 40 CFR § 51.309 ("309 SIP"). States submitting SIPs in the 2004-2008 time frame will be focusing on a broader range of sources and programs, per 40 CFR § 51.308 ("308 SIP").

The stakeholder process that began in August 2001 ended in early November 2001 with a consensus that ADEQ pursue the option to submit a SIP by December 31, 2003, in accordance with 40 CFR § 51.309. The stakeholders further agreed that the SIP should include the eight Arizona mandatory Federal Class I areas outside of the GCVTC region in addition to the four GCVTC region Class I areas [1].

ARIZONA CLASS I AREAS

ALL CLASS I AREAS

- Federal Class I Areas
- GCVTC Class I Areas
- State Boundaries
- Major Freeways
- Major Cities

July 2000

Author: TS Summers, [illegible]

For more information about this map contact:

Air Quality Division, GIS Mapping Staff
Arizona Department of Environmental Quality
3033 North Central Avenue, Phoenix, Arizona 85012

[illegible] GIS Project Manager

Phone: [illegible]
Fax: [illegible]
E-mail: [illegible]

[illegible] Unit Manager

Phone: [illegible]

Disclaimer Information:
This map is a (WORKING DOCUMENT), it is designed for presentation and discussion and is subject to change and further refinement.

Role of Emissions Inventory Workgroup

The Emissions Inventory Work Group is responsible for the review and recommendation of emission baseline and projections used in the SIP analysis. Specific responsibility areas include:

- Develop and review emission inventory work products, as needed.
- Review WRAP emission inventories/projections.
- Consult with long-term strategy work groups to identify data gaps, and review projections of the effect of long-term strategies on emissions.
- Develop updates for emission inventories/projections to be forwarded to the WRAP Regional Modeling Center [1].

WRAP Emissions Inventory

The 1996 WRAP emissions inventory (EI) includes four separate inventories for point sources, mobile sources, area sources, and fire by county for the thirteen states that are WRAP members. ADEQ and some counties in Arizona supplied point source emission estimates to the WRAP point source EI. The mobile source emissions were compiled by the WRAP Mobile Sources Forum using EPA's MOBILE6 and NONROAD emissions models for onroad and offroad sources. Arizona area source emissions in the WRAP EI were based on estimates from the 1996 National Emissions Inventory and did not include geogenic wind blown dust from undisturbed natural soils. Fire emissions were compiled by the WRAP Fire Emissions Joint Forum [2].

DISCUSSION

The Emissions Inventory Workgroup (EIWG) has met four times: June 19, 2002; July 17, 2002; August 14, 2002, and September 16, 2002. During these meetings, EIWG members reviewed the Arizona portion of the WRAP EI, discussed the methodology used to develop the WRAP EI and how to utilize the WRAP EI in Arizona Regional Haze SIPs submitted after Year 2003 (e.g., 309G / 308 SIPs), and suggested enhancements to the WRAP EI for making Year 2018 forecasts. The following sections summarize the EIWG members' review of the methodology and emissions data for the 1996 WRAP EI source categories.

Mobile Sources

Onroad Emissions - Maricopa County

Based on very limited model-compatible data, the WRAP EI's onroad CO emission rates for 1996 are comparable to MAG estimates for 1994 (Table 1). The WRAP EI does overstate 1996 Maricopa County VMT by about 8% in the winter (CO), 13% on an average annual day (PM-10), and 25% in the summer (VOC, NOx). In addition, WRAP summer season VMT in 1996 (from onroad spreadsheet) is 13% higher than winter VMT. This is opposite to MAG's VMT data that shows higher VMT in the winter than in the summer.

Table 1 – Maricopa County Vehicle Miles Traveled	
1996 WRAP Onroad Inventory	71,538,442 mi/day
1996 MCESD Onroad Inventory	51,329,514 mi/day
Difference	20,208,928 mi/day
% Difference	-28.2%

Both emissions inventories did use the MOBILE6 emissions model. The higher WRAP VMT estimates in the summer would explain some, but not all, of the higher VOC and NOx emissions listed for Maricopa County in the WRAP EI.

Onroad Emissions - Pima County
For Pima County, the local VMT value used for the Pima Association of Government's (PAG) 2003 Transportation Improvement Program (TIP) is 10.93% lower than the Year 2003 VMT (average over 4 seasons) used for the WRAP EI. It is also important to note that the Year 2003 VMT used for the TIP only applies to eastern Pima County, which is the transportation planning area. The results are displayed in Table 2.

Table 2 – Pima County Vehicle Miles Traveled	
2003 WRAP Onroad Inventory	21,760,515 mi/day
2003 TIP	19,382,125 mi/day
Difference	2,378,390 mi/day
% Difference	-10.93%

The WRAP average annual daily VMT for Pima County (1996) is 19.4% higher than the Highway Performance Monitoring System (HPMS) average annual daily VMT for Pima County (1996). A discrepancy also exists with the seasonal VMT allocation in the WRAP EI for Pima County. The highest VMT for the WRAP Onroad EI was applied to the summer season. However, the summer season in Pima County typically yields the lowest VMT, with the spring season having the highest VMT. Table 3 lists the onroad emissions in the WRAP EI and the PAG EI.

Table 3 – Pima County Onroad Emissions (tons per day)			
	VOC	**NOx**	**CO**
2003 WRAP EI	57.8	53.6	517.7
2003 PAG Onroad Mobile	37.3	55.9	370.7
% Difference	-35.5%	+4.3%	-28.4%

Nonroad Emissions - Maricopa County
1996 Maricopa County periodic inventories are lower than the WRAP EI for VOC (-43%) and NOx (-84%), and slightly higher (+21%), for CO (Table 4). Note that the periodic inventories were developed for a smaller CO/Ozone Nonattainment Area of about 2,000 square miles versus Maricopa County, which is 9,200 square miles in area, which was used for the WRAP EI. The EPA NONROAD model used by WRAP is known to overstate nonroad activity levels. It is understood that a new and improved NONROAD model will be used by WRAP in the future. This should reduce some, if not all, of the disparity between WRAP's and Maricopa County's estimates of VOC and NOx emissions.

Table 4 – Maricopa County Nonroad Emissions (tons per day)

	VOC	NOx	CO (winter)	PM10
1996 WRAP EI	115.4	196.7	375.1	13.8
1996 MCESD EI	66.3	32.0	452.4	NA
%Difference	-42.5%	-83.7%	+20.6%	NA

Nonroad Emissions - Pima County
PAG developed a nonroad mobile source inventory for the Year 2000. The PAG EI nonroad mobile emission estimates were compared with the Year 1996 nonroad mobile emissions estimates (tons/day) for the WRAP EI and are listed in Table 5.

Table 5 – Pima County Nonroad Emissions (tons per day)

	VOC	NOx	CO	PM10	PM2.5	SO2
1996 WRAP EI	19.30	35.30	220.89	3.82	3.57	6.74
2000 PAG EI	16.53	20.75	198.90	2.56	2.35	4.90
%Difference	-14.4%	-41.2%	-10.0%	-33.0%	-34.2%	-27.3%

Note that the area included in the PAG nonroad EI was the Tucson Air Planning Area (TAPA), which includes the bulk of the population within eastern Pima County (~96.5%), while the estimate for the WRAP EI includes all of Pima County.

Point Sources
Maricopa County
The accuracy of the data on large point sources (>100 TPY) in the ***revised*** WRAP EI appears to be in generally good agreement with Maricopa County's EI (Maricopa County submitted updated point source emissions data to WRAP contractors to revise the WRAP EI). Table 6 compares Maricopa County's emissions with the emissions in the ***original*** WRAP EI. The emissions data that Maricopa County submitted to WRAP

in 2001 contained all point sources included in the 1999 periodic emissions inventory for Maricopa County, with some sources having annual emissions as small as ten tons per year. Since the WRAP point source data only includes those sources greater than 100 tons per year, Maricopa County submitted a revised set of point source data to WRAP contractors in July 2002.

Table 6 – Comparison of Maricopa County and Original WRAP Point Source Emissions (tons per year)

	VOC	NO_X	CO
WRAP Maricopa County 1996 EI Base Case	5,866	3,319	736
Maricopa County 1996 EI	1,489	2,536	266
% Difference between local and original WRAP/NEI data	-75%	-24%	-64%
Difference between local and original WRAP/NEI data in Tons	-4,377	-783	-469

Pinal County
There appear to be large discrepancies between the WRAP EI and Pinal County's data on point source emissions. Tables 7 lists the results of comparing the Pinal County's point source emissions with the WRAP EI.

Table 7 – Comparison of Pinal County and Original WRAP Point Source Emissions (tons per year)

	VOC	NO_X	CO	SO2	PM10	PM2.5	NH3
WRAP Pinal County 1996 EI Base Case	144	2,076	483	27,974	2,531	990	2
Pinal County 1996 EI	188	1,059	254	16,678	3,252	267	0.00
% Differences (Increases from using WRAP/NEI data)	*-23.4*	*+96*	*+90.2*	*+67.7*	*-22.2*	*+270.7*	*Na*
Differences (Increases from using WRAP/NEI data) in Tons	*-44*	*+1,017*	*+229*	*+11,296*	*-721*	*+723*	*+2*
Grand Total [Differences (Increases from using WRAP/NEI data) in tons]: +10,552							

Pima County

There also appear to be large discrepancies between the ***original*** WRAP EI and Pima County's data on point source emissions. Table 8 lists the results of comparing the Pima County's point source emissions with the original WRAP EI. In July 2002, Pima County also submitted corrected point source emissions data to WRAP contractors and the mentioned discrepancies in Pima County's point source emissions should have been corrected in the ***revised*** WRAP EI.

Table 8 – Comparison of 1995 Pima County and 1996 Original WRAP Point Source Emissions (tons per year)

	VOC	NO_X	CO	SO2	PM10	PM2.5	NH3
WRAP Pima County 1996 EI Base Case	358	9,312	4,827	8,338	11,236	6,308	4
Pima County 1995 EI	56	7,142	5,520	2,787	1,167 (5,116)*	NA	NA
% Differences (Increases from using WRAP/NEI data)	*+539*	*+30.4*	*-12.5*	*+199*	*+862 (+119)**	*NA*	*NA*
Differences (Increases from using WRAP/NEI data) in Tons	*+302*	*+2170*	*-693*	*+5551*	*+10,069 (+6,120)**	*+6,308*	*+4*

Grand Total [Differences (Increases from using WRAP/NEI data) in Tons]: +13,995; (+10,046)*

* Totals with Fugitives

Five facilities in Pima County were identified as PM_{10} point sources that emitted more than 100 tons per year in 1996 based on Pima County and ADEQ permitted source records. These facilities and their associated PM_{10} emissions are listed in Table 9.

Table 9 – 1996 Pima County Point Sources (> 100 tons per year)

Permitted By	Facility Name	PM_{10} Total With Fugitives	PM_{10} Total Without Fugitives
ADEQ	Cypress Sierrita (now known as Phelps Dodge Sierrita)	2,633 tons	185 tons
ADEQ	Arizona Portland Cement	1,585 tons	84 tons
ADEQ	Tucson Electric Power	121 tons	121 tons
PDEQ	ASARCO	Unknown	650 tons
PDEQ	Silver Bell Mining L.L.C.	Unknown	127 tons
Total		**4,339**	**1,167**

As shown in Table 9, fugitive PM_{10} emissions can make a significant difference in the PM_{10} emission totals, especially with respect to sources such as mines. Thus, a determination needs to be made whether or not fugitive dust emissions should be included as part of the point source inventory that will be used in Arizona Regional Haze SIPs submitted after Year 2003. If it is determined that fugitive dust emissions should be included in the point source inventory, then this needs to be applied consistently among all of Arizona counties' emissions inventories.

In order to ensure more accurate point and area source emission inventory reporting for future WRAP EI's, the EIWG recommends that WRAP rely more on state/local/tribal entities for emissions data wherever possible, rather than using national surrogates. For example, there was little or no communication between WRAP's contractor and Pinal and Pima counties during the building of the 1996 WRAP EI base case. This resulted in some discrepancies in the emissions for these counties that could have been corrected with input from the counties.

Area Sources

The EIWG reviewed the WRAP EI at the county level, and selected several subcategories for comparison with locally developed emissions estimates.

Maricopa County

Four emissions subcategories, that had the potential for large discrepancies between WRAP and Maricopa County values, were investigated further:

- PM10: WRAP data for PM10 from industrial processes agree well with local 1995 estimates.

- VOC: WRAP estimates of VOC emissions from solvent use appear to be reasonably close to local numbers.

- NOx: WRAP emission values for NOx from stationary source fuel combustion are grossly overestimated for Maricopa County and presumably statewide.

- CO: WRAP data on emissions from waste disposal, treatment and recovery show nearly 9,000 tons of CO emissions from residential incineration in Maricopa County. However, there should be nearly no emissions from this source category because residential incineration is rare in Maricopa County.

Table 10 compares WRAP estimates of area source emissions in Maricopa County with values from the County's 1995 Periodic Emission Inventory.

Table 10 – Comparison of 1995 Maricopa County and 1996 WRAP Area Source Emissions (tons per year)

	VOC	NO_X	CO
WRAP Maricopa County 1996 EI Base Case	64,712	36,797	22,470
Maricopa County 1995 EI	39,550	4,589	1,678
% Difference (Increases from using WRAP/NEI data)	-39%	-88%	-93%
Difference (Increases from using WRAP/NEI data) in Tons	-25,162	-32,207	-20,792

Pima County

Area source emission totals in the Pima County portion of the WRAP EI were compared with Pima County's emissions data. The difference in the seven emission categories ranged from a negative 24% to a plus 107%. Table 11 lists the total emissions and differences for area sources in Pima County.

Table 11 – Comparison of 1995 Pima County and 1996 WRAP Area Source Emissions (tons per year)

	VOC	NO_X	CO	SO2	PM10	PM2.5	NH3
WRAP Pima County 1996 EI Base Case	19,627	4,185	8,435	400	7,294	2,697	1,503
Pima County 1996 EI	9,443	7,822	11,106	2,213	5,786	NA	NA
% Differences (Increases from using WRAP/NEI data)	*+107*	*-46.5*	*-24.1*	*-81.3*	*+26*	*NA*	*NA*
Differences (Increases from using WRAP/NEI data) in Tons	*+10,184*	*--3637*	*-2671*	*-1813*	*+1,508*	*+2,697*	*+1,503*
Grand Total (Difference / Increases from using WRAP/NEI data in tons): +12,029							

Forest Fire
The Arizona Smoke Management Program, conducted by the U.S. Forest Service in conjunction with ADEQ, makes daily decisions on which prescribed fires should be approved based on weather conditions, fuel loading, location of fires, size of fires, and other fires in an air basin. The Arizona Smoke Management Program also tracks wildfire activity in Arizona. Annually, there are approximately 100 days when prescribed burning can take place in Arizona. The decision to approve a prescribed burn must balance both the need to promote forest health and the negative effects of fire on air quality. In the future, the number of prescribed fires will likely increase, while the number of wildfires will probably remain constant. The WRAP EI uses the activity data collected by the Arizona Smoke Management Program. The WRAP EI may use different emission factors than the ones use by Arizona Smoke Management Program; therefore, the EIWG suggests that forest fire emissions from the WRAP EI be compared to the Arizona Smoke Management Program's and for WRAP to lobby USEPA to use the most current emission factors for estimating emissions from forest fires (WRAP is currently using AP-42 emission factors).

Agricultural / Rangeland Burning
Agricultural burning was not included in the 1996 WRAP Fire EI, but it is planned to be included in the 2018 Fire Emissions Inventory. Currently, there are little specific data collected on agricultural / rangeland burning by WRAP, by counties, or the state of Arizona. (See appendix for overview of recommendations for improving collection of activity data for agricultural burning emissions).

Biogenics
Maricopa County
A comparison of the WRAP estimates of biogenic VOC and NOx emissions with those developed as part of the Maricopa County ozone nonattainment area inventory for 1996 shows that WRAP EI estimates are much smaller (30 to 70 times) than the county-derived estimates. The WRAP modeling center in Riverside, California has been requested to prepare biogenic emissions, by county in Arizona, to facilitate further investigation of these large discrepancies.

Pima County
In 1998, PAG contracted with the University of Arizona to develop a biogenic emissions inventory for roughly the eastern half of Pima County. This inventory indicated that 50% of the total VOCs for this study area are emitted by biogenic sources. In contrast, for the Tucson metropolitan study area (developed urban and suburban area without surrounding elevated regions), 6% of the total VOCs are emitted by biogenic sources. Pima County biogenic emissions will be compared to the WRAP's biogenic emissions when these data are received from the WRAP Modeling Center.

Ammonia
The ammonia emission factors used for the WRAP EI are lower than those used to develop the 1994 Maricopa County PM10 inventory. Only livestock emissions could be compared, since Maricopa County did not calculate ammonia emissions from crops. The difference in the two sets of livestock emissions is proportional to the difference in emission factors, thus the activity numbers used in the WRAP EI and the 1994 Maricopa County PM10 Inventory are in good agreement.

Power Plants
The EIWG assumed that power plant emissions in the WRAP EI would be fairly accurate because these data are based on the acid rain reports submitted to U.S. agencies.

Wind Erosion
Emissions from wind erosion were not included in the 1996 WRAP EI. However, WRAP recently submitted a Request for Proposal for a contractor to add this emissions category to the WRAP EI.

CONCLUSIONS

The WRAP is to be commended for developing a comprehensive emissions inventory for the western states. The Arizona portion of the WRAP EI will be an integral part of Arizona Regional Haze SIPs submitted after Year 2003. Following are the EIWG's review and recommendations for enhancing certain emission source categories in the WRAP EI for use in Arizona Regional Haze SIPs submitted after Year 2003.

Onroad Emissions

WRAP's VMT in Maricopa County overstates Maricopa County's VMT with the discrepancy being largest for the summer season (e.g., 8% more in winter and 25% more in summer). Pima County's VMT may be also overstated (11%), and as with Maricopa County's VMT, the WRAP seasonal allocation does not agree with Pima County's data. The EIWG suggests that local VMT data be used for developing the mobile onroad emissions for Arizona Regional Haze SIPs submitted after Year 2003 with particular attention to allocating VMT by season, because Arizona does not follow the national pattern for high VMT occurring during the summer season.

Nonroad Emissions

The WRAP used an updated NONROAD model for developing their nonroad emissions. However, a new NONROAD model, to be released soon by EPA, shows significantly lower nonroad activity levels. The technical support document being developed by ENVIRON will shed more light on the differences in assumptions and models that produced the WRAP EI estimates. However, since the temporal pattern of nonroad equipment activity in Arizona can be quite different from the national average, the EIWG recommends that local Arizona nonroad emissions data be used in the Arizona Regional Haze SIPs submitted after Year 2003.

Point Sources

Emissions data for point sources, greater than 100 tons per year, in the 1996 WRAP EI were larger than the emissions data for Maricopa County, and much larger than the point source emissions data in Pima County and Pinal County emissions inventories (e.g., as much as an order of magnitude for PM10 emissions from point sources in Pima County). In July 2002, both Maricopa and Pima Counties submitted corrected point source emissions data to WRAP's contractor.

In order to ensure more accurate point and area source emission inventory reporting for future WRAP EIs, the EIWG suggests that emissions data from the state, local governments, and tribal entities be used, instead of national surrogates, for Arizona Regional Haze SIPs submitted after Year 2003. The EIWG also recommends that a decision be made whether fugitive dust emissions should be included as part of the point source inventory for Arizona Regional Haze SIPs submitted after Year 2003.

Area Sources
WRAP data for PM10 emissions from industrial processes and VOC emissions from solvent use agree well with Maricopa County data. However, WRAP emission values for NOx from stationary source fuel combustion are grossly overestimated for Maricopa County and presumably statewide. WRAP data on area source emissions for Pima County were not in good agreement with Pima County's EI data. The EIWG suggests that area source emissions in the WRAP EI be reviewed for accuracy before these data are used in Arizona Regional Haze SIPs submitted after Year 2003.

Forest Fires
The WRAP EI and Arizona Smoke Management Program may use different emission factors (but same activity data) to estimate emissions from forest fires. The EIWG suggests that forest fire emissions from the WRAP EI be compared to the Arizona Smoke Management Program's and for WRAP to lobby USEPA to use the most current emission factors for estimating emissions from forest fires.

Agricultural / Rangeland Burning
Emissions data on agricultural / rangeland burning are planned to be included in the WRAP's Year 2018 Fire EI. The EIWG suggests that the WRAP' emissions estimates for this category be used, since there are little data collected on agricultural / rangeland burning in Arizona. In the future, a statewide tracking system for the location, size, fuel type and loading, and time of burning would greatly benefit the understanding of the contribution of this emission source to regional haze.

Biogenics
The WRAP biogenic emission estimates for Maricopa County are much smaller than Maricopa County's estimates. The EIWG plans to investigate this discrepancy further after receiving biogenic emissions data grouped by counties from the WRAP modeling center.

Ammonia
Ammonia emissions from livestock in the WRAP EI appear to be reasonable when compared to Maricopa County's ammonia emissions data.

Power Plants
The EIWG assumes that the power plant emissions in the WRAP EI are fairly accurate, because these data are based on the acid rain reports submitted to U.S. agencies.

Wind Erosion
This emission category is scheduled to be added to the WRAP EI after completion of a WRAP research contract. Estimating emissions from wind erosion will entail taking into account local variations in soil type, wind patterns, precipitation patterns, vegetation growth, and topography. Due to the inherent complexity of developing wind erosion estimates for a region as large as Arizona, the EIWG suggests that the wind erosion data produced by WRAP's contractor be used in Arizona Regional Haze SIPs submitted after Year 2003.

REFERENCES

1. ADEQ Website (Regional Haze): http://www.adeq.state.az.us/environ/air/plan/haze.html

2. WRAP Website (Emissions Forum): http://www.wrapair.org/forums/ef/index.html

3. Eastern Research Group Inc. (ERG) and Enviro-Tech Communications, technical paper, dated February 15, 2002: "Non-Burning Management Alternatives on Agricultural Lands in the Western United States, Draft Final, Prepared for The Fire Emissions Joint Forum of the Western Regional Air Partnership."

APPENDIX

Maricopa County Onroad Mobile Source Data (MAG)
The following data and assumptions were used in developing MAG's onroad emission estimates:

- The 1996 average annual vehicle miles of travel (VMT) used by WRAP in developing onroad emissions is 13% higher than comparable 1996 MAG VMT estimates and 15% higher than the Highway Performance Monitoring System (HPMS).

  - VMT from 1996 MAG traffic assignment = 58.85 million/weekday in the transportation modeling area

  - Factor to expand from MAG modeling area to Maricopa County = 1.11
    - Maricopa County average weekday VMT = 58.85 x 1.11 = 65.32 million/day
    - Factor to convert from average weekday to average annual day (including weekends) = .91
    - 1996 Maricopa County average annual daily VMT = 65.32 x .91 = 59.44 million/day
    - 1996 HPMS average annual daily VMT for Maricopa County reported to the Federal Highway Administration = 58.66 million/day
    - 1996 WRAP average annual daily VMT (from ENVIRON onroad spreadsheet) for Maricopa County = 67.26 million/day

- Seasonal variations in VMT used by WRAP are not consistent with traffic counts in Maricopa County.
  - WRAP summer season VMT in 1996 (from onroad spreadsheet) is 13% higher than winter VMT.
  - The WRAP 1996 seasonal VMT estimates are 7.5% higher than the automatic traffic recorder-based estimates in winter and 25.3% higher in summer.
  - Automated traffic recorders (ATR) in Maricopa County indicate winter season traffic is consistently higher than summer traffic.
  - Based on ATR data, the 1996 VMT in the winter was 59.04 million/day and in the summer was 57.08 million/day.

- The conclusions for Maricopa County onroad and nonroad emissions are derived from analyses of spreadsheets obtained from ENVIRON in July 2002.

Pima County Onroad Mobile Source Data (PAG)

PAG calculated the Year 2003 onroad emissions factors using the MOBILE6 emissions model with the following inputs:

- Low altitude only
- Averaging summer and winter
- Average freeway speed = 44.8 mph
- Arterial speed = 35.4 mph
- Local speed = 12.9 mph
- The MOBILE6 emission factors were then applied to the estimated VMT for each roadway type (provided by PAG-Transportation Planning Division).

Average Annual Daily VMT for Pima County

- 1996 HPMS average annual daily VMT for Pima County = 15.71 million/day
- 1996 WRAP average annual daily VMT for Pima County = 18.75 million/day, an increase of +19.4% over the HPMS data.

Seasonal VMT Allocations - Tucson Permanent Traffic Count Recorders

- March daily VMT is generally 7% higher than average daily VMT
- July daily VMT is generally 5% less than average daily VMT

Improving the Estimation of Emissions from Agricultural Burning

$ As stated in the draft report, Non-Burning Management Alternatives in Agricultural Lands in the Western U.S. [3]: "...obtaining agricultural burning data presented a significant challenge... Documented agricultural burning activity data exist for only a portion of the 15-state domain, although agricultural burning is known to occur in nearly every state". Accordingly, all 15 western states should consider having mandatory organized smoke management programs that track agricultural burning activities.

- Require all sources which obtain agricultural open burn permits to expand reporting parameters to include acres burned, duration of burn, exact location, (example: section/township/range) fuel loading specifications, and crop species to permitting agencies. This should be accomplished by amending current open burn permit regulations throughout the western region.

- Capture agricultural burn permit parametric information in a regional database with a common/ consistent computerized format that can be easily utilized by various governmental agencies.

- Display agricultural burning data utilizing a geographic information system (GIS). The goal is to illustrate the level of open burning in acres and to show, county by county, burning locations and type of residue burned.

- Every state, local and tribal entity should implement a single agricultural burning reporting standard for continuity and consistency of parametric data.

- Periodic agricultural burn site visits (i.e., random checks) should be conducted by governmental personnel to verify the accuracy and completeness of burning information provided by sources.

- Resolve, or at least note differences, in permitted agricultural burn restrictions between counties or other localities. For example, Pima County and Maricopa County no longer allow the burning of agricultural fields as part of their counties' open burning programs, whereas Pinal County continues to allow burning of agricultural fields. Pima County and Maricopa County do allow burning of ditch banks.

- Establish a statewide agricultural burning program for tracking agricultural burning for location, size, fuel type and loading, and time of burning. To take it a step further, this program could be used as a control measure by making daily approval / disapproval of agricultural burning similar to the Arizona Smoke Management Program for prescribed forest fires. Currently, ADEQ's statewide open burn permits are issued in advance for one year and only have restrictions on the time of day and season to conduct the agricultural burning. No data are collected on size, fuel type and loading, and time of burning as part of ADEQ's open burn permits.

Maricopa County

Environmental Services
Air Quality

Steven E. Peplau
Division Manager
1001 N. Central Ave. # 695
Phoenix, Arizona 85004
Phone: (602) 506-6701
Fax: (602) 506-6179

July 8, 2003

Ms. Alice Edwards
Air Non-Point & Mobile Sources Program
Alaska Department of Environmental Conservation
410 Willoughby Avenue, Suite 303
Juneau, AK 99801-1795

Mr. Dennis Schwehr
Strategic Issues Management Group Inc.
P.O. Box 2166
Thompson Falls, MT 59873

Mr. Bobby Ramirez
Salt River Pima-Maricopa Indian Community
10005 E. Osborn Road
Scottsdale, AZ 85256

Dear Ms. Edwards, Mr. Schwehr, and Mr. Ramirez:

The Arizona Regional Haze Emissions Inventory Work Group (EIWG) would like to provide the WRAP Emissions Forum with the results of our review of the WRAP's projections for Year 2018. It is important to note that if the EIWG's suggestions for improving the 1996 WRAP emissions inventory (December 2, 2002 letter from EIWG to WRAP) are not implemented before applying the growth factors for the Year 2018, then the Year 2018 WRAP emissions inventory will reflect the same errors noted in the Year 1996 WRAP emissions inventory.

Following are general observations and comments from the EIWG, and specific comments from two EIWG members, Maricopa Association of Governments (MAG) and Pima Association of Governments (PAG) regarding vehicle miles traveled (VMT) and population projections.

General Observation of Long-Range Econometric Projections

The Arizona Regional Haze Emission Inventory Work Group examined the accuracy of earlier projections of population growth used by the Grand Canyon Visibility Transport Commission that relied on the REMI model. The REMI modeling performed by the GCVTC subdivided the state into three economic sub-regions. The projections of the 2000 population were compared to the 2000 Census. Generally,

Steven E. Peplau
Division Manager
1001 N. Central Ave. # 695
Phoenix, Arizona 85004
Phone: (602) 506-6701
Fax: (602) 506-6179

projected annual compound growth factors were lower than the actual, with a 95% confidence interval of approximately 1% per year. A similar analysis against Arizona Department of Economic Security projections showed that uncertainties in prediction could be as high as 3%. Thus, it is reasonable to expect that differences in projections from different sources could be 10% per decade.

There are two major urban areas in Arizona. The following are observations from Maricopa Association of Governments (MAG) and Pima Association of Governments (PAG) regarding VMT and population projections that could be used by WRAP to improve future projections.

Review of WRAP 2018 VMT and Population Estimates for Maricopa County

The rate of growth (3.1% annually) in average annual VMT for Maricopa County between 1996 and 2018, used by the WRAP, is comparable to the VMT growth rate based on the ASU Center for Business Research population projections (Middle series). However, for the summer season, the rate of growth (3.5% annually) in the WRAP projections is much higher, resulting in a 2018 VMT for Maricopa County that is about 10-11 % more than 2018 estimates using the latest ASU population projections. Since visibility impairment at the Class I areas on the Colorado Plateau tends to be highest during the summer, the over-estimation of summer VMT will overstate Maricopa County's contribution to regional haze on the 20 % worst days. This problem can be corrected in future WRAP modeling for the desert Southwest by reversing the seasonal factors so that they are lower in the summer and higher in the winter. Appropriate seasonal factors for vehicle travel in Maricopa County can be obtained from the Maricopa Association of Governments (see enclosure for supporting documentation for calculations).

MAG's population data as a whole falls within 10% of the WRAP population data. It is useful to compare MAG's own population projection done in 1993 that predicted a population of 2.95 million in the Year 2000. The actual population in the Year 2000 was 3.1 million, a 4.8% difference.

Review of MAG Growth Factors for Agricultural Activity

MAG developed a set of emissions growth factors for agricultural activity projected from 1996 to 2018 and compared them with those used in WRAP. Please note that MAG's comments can only be made based on the comparable pairs, since a direct comparison between MAG's and WRAP's projections cannot be made because many

Steven E. Peplau
Division Manager
1001 N. Central Ave. # 695
Phoenix, Arizona 85004
Phone: (602) 506-6701
Fax: (602) 506-6179

of the SCC codes either use different growth factor references or are not used in MAG's inventory.

The comparison reveals no significant discrepancies between the WRAP and MAG agricultural growth factors, except for the emissions from agricultural equipment. The surrogate used for agriculture equipment is the harvested area. The Arizona Agricultural Statistics showed that the harvested area in Maricopa County decreased from 449,160 acres in 1980 to 236,000 acres in 1999. Based on that, the growth factor MAG derived for agricultural equipment from 1996 to 2018 is 0.28. However, the growth factor for agricultural equipment used in WRAP is 1.61, implying an increase in that source category.

As previously noted, the WRAP growth factor for agricultural equipment is projected to increase in the WRAP modeling. Agricultural activity in Maricopa County is, in fact, decreasing. The EIWG recommends that the WRAP should examine the growth factors for agricultural activities, especially in urbanized counties, to ensure the projections are reasonable.

Review of WRAP 2018 VMT and Population Estimates for Pima County

The Pima Association of Governments (PAG) developed draft population growth factors for Pima County based on Year 2000 Census data. These data are still in draft form and will be utilized for PAG’s Year 2030 Regional Transportation Plan planning process. The projections represent the traffic analysis zones comprising eastern Pima County and part of southeastern Pinal County. PAG’s projected growth factors were compared with the GCVTC IAS growth factors for population (e.g., 1990 compared to 2000, 2010, 2020 and 2030). It appears that the IAS Years 2000 and 2010 growth factors compare well with PAG’s, however the Years 2020 and 2030 factors used by PAG are higher than those used by the WRAP (e.g., Year 2020 = 1.956 vs. 1.757 and Year 2030 = 2.303 vs. 1.973). Year 2040 projections have not yet been developed by PAG.

With respect to VMT, it is difficult to compare locally developed data with WRAP data because the data have been developed in different formats and for different years. However, it is probably safe to assume that the concerns of Maricopa County for VMT can be mirrored by Pima County. WRAP's numbers tend to overestimate locally-derived VMT numbers, particularly in the summer, which is the worst season for regional haze. For the Year 2003, the local VMT value used for the PAG 2003 Transportation Improvement Program (TIP) is 11% lower than the 2003 VMT used for the WRAP EI. In a similar pattern to Maricopa County, the Tucson metropolitan

Steven E. Peplau
Division Manager
1001 N. Central Ave. # 695
Phoenix, Arizona 85004
Phone: (602) 506-6701
Fax: (602) 506-6179

region records its lowest VMT in the summer and its highest VMT in the spring season.

General Observation and Recommendation

The Emission Inventory Work Group notes that the growth factors used by WRAP are within the expected range of uncertainty for long-range projections. In development of future projections it is recommended that WRAP consider utilizing local population and VMT projections, and seasonally correct for the fact that summer activity data is generally lower than the winter.

We appreciate the WRAP's hard work and diligence in developing Year 2018 projections for the western states. ADEQ and its stakeholders are committed to working with the Emissions Forum in its future work. For additional information on this report, please contact Randy Sedlacek, ADEQ, at 602-771-2352 or rfs@ev.state.az.us.

Sincerely,

Steven E. Peplau
EIWG Chair
Air Quality Division Manager
Maricopa County Environmental Services Department

cc: Tom Moore, WRAP
Lee Gribovicz, Wyoming DEQ

Steven E. Peplau
Division Manager
1001 N. Central Ave. # 695
Phoenix, Arizona 85004
Phone: (602) 506-6701
Fax: (602) 506-6179

ENCLOSURE

<u>Maricopa County VMT projections for 1996-2018</u>

In May 2001, MAG provided 1996 and 2018 traffic assignments for Maricopa County to WRAP consultants. They were also given growth factors for the intermediate years: 2003, 2008 and 2013. The MAG traffic assignments were produced on the 1272 TAZ system which did not
cover all of Maricopa County. The consultants were advised to factor the VMT produced by the assignments by 11% to expand the VMTs to cover all of Maricopa County. Based on the information provided, the VMTs for Maricopa County should have been as follows:

Maricopa County VMT (in 1000's per weekday)		Growth Factors Provided to ENVIRON
1996	65,321	
2003	82,850	1.27
2008	95,176	1.46
2013	106,386	1.63
2018	116,854	1.79

Average annual VMT growth rate: 1996-2018= 2.70%
Note that the VMTs above represent an average weekday and should have been multiplied by .91 to obtain VMT on an average annual day (before applying seasonal factors).

The ASU population projections done by the Center for Business Research in 2001 show a 2.64% growth rate between 2000 and 2020 (for the Middle projection series). MAG is in the process of using these same ASU projections for Maricopa County to prepare interim small area population and employment projections that, at the end of May, will be presented for approval to the MAG Regional Council. MAG has completed preliminary traffic assignments on a 1941 TAZ system using the draft interim projections. The resultant VMTs (which include most of the populated areas of both Maricopa and Pinal Counties) produce an average annual VMT growth rate of about 3.09% for 2000-2020.

An analysis of the WRAP VMT projections provided by Alison Pollack of ENVIRON on 7/11/02 can be found in the attached spreadsheet.

Steven E. Peplau
Division Manager
1001 N. Central Ave. # 695
Phoenix, Arizona 85004
Phone: (602) 506-6701
Fax: (602) 506-6179

The WRAP's average annual growth factors are slightly lower than the factors calculated in Environ spreadsheet. However, this does not take into account the over-estimation of 1996 VMTs, as documented in the Fall of 2002 for the EIWG. In that previous analysis, the WRAP's 1996 VMT estimates were found to be 13% high on an average annual basis, 8% high for the winter season, and 25% high for the summer season. Reducing the WRAP's 1996 VMTs by these amounts and comparing them with the WRAP's projected VMTs, results in the adjusted growth factors shown at the bottom of the attached spreadsheet.

The rate of growth between 1996 and 2018 for the average annual VMT used by the WRAP is approximately the same (3.07%) as for the new VMT projections in #2 above (3.09%). However, in the summer, the rate of growth between 1996 and 2018 (3.54%) is much higher. Using the latest ASU population projections, results in a Maricopa County VMT projection for 2018 that is about 10-11 % higher than VMT estimates.

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 West Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Janet Napolitano
Governor

Stephen A. Owens
Director

October 20, 2003

Tom Moore
Technical Coordinator
Western Regional Air Partnership
Cooperative Institute for Research in the Atmosphere
Colorado State University
1375 Campus Delivery
Fort Collins, CO 80523-1375

Dear Tom:

Arizona's Regional Haze Technical Assessment Work Group (TAWG) met on August 14, 2003, to review the draft *WRAP Technical Support Document (TSD) for Regional Haze State Implementation Plans* (July 14, 2003). Informal feedback was provided to you a few days later; and TAWG appreciates the changes reflected in the August 27, 2003, draft TSD. In September, the group met again to discuss this later version and produced several comments that are attached to this letter. The following points summarize the detailed comments.

- Some technical materials are better relegated to appendices, especially all of the Integrated Assessment Section, most of the SMOKE, and some of the CMAQ sections. For example, in SMOKE, the specific file names and dates, as well as much of the detailed descriptions of the emission processing mechanics, while useful for modelers, make it difficult for others to understand the work done.

- TAWG requests that additional work be done related to redoing the ammonia emissions inventory and performing a CMAQ modeling run to determine the sensitivity of fine particulates and visibility from Mexican sources.

- The protracted discussion on the non-road models did not explain which model was used to generate which emissions for which are quality modeling run. This needs to be clarified. If the NONROAD2002 work was only emission sensitivity testing, then this needs to be so stated. The reader is left with the impression that differences in non-road estimates are significant and important, but the discussion fails to explain how or whether these differences affected the outcome of the modeling.

Northern Regional Office
1515 East Cedar Avenue • Suite F • Flagstaff, AZ 86004

Southern Regional Office
400 West Congress Street • Suite 433 • Tucson, AZ 85701

- In spite of the descriptions of the many methods employed to construct the inventory, the fire emissions section needs a clear explanation of what and why certain emissions were used for the 1996 model validation work and what emission were used for the 1996 base case. A table that presents these emissions for agricultural, prescribed, and wild fire burns for all of the important 1996 and 2018 air quality modeling runs would be helpful.

- It was unclear how point sources emitting <100 tons of sulfur dioxide per year were treated. Are they included in the area source totals?

- Throughout the document, the tabulated data and charts covered different numbers of states: sometimes six, sometimes nine, sometimes 13, sometimes 20+. This inconsistency should be remedied, if, by no other means, than by giving the subtotals for the various group of states in each chart.

- Several sections would benefit from some basic explanatory material (for example, biogenic VOC emissions come from plants and biogenic nitrogen oxide emissions come from microbial activity in the soil.) On the first page of the Technical Analysis Approach, some introductory material would be helpful before getting in the details of emissions. The relationship of emissions inventories, SMOKE, MM5, MCIP, and CMAQ could be shown in a simple diagram. The general modeling approach needs to be explained in terms of reconstructed visibility. In addition, the general modeling approach needs to be discussed in terms of the speciated fine particulates measurements of the IMPROVE network. Although this material would amount to no more than two or three paragraphs, through it, the reader would be informed at the beginning of all the various interlocking pieces of the modeling system.

On behalf of the Technical Assessment Work Group, I thank you for the opportunity to review the draft TSDs and am willing to discuss anything in further detail. I may be reached at (602) 771-7642.

Cordially,

Peter Hyde, Chair
Arizona Regional Haze Technical Assessment Work Group

Attachment

cc: TAWG Members
Nancy Wrona
Corky Martinkovic

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 W. Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Janet Napolitano
Governor

Stephen A. Owens
Director

September 23, 2003

The following comments on the WRAP TSD for regional haze are from various members of the Arizona Regional Haze SIP Technical Assessment Work Group. The first set of comments comes from an August 14, 2003, meeting, and immediate follow-up. The version of the TSD for these comments is July 14, 2003.

FIRST SET

COMMENTS ON THE DRAFT REGIONAL WRAP TSD FOR THE REQUIREMENTS OF §309 OF THE REGIONAL HAZE RULE

Shawn Kendall distributed copies of his comments. Discussion and changes suggested to the TSD, as posted to the ADEQ website on July 16, 2003, included:

- (website) – Kendall and Rory MacArthur suggested deleting the subchapter pieces of the TSD due to wrong legends appearing on the pdf files.
- Table of Contents – Change headings for chapters 3-8 to read "Assessment of …" (Kendall).
- P. 9, line 17 – Change to "with a simplified chemistry" (MacArthur, Kendall).
- P.11 – MacArthur asked about Mexican emissions. Kendall and others said that this information was used and modeled, but not singled out for comment. TAWG members agreed that WRAP should be asked to assess the impact of Mexico's emissions. Kendall suggested that WRAP also cross check the inventory for Mexico for new and upcoming sources scheduled to begin operations prior to 2018.
- P. 16 – Hyde noted that emissions inventories are available for Nogales and Agua Prieta, Sonora.
- Bill Wiley commented that the commercial marine emissions information needs to be moved up to the international emissions section.
- P. 16 – Kendall said that it appears that geogenic information was not included, and that 2018 PM figures will equal those for 1996. He said that PM will need to be able to be modeled in the future.
- MacArthur asked if wind erosion had been calculated for property lots. Don Gabrielson said that there is an overall lack of windblown inventory.
- P. 18, top – Kendall asked about the relevance of the P2 information. The group agreed to eliminate the chart, but keep the information.
- P. 19 – Hyde noted that the charts do not show off-shore emissions.
- P. 19 – Kendall suggested showing tons reduced in the 2018 pie chart.
- Wiley asked about sources of NH_3 emissions. Gabrielson said that he believes this is feed lots and dairies.

- Gabrielson asked if the pie charts are available showing state-by-state results. Kendall said he does not think these are available, but could be generated if the data was obtained.
- P. 23, line 23 – Hyde asked if the date was necessary. Kendall said this helps explain which version of the data was used.
- Hyde asked about emissions from point sources emitting less than 100 tpy. Kendall said this limit was used since this is the value used in determining sources eligible to participate in the SO_2 trading program. Wiley asked if sources below this threshold were included in the area source emission inventory. TAWG members agreed this issue should be pursued.
- P. 24 – The workgroup agreed that the NH_3 inventory needs to be reworked.
- P. 25 – Members commented that the Integrated Assessment Section does not seem relevant.
- P. 27 – Hyde questioned why the PM figures don't decrease from Table 2 to Table 3.
- Add a table with the WRAP annex results (Gabrielson).
- P. 28 – Explain the delineation between stationary source and those under 100 tpy (Gabrielson). Also, name the important subcategories (Hyde).
- P 29, line 1 – Expand the discussion of other windblown dust categories that are not included (Gabrielson, Hyde).
- P. 31, lines 6 and 8 – Kendall suggested improving the subtitle formatting, adding titles to these tables, and reviewing the document globally for this concern.
- Tables 4 and 5 – add column showing the percent change for the nine GCVTC states and 13 WRAP states (Ruey-in Chiou).
- P. 32, line 10 – Hyde said that the off-road mobile equipment does not include commercial marine. Kendall noted that commercial marine was in a later section.
- A summary should be added showing relevant emission of aircraft, locomotives, and commercial marine (Hyde).
- P. 32 – MacArthur noted that it was unclear which non-road model was used to calculate emissions.
- P. 34, line 26 – MacArthur asked how nonroad modeling was used. If the results of NONROAD2002 weren't used, this information does not need to be included in this preliminary section (Hyde).
- Add tables to consistently show nonroad sources (Kendall).
- Break down subcategories of nonroad (Hyde).
- MacArthur commented that the mobile source significance issue is very sensitive, and noted that the WRAP policy group determined that reasonable progress must be made. Kendall remarked that the discussion is too detailed to appear in the TSD. Hyde and MacArthur said that the mobile information should be improved.
- Wiley noted a lack of consistency in the states included for analysis. Add a subtotal of the nine GCVTC states.
- MacArthur was concerned that commercial marine and locomotives are discussed simplistically. Kendall suggested referencing material used for aircraft, commercial marine and locomotive categories.
- P. 42 – Wiley noted that six states were used in the table, and that too many different domains are referenced. Remove Table 6 and change text on p. 43 to read "see Chapter 8 for a detailed discussion."

- Hyde said that it is not clear whether 1996 and 2018 prescribed fire figures were included in the base case. He would like additional information included. Kendall commented that WRAP used 2018 "typical" wildfire data.
- Wiley asked about missing agricultural burning information. Kendall replied that agricultural burning is quite low.
- Kendall distributed the draft of Table 14-1 and Appendix A-14.1a,b, and c and said that the TSD should report whether typical or actual 1996 data was used for model calibration. He also noted that the anticipated growth in prescribed fire is not shown. Kendall and Wiley commented that the fire emissions data for 1996 is missing. Kendall said that the spread sheets provided by WRAP don't show the change, but the pie charts do.
- P. 47 – Add tables showing 1996 acreage and emissions of fires; plus, a similar summary for 2018 (Hyde).
- P. 56, biogenic emissions – Replace the detailed variable list with a narrative description of the ASCII file. Show total VOC emissions in Table 10. Describe where biogenics emissions come from and how they are produced. Revamp this section and include a discussion of biogenics as the largest source of VOCs.
- Windblown dust – Discuss how days with windblown dust would impact results. Table 11 is too extensive. Change to a description of the scenarios in the TSD and move the table to the appendix.
- P. 64-66 – Clarify which states the pie charts represent.
- SMOKE section – Most of the section needs to go into an appendix. The introductory paragraph should include generic information on how a computerized tool manipulates files to produce usable information for use in air quality.
- Gabrielson asked about the target audience of the document. The group agreed that the body of the TSD should be aimed at the technical/policy analysts, with detailed information needed for reconstructing the modeling in appropriate appendices.
- P. 65-70 pie charts – Kendall asked if one-day averages are relevant. Hyde responded positively, saying that if the average weekday was used, the information is relative, except perhaps in fire emissions.
- P. 65, scales for off-road for VOCs for biogenics; and p. 67, SO_2 columns – Delete these pie charts and reduce the corresponding narrative.
- P. 86 – Hyde suggested writing this in layman's terms as much as possible. Eliminate tables 22, 23, 24 and much of the discussion.
- P. 87, line 6 – The TSD currently reads "performed well." Chiou suggested that actual performance information replace this conclusion.
- Gabrielson suggested that overall, the narrative should address somewhat technical policymakers and other information should be shifted to the back of the document. There was general work group agreement.
- P. 93 – Kendall suggested adding a flow model.
- Gabrielson suggested that each discussion of a model include information about where the reader can get more information.
- MacArthur commented that the MSIP was known to have a bug and asked if the subsequent WRAP modeling addressed this issue.
- Kendall commented on how robust the CMAQ modeling is, compared to other models. MacArthur agreed, saying that this should be a consideration.

- Kendall was concerned about the lack of information on PM speciation (elemental carbon and organic carbon). P. 91, line 2 – Add a lead paragraph that compares and contrasts the GCVTC air quality modeling with the described anticipated modeling, including the benefits.

- MacArthur requested more information about performance in the summer versus winter months.
- P. 101 – Hyde suggested that the axis on the scatter plots be reduced in value, which would result in showing more accurate information. The group agreed that this was not a crucial issue.
- P. 113 – Add language to the effect that many of the 20% dirtiest days occur in the summer, when the model performance is best.
- P. 114, line 20 and globally – eliminate use of "we" (Kendall).
- P. 114, line 20 – Wiley said this section needs to explain that this is the best model available, and that it works best in the summer. Kendall said that there should be an acknowledgment that there are other ways to evaluate a model rather than paired-in-time-and-space, and include language to the effect "nonetheless, the modeling represents the best available science…"
- P. 114, line 20 – Paragraph should be changed to support the use of the modeling results in general, since this is the best available modeling, and acknowledge that it works best in the summer, which is during Arizona's 20% worst days (Kendall, Wiley, MacArthur).
- Gabrielson commented that these "other approaches" that could be used would have more uncertainty than this model. Kendall suggested acknowledging uncertainties with a neutral voice, and eliminate personal expressions and the use of "we."
- P. 114, line 36. Gabrielson said the reference to §308 was not relevant and should be replaced with <u>future SIP processes, since 309(g) is also a future path</u>. Other changes also accepted by the group included:
    - Line 22 – uncertainty in the meteorology and chemistry results in constant uncertainty for prescribing new emissions control strategies.
    - Line 28 – Change "that that" to "<u>than</u> that."
    - Line 29 – Strike "we believe that."
    - Line 31 – SOx emissions which constitutes a policy question.
    - Line 32 – Add, "should <u>ideally</u> be based…"
- P. 117 – Gabrielson suggested moving the formula for light extinction to p. 11 in the WRAP analytical approach and include a discussion of the use of the equation versus forensic observation to explain the difference between a mathematical analysis of visibility, and a direct measurement. Point to the location where readers can find additional information. Kendall recommended leaving the current materials in place but adding a paragraph in the introduction to explain the differences between measured light extinction, modeled light extinction, and the policy basis for using modeled light extinction (focus on PM mass speciated measurements for control strategy development and elimination of meteorology (humidity) as a variable for control strategy development).
- P. 118 – Hyde said that the "1-2 deciview" reference should be more specific.
- Kendall noted increases in emissions in the 20% best days at four parks may be due to anticipated increases in prescribed fires.
- P. 121, line 14 – explain results (Hyde).

- P. 121, line 22 – Delete the sentence that begins on line 22. Add fire information. (Hyde.)
- P. 121, line 26 – Explain why 1996 data is not used in tables 30 and 31 (Gabrielson).
- Kendall said to replace "1996 baseline" with <u>from the 1997-2001 current visibility conditions</u>. Explain the three different baselines and why the baseline from the most recent five years is used.
- P. 127, Figure 24 – Map shows tribal information which is irrelevant in this context. Delete Figure 24; Figure 25 can be used. (Kendall.)
- Chapter 4 – Change 13 WRAP states to 9 GCVTC states.

- MacArthur –
  - Add a chart similar to Figure 36 showing the ammonium nitrate delta and ammonium sulfate.
  - Explain which mobile source model was used for representation on nonroad diesel rule and how it was used.
- Wiley was concerned about the stationary source Figure 33 conclusion. He said to add stationary source-only with SO_2, or remove. Figure 33 doesn't belong in this section.
- Kendall –
  - Additional comments are included in the memo previously distributed.
  - Concerned that it looks as if WRAP endorses EPA draft guidance default values for natural conditions without appropriate peer review.
  - Concerned that Chapter 9 appears to provide "presumptive reasonable progress goals" based on the EPA draft guidance default values for natural conditions which may challenge future SIP efforts by states establishing natural conditions based on improved science.
  - Add modeling results for mobile sources, since the rule change is not finalized. MacArthur would like the history of mobile source significance included. Kendall noted that the information is in the body of the SIP, and is not appropriate for the TSD.
- Gabrielson – Wants to see a clear statement of fire emissions modeling regarding 1996 and 2018 and what actual data was used for computing the relative reduction factors.
- Kale Walch did not have additional comments.

- Chris Janick, Salt River Project **--**What is the basis for the 100 acre wildfire threshold? I would think they should be included in some fashion or another, rather than excluded altogether, unless there is some reason to believe all of those are insignificant compared to the larger fires.

- Shawn Kendall, The Kendall Group, Inc**.** **--** Table 4 and 5 present area source emissions (pg 30), but nowhere is there a list of the source category codes that were included in this inventory. The SCC codes should be in an appendix for each of the key emission inventories presented (stationary, area, mobile-on road, mobile-non road, road dust, fires etc).

SECOND SET: FROM TELEPHONE CALL OF SEPTEMBER 10, 2003

The following comments are on the August 27, 2003 version of the TSD

- P. 159 – Rory MacArthur said that a figure showing the delta of ammonium nitrate increases/reductions with SO_2 reductions had not been added to the TSD. This data is available on the WRAP website under "better than BART" information. Kendall and MacArthur agreed to add the figure to Chapter 3, in the SO_2 BART sensitivity section. MacArthur will ask Gail Tonnesen to draft language, and will forward the draft to Hyde.
- P. 118, line 24 – Kendall said this paragraph is improved, and asked TAWG members to review it.
- P. 45 – Hyde would like to see a major revision to the document regarding fire emissions inventories which details: the emissions that were used, for what reason, and in which model run. Kendall reviewed pp. 47 and 55, which provides contradictory information on agriculture burning. Hyde will ask for a modified smoke section, and a table showing what data went into what modeling.
- (global) – Kendall said that the emissions inventories used to validate the model should be shown, overall. Hyde agreed that the information should be provided as a courtesy to the reader, even if it is noted elsewhere in the document.
- P. 119 – Hyde noted the document reads "no prescribed or agriculture burning." He was also concerned about using the typical wildfire information for 1996.
- Hyde asked about the 1996 and 2018 deciview values. He questioned whether there would be a different prediction by using these artificially lowered 1996 emissions compared to actual values. Kendall reviewed the Class I Areas in Table 2.2.2.1 for deciview changes from 1996 to 2018. Eight of the 16 are predicted to get worse, and all are located in the southern Colorado/northern New Mexico area. Kendall asked if the culprit may be the use of 1996 as typical wildfire data. He said that he believes there is a lot of smoke contamination, but can't make this determination because the data is not presented.

MacArthur reviewed additional items:

- P. 16 – Graphic is not appearing properly in the Acrobat version of the document.
- P. 67, table 1.2.1.3a – 1996 legend does not correspond with figure in the Acrobat version.
- P. 68 – Road dust does not look like the pie chart that is shown for PM. Legend graphics are unrelated to the graphics used in the pie charts. Kendall said the Word version should also be checked.
- The non-road discussion has not been improved. Throughout the document, the reader does not know what they did or what they used. Kendall said that 2002 information was not used. Hyde agreed that this should be addressed similarly to the fire emissions, with additional references to which data was used to support which modeling. Hyde said that this must be updated for the December version of the document.
- It is not clear whether MOBILE5B or MOBILE6 was used. Kendall thinks that the 1996 modeling was MOBILE5B. The document should specify what modeling was used in NEI6.

Kendall noted that it will be necessary to know what WRAP is doing with 2018 CENRAP inventory for next year. He said that the TSD is acceptable for the SIP in its current form, but would prefer to see improvements such as exposing fire, mobile and road data used for modeling in the text.

THIRD SET

The following comments are from Peter Hyde, and concern the August 27, 2003 version of the TSD.

Section 1.1.7 Fire emissions, pp 48-55

P 46, line 40

"The 2018 fire projections should not be compared directly with the 1996 fire emission inventories. Etc. Etc."

Recognizing the unique difficulties of constructing fire emission inventories, and acknowledging the uncertainties inherent in the 2018 forecast, this plea for a "separation" falls on deaf ears and would be best removed. Fire emissions are of particular importance in western states, and base year estimates will be compared with future year estimates, despite the plea.

This section – the entirety of fire emissions -- is in desperate need of some tabular emissions data and of an additional subsection that explains what model runs used what emissions. The tabular data should present the following:

	wildfires	prescribed fire	ag fire	Total
1996 actual wildfire				
1996 average wildfire				
2018 average wildfire				

These data would go a long ways to understanding the relative importance of each type of emissions.

Of particular aggravation is the impossibility of finding out what emissions went into each model run. Yes, one can consult tables in the emissions processing or modeling sections, but the narrative needs to give the reader – in this section – a clear picture of which emissions went into which model run and why. For example, on page 119, Table 1.2.6.1 states that the 1996 base case for model validation had actual wildfire but no prescribed fire emissions. Why not prescribed fire emissions? The same table states that the 1996 base case with typical wildfire uses average wildfire emissions, but 2018 emissions for prescribed and ag burning emissions. How is one to make sense of this? The reader needs to come away from this section understanding not only how the inventories were compiled; but, more importantly, what decisions were made and why about which inventories actually went into which model runs.

This section also lacks a discussion on how reducing the actual wildfire emissions to average wildfire emissions – a fivefold reduction -- might affect the outcome of the projected visibility values. Although this discussion might fit better in the modeling section, it needs to come in somewhere. The following considerations should be weighed:

- Wildfire emissions are 41% of the base year inventory, dropping to 14% of the future year inventory of $PM_{2.5}$. Prescribed fire emissions are 3% of the base year and 27% of the future year $PM_{2.5}$. How are these significant contributions to $PM_{2.5}$ affected by the five-fold reduction from actual to typical wildfires?

- If we use average wildfire emissions in both 1996 and 2018, instead of the actuals for both years, then effectively we are artificially reducing the size of a constant contributor to visibility impairment. As the size of this constant decreases, there is more latitude for change in the variable contributors. The net change in visibility, then, may be inflated by this wildfire reduction. Perhaps some sensitivity tests would be in order to estimate the magnitude of this somewhat artificial emissions change.

- Some discussion of the wildfire and prescribed f ire emissions in the period 1997-2001 would seem to be in order, given that this is the baseline visibility period. For example, those Class I areas subject to above average fire emissions would have projections that error on the high side, and visa versa.

2.2.2 Visibility modeling results using relative reduction factors

The explanation of projected visibility increases and decreases at Class I areas, based on their proximity to large power plants slated for SO2 reductions, or alternatively, subject only to increasing emissions from the nonroad sector, sounds convincing, but a quick matching of the SO2 emission changes (Figure 2.2.2.1, page 131) with the visibility changes brings up a pattern of ambiguities that defies this paradigm. The table below gives the percentage change in visibility for the 20% best and 20% worst visibility days for the 16 Class I areas, along with the SO2 emission changes in the four counties contiguous with and generally west of the site. The emission changes are in tons per year. Negative percentages are visibility decreases; positive are visibility increases. The Class I areas are presented in the order of visibility changes for the worst days.

Class I area	best	worst	County 1	county 2	county 3	County 4	Total
San Pedro Parks	-39.8	-15.2	750	750	15000	0	16500
West Elk	-25.5	-5.6	0	0	0	750	750
Maroon Bells-Snowmass	-25.8	-5.2	0	0	0	750	750
Flat Tops	-27.7	-5.1	0	0	750	-15000	-14250
Bryce	9.1	-3.9	0	0	0	0	0
Capitol Reef	13.4	-3.4	0	0	0	750	750
Arches	11.8	-2.6	750	0	750	0	1500
Canyonlands	13.0	-2.6	750	750	0	0	1500
Weminuche	13.7	1.9	0	0	0	0	0
Black Canyon	15.4	3.5	0	0	0	750	750
Grand Canyon	0.8	5.5	-50000	750	750	-25000	-73500
Mesa Verde	20.0	6.6	0	15000	750	0	15750
Petrified Forest	20.3	7.8	-50000	15000	750	750	-33500
Zion	35.4	10.8	750	-25000	0	0	-24250
Mount Baldy	0.2	14.5	750	15000	-750	750	15750
Sycamore Canyon	23.0	24.5	-50000	750	750	-750	-49250

Of the top four areas with the greatest degradation on the best days, only one, San Pedro Parks, has a large S02 increase; of the other three, two have almost no change and one has a large decrease. Among the best performing areas – the last five entries in the table – Mesa Verde shows decided improvement despite a hefty SO2 increase, and Mount Baldy shows less improvement with the same increase in SO2 emissions. While county-wide emission changes do not equate with source-receptor dynamics, a more in-depth discussion, or at least one that acknowledges these ambiguities, would be appropriate here.

Several other aspects of these projected visibility changes warrant further discussion. For example, it would be illuminating to explore the contrast between the percentage changes in visibility between the best and worst days. With three exceptions -- Grand Canyon, Mount Baldy, and Sycamore Canyon – the visibility change for the best days is on average four times that of the worst days. Is this readily understood from a physical or mathematical basis? Four Utah sites display improvement for the best days but degradation for the worst days. How can this be explained by emission changes? Two sites exhibit virtually no change in the best days but considerable improvement in the worst: Grand Canyon and Mount Baldy. Can we really be cleaning the air to the tune of a 14.5% visibility improvement for the worst days at Mount Baldy, without a concomitant improvement for the best days? Attempting to answer this set of questions would be doing the inquisitive reader a service.

Section 1.2.4 Model Performance Results (p 112)

L 31 "The model substantially underpredicts soil and coarse mass. This most likely can be attributed to the lack of a fugitive dust emissions inventory…"

This explanation is inadequate if not misleading. Area source dust emissions were inventoried, as were unpaved and paved road dust. The only omission was wind-blown dust, which, on an annual basis, with a frequency of 3 to 7 events per year, would not be expected to perturb a 100-sample comparison. A more likely reason for the underprediction can be found on page 43, line 10, where the authors state that the net effect of revising silt loading values, of revising average daily traffic counts, and of incorporating transport fractions was an 89% decrease in road dust emissions from the original estimate. Maybe the original estimates weren't so bad after all. In any case, the lack of a wind-blown inventory cannot explain the underprediction.

Section 1.2.5 Model Uncertainties and Quality Assurance

P 116

This discussion explains "two key issues [about] assessing the model performance for use in the 309 analysis." [line 40]

A third issue ought to be recognized, and is stated as follows:

Virtually all air quality models, including CMAQ, were developed principally to predict short-term, episodic, relatively high air pollutant concentrations. The application of these models to predicting speciated fine particulates concentrations in pristine areas on an annual basis constitutes a use for which they were not expressly designed. It should surprise no one that the model performance in this arena has been questionable in certain aspects.

4.2 Stationary source NOx and PM sensitivity testing

P 155, line 14

"The fact that stationary source NOx emissions are not as well controlled as stationary source PM_{10} emissions in the West actually lends some relevance to the outcome that NOx emissions are altered more in the sensitivity analysis than PM_{10} emissions."

This sentence is confusing. Usually the "outcome" of a model sensitivity test is a change in pollutant concentrations, not emissions. If NOx emissions are altered more, then it's because of the greater contribution of point-source NOx to the total inventory. If they comprise a greater share of the inventory because they're not well controlled, then OK. My suspicion is that even if they were well controlled, they would still contribute more to the inventory than the 10% PM_{10}. I'm still confused.

Appendix A-14b. Summary of Emission Inventories used in WRAP Modeling

Appendix A-14b. Table 1.
Changes in Emissions - 1996 vs 2018 w/309 Programs
(Thousands of Tons per Year)

A. ARIZONA EMISSIONS BY SOURCE CATEGORY		PM2.5	CM	SOX	NOX	VOC
Area Sources	1996	23.0	49.0	3.2	49.3	115.4
	2018 w/309	25.2	48.2	5.3	79.0	140.5
	% Change	10%	-2%	68%	60%	22%
Point Sources	1996	11.7	10.6	195.8	108.7	10.5
	2018 w/309	9.5	17.2	113.9	134.6	10.8
	% Change	-18%	63%	-42%	24%	3%
Mobile Sources - On-Road	1996	4.6	0.6	2.9	140.5	150.4
	2018 w/309	1.7	0.1	0.8	47.3	55.6
	% Change	-63%	-88%	-74%	-66%	-63%
Mobile Sources - Non-Road	1996	9.0	0.7	9.2	98.6	51.5
	2018 w/309	7.6	0.5	12.6	66.2	27.0
	% Change	-16%	-18%	37%	-33%	-48%
Road Dust	1996	4.5	21.2	-	-	-
	2018 w/309	5.2	21.0	-	-	-
	% Change	16%	-1%	N/A	N/A	N/A
Sub-Total - Non-Fire Emissions	1996	52.8	82.1	211.2	397.1	327.8
	2018 w/309	49.3	87.1	132.6	327.1	233.8
	% Change	-7%	6%	-37%	-18%	-29%
Agricultural Burning	1996	0.2	0.0	0.0	0.1	0.2
	2018 w/309	0.1	0.0	0.0	0.0	0.0
	% Change	-73%	-80%	-83%	-74%	-74%
Prescribed Fire on Wildlands	1996	65.8	11.8	4.6	49.3	28.0
	2018 w/309	64.8	11.7	4.6	48.6	27.6
	% Change	-1%	-1%	-1%	-2%	-1%
Wild Fire	1996	29.1	4.8	2.1	7.5	16.4
	2018 w/309	29.1	4.8	2.1	7.5	16.4
	% Change	0%	0%	0%	0%	0%
Sub-Total - Fire Emissions	1996	95.1	16.7	6.7	56.9	44.6
	2018 w/309	94.0	16.5	6.6	56.1	44.1
	% Change	-1%	-1%	-1%	-1%	-1%
TOTAL EMISSIONS IN ARIZONA	1996	147.9	98.8	217.9	454.0	372.3
	2018 w/309	143.3	103.6	139.3	383.2	277.8
	% Change	-3%	5%	-36%	-16%	-25%

Appendix A-14b. Table 1.
Changes in Emissions - 1996 vs 2018 w/309 Programs
(Thousands of Tons per Year)

B. EMISSIONS IN FIVE 309 STATES (AZ,NM,OR,UT,WY)		PM2.5	CM	SOX	NOX	VOC
Area Sources	1996	148.6	279.7	37.3	158.2	560.6
	2018 w/309	197.0	282.1	46.8	227.8	541.2
	% Change	33%	1%	25%	44%	-3%
Point Sources	1996	54.2	41.5	541.3	512.7	83.5
	2018 w/309	54.7	50.4	384.9	556.7	100.3
	% Change	1%	21%	-29%	9%	20%
Mobile Sources - On-Road	1996	14.9	1.9	10.7	439.7	424.0
	2018 w/309	5.9	0.3	2.1	132.6	136.7
	% Change	-60%	-86%	-80%	-70%	-68%
Mobile Sources - Non-Road	1996	27.1	2.2	47.9	388.5	189.9
	2018 w/309	26.0	2.1	74.4	309.9	114.7
	% Change	-4%	-3%	55%	-20%	-40%
Road Dust	1996	20.5	96.3	-	-	-
	2018 w/309	25.0	108.5	-	-	-
	% Change	22%	13%	-	-	-
Sub-Total - Non-Fire Emissions	1996	265.3	421.6	637.2	1,499.2	1,258.0
	2018 w/309	308.7	443.3	508.2	1,227.1	893.0
	% Change	16%	5%	-20%	-18%	-29%
Agricultural Burning	1996	3.2	0.2	0.2	1.2	2.9
	2018 w/309	1.2	0.1	0.1	0.4	1.0
	% Change	-62%	-64%	-67%	-65%	-65%
Prescribed Fire on Wildlands	1996	230.2	41.4	16.2	178.8	97.3
	2018 w/309	224.0	40.3	15.8	172.7	94.8
	% Change	-3%	-3%	-3%	-3%	-3%
Wild Fire	1996	111.4	18.5	7.9	28.7	62.9
	2018 w/309	111.4	18.5	7.9	28.7	62.9
	% Change	0%	0%	0%	0%	0%
Sub-Total - Fire Emissions	1996	344.9	60.1	24.3	208.7	163.1
	2018 w/309	336.7	58.9	23.7	201.8	158.7
	% Change	-2%	-2%	-2%	-3%	-3%
TOTAL EMISSIONS IN FIVE 309 STATES	1996	610.2	481.7	661.4	1,707.9	1,421.1
	2018 w/309	645.3	502.2	532.0	1,428.8	1,051.7
	% Change	6%	4%	-20%	-16%	-26%

Appendix A-14b. Table 1.
Changes in Emissions - 1996 vs 2018 w/309 Programs
(Thousands of Tons per Year)

C. EMISSIONS IN THE NINE GCVTC STATES		PM2.5	CM	SOX	NOX	VOC
Area Sources	1996	304.3	698.2	61.0	297.2	1,094.6
	2018 w/309	352.4	698.7	74.7	377.8	1,156.1
	% Change	16%	0%	22%	27%	6%
Point Sources	1996	97.9	77.1	770.4	849.4	193.1
	2018 w/309	110.1	101.1	510.0	852.7	251.4
	% Change	12%	31%	-34%	0%	30%
Mobile Sources - On-Road	1996	39.8	9.1	20.6	1,458.3	1,268.8
	2018 w/309	23.0	8.6	5.4	407.8	359.0
	% Change	-42%	-6%	-74%	-72%	-72%
Mobile Sources - Non-Road	1996	67.9	5.7	140.1	984.3	463.2
	2018 w/309	61.1	5.1	175.3	700.3	277.3
	% Change	-10%	-11%	25%	-29%	-40%
Road Dust	1996	59.8	272.8	-	-	-
	2018 w/309	66.5	278.2	-	-	-
	% Change	11%	2%	-	-	-
Sub-Total - Non-Fire Emissions	1996	569.7	1,062.9	992.2	3,589.1	3,019.7
	2018 w/309	613.1	1,091.6	765.5	2,338.5	2,043.8
	% Change	8%	3%	-23%	-35%	-32%
Agricultural Burning	1996	15.8	0.8	1.0	8.0	15.3
	2018 w/309	6.5	0.4	0.5	3.2	5.8
	% Change	-59%	-58%	-50%	-60%	-62%
Prescribed Fire on Wildlands	1996	387.4	69.7	27.3	297.5	164.1
	2018 w/309	384.8	69.3	27.1	292.5	163.2
	% Change	-1%	-1%	-1%	-2%	0%
Wild Fire	1996	223.9	37.2	15.8	57.6	126.3
	2018 w/309	223.9	37.2	15.8	57.6	126.3
	% Change	0%	0%	0%	0%	0%
Sub-Total - Fire Emissions	1996	627.0	107.7	44.1	363.0	305.7
	2018 w/309	615.2	106.8	43.4	353.3	295.4
	% Change	-2%	-1%	-1%	-3%	-3%
TOTAL EMISSIONS IN THE NINE GCVTC STATES	1996	1,196.7	1,170.6	1,036.3	3,952.1	3,325.3
	2018 w/309	1,228.3	1,198.4	808.9	2,691.8	2,339.2
	% Change	3%	2%	-22%	-32%	-30%

Appendix A-14b. Table 1.
Changes in Emissions - 1996 vs 2018 w/309 Programs
(Thousands of Tons per Year)

D. EMISSIONS IN THE 13 WRAP STATES		PM2.5	CM	SOX	NOX	VOC
Area Sources	1996	523.2	1,398.2	141.8	352.6	1,411.9
	2018 w/309	578.0	1,403.0	167.4	449.6	1,508.3
	% Change	10%	0%	18%	27%	7%
Point Sources	1996	118.1	89.9	1,196.5	1,085.0	224.5
	2018 w/309	132.0	115.1	763.8	1,104.2	289.3
	% Change	12%	28%	-36%	2%	29%
Mobile Sources - On-Road	1996	48.8	10.3	28.3	1,755.7	1,565.5
	2018 w/309	26.3	8.7	6.5	485.3	444.4
	% Change	-46%	-15%	-77%	-72%	-72%
Mobile Sources - Non-Road	1996	95.0	8.0	213.3	1,367.8	621.3
	2018 w/309	84.2	7.1	272.1	949.4	365.1
	% Change	-11%	-12%	28%	-31%	-41%
Road Dust	1996	84.4	399.9	-	-	-
	2018 w/309	93.7	410.7	-	-	-
	% Change	11%	3%	-	-	-
Sub-Total - Non-Fire Emissions	1996	869.5	1,906.3	1,579.9	4,561.0	3,823.2
	2018 w/309	914.3	1,944.6	1,209.8	2,988.5	2,607.1
	% Change	5%	2%	-23%	-34%	-32%
Agricultural Burning	1996	20.9	1.1	1.4	10.1	20.3
	2018 w/309	9.4	0.5	0.7	4.3	8.5
	% Change	-55%	-55%	-49%	-58%	-58%
Prescribed Fire on Wildlands	1996	445.5	80.2	31.4	342.3	188.7
	2018 w/309	442.7	79.7	31.2	336.7	187.8
	% Change	-1%	-1%	-1%	-2%	0%
Wild Fire	1996	231.5	38.4	16.3	59.6	130.6
	2018 w/309	231.5	38.4	16.3	59.6	130.6
	% Change	0%	0%	0%	0%	0%
Sub-Total - Fire Emissions	1996	698.0	119.7	49.1	412.0	339.6
	2018 w/309	683.6	118.6	48.3	400.5	327.0
	% Change	-2%	-1%	-2%	-3%	-4%
TOTAL EMISSIONS IN THE 13 WRAP STATES	1996	1,567.4	2,026.0	1,629.0	4,973.0	4,162.9
	2018 w/309	1,597.8	2,063.2	1,258.1	3,389.0	2,934.1
	% Change	2%	2%	-23%	-32%	-30%

Appendix A-14b. Table 1.
Changes in Emissions - 1996 vs 2018 w/309 Programs
(Thousands of Tons per Year)

Year Definitions
"1996" is the WRAP Inventory used for validation of WRAP Modeling to generate relative reduction factors
"2018 w/309" is the WRAP Inventory projection assuming all 309 programs are implemented.

Pollutant Definitions
"PM2.5" - Fine Particulate Matter < 2.5 Micron
"CM" - Coarse Material (Soils/Dusts) > 2.5 Micron & < 10 Micron
"SO2" - Sulfur Dioxide - Precursor to Sulfate Particles
"NOX" - Oxides of Nitrogen - Precursor to Nitrate Particulate
"VOC" - Volitile Organic Carbon Gases - Precursor to "OC"

Appendix A-14b. Table 2.
WRAP Emissions by Pollutant
(Thousands of Tons Per Year)

	Soil and Dust Particulate Emissions					
Modeled Pollutants >>>	Fine Material < 2.5 Micron (PM2.5)			Coarse Material (> 2.5 micron) (CM)		
A. ARIZONA EMISSIONS BY SOURCE CATEGORY	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Area Sources	23.0	25.2	25.2	49.0	48.2	48.2
Point Sources	11.7	20.1	9.5	10.6	18.1	17.2
Mobile Sources - On-Road	4.6	1.7	1.7	0.6	0.1	0.1
Mobile Sources - Non-Road	9.0	7.6	7.6	0.7	0.5	0.5
Road Dust	4.5	5.2	5.2	21.2	21.0	21.0
Sub-Total - Non-Fire Emissions	52.8	59.9	49.3	82.1	88.0	87.1
Agricultural Burning	0.2	0.2	0.1	0.0	0.0	0.0
Prescribed Fire on Wildlands	65.8	65.8	64.8	11.8	11.8	11.7
Wild Fire	29.1	29.1	29.1	4.8	4.8	4.8
Sub-Total - Fire Emissions	95.1	95.1	94.0	16.7	16.7	16.5
TOTAL EMISSIONS IN ARIZONA	147.9	155.0	143.3	98.8	104.7	103.6
B. EMISSIONS IN FIVE 309 STATES (AZ,NM,OR,UT,WY)	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Area Sources	148.6	197.0	197.0	279.7	282.1	282.1
Point Sources	54.2	72.0	54.7	41.5	54.7	50.4
Mobile Sources - On-Road	14.9	5.9	5.9	1.9	0.3	0.3
Mobile Sources - Non-Road	27.1	26.0	26.0	2.2	2.1	2.1
Road Dust	20.5	25.0	25.0	96.3	108.5	108.5
Sub-Total - Non-Fire Emissions	265.3	326.0	308.7	421.6	447.7	443.3
Agricultural Burning	3.2	3.2	1.2	0.2	0.2	0.1
Prescribed Fire on Wildlands	230.2	230.2	224.0	41.4	41.4	40.3
Wild Fire	111.4	111.4	111.4	18.5	18.5	18.5
Sub-Total - Fire Emissions	344.9	344.9	336.7	60.1	60.1	58.9
TOTAL EMISSIONS IN FIVE 309 STATES	610.2	670.8	645.3	481.7	507.8	502.2
C. EMISSIONS IN THE NINE GCVTC STATES	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Area Sources	304.3	352.4	352.4	698.2	698.7	698.7
Point Sources	97.9	127.4	110.1	77.1	105.4	101.1
Mobile Sources - On-Road	39.8	23.0	23.0	9.1	8.6	8.6
Mobile Sources - Non-Road	67.9	61.1	61.1	5.7	5.1	5.1
Road Dust	59.8	66.5	66.5	272.8	278.2	278.2
Sub-Total - Non-Fire Emissions	569.7	630.4	613.1	1,062.9	1,095.9	1,091.6
Agricultural Burning	15.8	15.8	6.5	0.8	0.8	0.4
Prescribed Fire on Wildlands	387.4	387.4	384.8	69.7	69.7	69.3
Wild Fire	223.9	223.9	223.9	37.2	37.2	37.2
Sub-Total - Fire Emissions	627.0	627.0	615.2	107.7	107.7	106.8
TOTAL EMISSIONS IN THE NINE GCVTC STATES	1,196.7	1,257.4	1,228.3	1,170.6	1,203.7	1,198.4
D. EMISSIONS IN THE 13 WRAP STATES	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Area Sources	523.2	578.0	578.0	1,398.2	1,403.0	1,403.0
Point Sources	118.1	149.0	132.0	89.9	119.4	115.1
Mobile Sources - On-Road	48.8	26.3	26.3	10.3	8.7	8.7
Mobile Sources - Non-Road	95.0	84.2	84.2	8.0	7.1	7.1
Road Dust	84.4	93.7	93.7	399.9	410.7	410.7
Sub-Total - Non-Fire Emissions	869.5	931.3	914.3	1,906.3	1,948.9	1,944.6
Agricultural Burning	20.9	20.9	9.4	1.1	1.1	0.5
Prescribed Fire on Wildlands	445.5	445.5	442.7	80.2	80.2	79.7
Wild Fire	231.5	231.5	231.5	38.4	38.4	38.4
Sub-Total - Fire Emissions	698.0	698.0	683.6	119.7	119.7	118.6
TOTAL EMISSIONS IN THE 13 WRAP STATES	1,567.4	1,629.3	1,597.8	2,026.0	2,068.6	2,063.2

Data Column Definitions
"1996" is the WRAP Inventory used for model validation
"2018 Base" is the WRAP Inventory w/o 309 Programs
"2018 w/309" is the WRAP Inventory w/ 309 Programs

Pollutant Definitions
"PM2.5" - Fine Particulate Matter < 2.5 Micron
"CM" - Coarse Material (Soils/Dusts) > 2.5 Micron & < 10 Micron
"SO2" - Sulfur Dioxide - Precursor to Sulfate Particles
"NOX" - Oxides of Nitrogen - Precursor to Nitrate Particulate
"VOC" - Volitile Organic Carbon Gases - Precursor to "OC"

Appendix A-14b. Table 2.
WRAP Emissions by Pollutant
(Thousands of Tons Per Year)

	Precursor Gases Forming Sulfate and Nitrate Particles					
Modeled Pollutants >>>	Sulfur Dioxide (SOX)			Oxides of Nitrogen (NOX)		
A. ARIZONA EMISSIONS BY SOURCE CATEGORY	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Area Sources	3.2	5.3	5.3	49.3	79.0	79.0
Point Sources	195.8	131.5	113.9	108.7	138.6	134.6
Mobile Sources - On-Road	2.9	0.8	0.8	140.5	47.3	47.3
Mobile Sources - Non-Road	9.2	12.6	12.6	98.6	66.2	66.2
Road Dust	-	-	-	-	-	-
Sub-Total - Non-Fire Emissions	211.2	150.2	132.6	397.1	331.1	327.1
Agricultural Burning	0.0	0.0	0.0	0.1	0.1	0.0
Prescribed Fire on Wildlands	4.6	4.6	4.6	49.3	49.3	48.6
Wild Fire	2.1	2.1	2.1	7.5	7.5	7.5
Sub-Total - Fire Emissions	6.7	6.7	6.6	56.9	56.9	56.1
TOTAL EMISSIONS IN ARIZONA	217.9	156.9	139.3	454.0	388.0	383.2
B. EMISSIONS IN FIVE 309 STATES (AZ,NM,OR,UT,WY)	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Area Sources	37.3	46.8	46.8	158.2	227.8	227.8
Point Sources	541.3	481.1	384.9	512.7	587.8	556.7
Mobile Sources - On-Road	10.7	2.1	2.1	439.7	132.6	132.6
Mobile Sources - Non-Road	47.9	74.4	74.4	388.5	309.9	309.9
Road Dust	-	-	-	-	-	-
Sub-Total - Non-Fire Emissions	637.2	604.4	508.2	1,499.2	1,258.2	1,227.1
Agricultural Burning	0.2	0.2	0.1	1.2	1.2	0.4
Prescribed Fire on Wildlands	16.2	16.2	15.8	178.8	178.8	172.7
Wild Fire	7.9	7.9	7.9	28.7	28.7	28.7
Sub-Total - Fire Emissions	24.3	24.3	23.7	208.7	208.7	201.8
TOTAL EMISSIONS IN FIVE 309 STATES	661.4	628.7	532.0	1,707.9	1,466.9	1,428.8
C. EMISSIONS IN THE NINE GCVTC STATES	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Area Sources	61.0	74.7	74.7	297.2	377.8	377.8
Point Sources	770.4	642.1	510.0	849.4	885.7	852.7
Mobile Sources - On-Road	20.6	5.4	5.4	1,458.3	407.8	407.8
Mobile Sources - Non-Road	140.1	175.3	175.3	984.3	700.3	700.3
Road Dust	-	-	-	-	-	-
Sub-Total - Non-Fire Emissions	992.2	897.6	765.5	3,589.1	2,371.6	2,338.5
Agricultural Burning	1.0	1.0	0.5	8.0	8.0	3.2
Prescribed Fire on Wildlands	27.3	27.3	27.1	297.5	297.5	292.5
Wild Fire	15.8	15.8	15.8	57.6	57.6	57.6
Sub-Total - Fire Emissions	44.1	44.1	43.4	363.0	363.0	353.3
TOTAL EMISSIONS IN THE NINE GCVTC STATES	1,036.3	941.7	808.9	3,952.1	2,734.6	2,691.8
D. EMISSIONS IN THE 13 WRAP STATES	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Area Sources	141.8	167.4	167.4	352.6	449.6	449.6
Point Sources	1,196.5	985.9	763.8	1,085.0	1,133.2	1,104.2
Mobile Sources - On-Road	28.3	6.5	6.5	1,755.7	485.3	485.3
Mobile Sources - Non-Road	213.3	272.1	272.1	1,367.8	949.4	949.4
Road Dust	-	-	-	-	-	-
Sub-Total - Non-Fire Emissions	1,579.9	1,431.9	1,209.8	4,561.0	3,017.5	2,988.5
Agricultural Burning	1.4	1.4	0.7	10.1	10.1	4.3
Prescribed Fire on Wildlands	31.4	31.4	31.2	342.3	342.3	336.7
Wild Fire	16.3	16.3	16.3	59.6	59.6	59.6
Sub-Total - Fire Emissions	49.1	49.1	48.3	412.0	412.0	400.5
TOTAL EMISSIONS IN THE 13 WRAP STATES	1,629.0	1,481.0	1,258.1	4,973.0	3,429.5	3,389.0

Data Column Definitions
"1996" is the WRAP Inventory used for model validation
"2018 Base" is the WRAP Inventory w/o 309 Programs
"2018 w/309" is the WRAP Inventory w/ 309 Programs

Pollutant Definitions
"PM2.5" - Fine Particulate Matter < 2.5 Micron
"CM" - Coarse Material (Soils/Dusts) > 2.5 Micron & < 10 Mi
"SO2" - Sulfur Dioxide - Precursor to Sulfate Particles
"NOX" - Oxides of Nitrogen - Precursor to Nitrate Particula
"VOC" - Volitile Organic Carbon Gases - Precursor to "OC"

Appendix A-14b. Table 2.
WRAP Emissions by Pollutant
(Thousands of Tons Per Year)

	Gases Forming Organic Particles		
Modeled Pollutants >>>	Volatile Organic Carbon (VOC)		
A. ARIZONA EMISSIONS BY SOURCE CATEGORY	1996	2018 Base	2018 w/309
Area Sources	115.4	140.5	140.5
Point Sources	10.5	17.2	10.8
Mobile Sources - On-Road	150.4	55.6	55.6
Mobile Sources - Non-Road	51.5	27.0	27.0
Road Dust	-	-	-
Sub-Total - Non-Fire Emissions	327.8	240.1	233.8
Agricultural Burning	0.2	0.2	0.0
Prescribed Fire on Wildlands	28.0	28.0	27.6
Wild Fire	16.4	16.4	16.4
Sub-Total - Fire Emissions	44.6	44.6	44.1
TOTAL EMISSIONS IN ARIZONA	372.3	284.7	277.8
B. EMISSIONS IN FIVE 309 STATES (AZ,NM,OR,UT,WY)	1996	2018 Base	2018 w/309
Area Sources	560.6	541.2	541.2
Point Sources	83.5	115.1	100.3
Mobile Sources - On-Road	424.0	136.7	136.7
Mobile Sources - Non-Road	189.9	114.7	114.7
Road Dust	-	-	-
Sub-Total - Non-Fire Emissions	1,258.0	907.7	893.0
Agricultural Burning	2.9	2.9	1.0
Prescribed Fire on Wildlands	97.3	97.3	94.8
Wild Fire	62.9	62.9	62.9
Sub-Total - Fire Emissions	163.1	163.1	158.7
TOTAL EMISSIONS IN FIVE 309 STATES	1,421.1	1,070.8	1,051.7
C. EMISSIONS IN THE NINE GCVTC STATES	1996	2018 Base	2018 w/309
Area Sources	1,094.6	1,156.1	1,156.1
Point Sources	193.1	266.2	251.4
Mobile Sources - On-Road	1,268.8	359.0	359.0
Mobile Sources - Non-Road	463.2	277.3	277.3
Road Dust	-	-	-
Sub-Total - Non-Fire Emissions	3,019.7	2,058.5	2,043.8
Agricultural Burning	15.3	15.3	5.8
Prescribed Fire on Wildlands	164.1	164.1	163.2
Wild Fire	126.3	126.3	126.3
Sub-Total - Fire Emissions	305.7	305.7	295.4
TOTAL EMISSIONS IN THE NINE GCVTC STATES	3,325.3	2,364.2	2,339.2
D. EMISSIONS IN THE 13 WRAP STATES	1996	2018 Base	2018 w/309
Area Sources	1,411.9	1,508.3	1,508.3
Point Sources	224.5	303.7	289.3
Mobile Sources - On-Road	1,565.5	444.4	444.4
Mobile Sources - Non-Road	621.3	365.1	365.1
Road Dust	-	-	-
Sub-Total - Non-Fire Emissions	3,823.2	2,621.5	2,607.1
Agricultural Burning	20.3	20.3	8.5
Prescribed Fire on Wildlands	188.7	188.7	187.8
Wild Fire	130.6	130.6	130.6
Sub-Total - Fire Emissions	339.6	339.6	327.0
TOTAL EMISSIONS IN THE 13 WRAP STATES	4,162.9	2,961.1	2,934.1

Data Column Definitions
"1996" is the WRAP Inventory used for model validation
"2018 Base" is the WRAP Inventory w/o 309 Programs
"2018 w/309" is the WRAP Inventory w/ 309 Programs

Pollutant Definitions
"PM2.5" - Fine Particulate Matter < 2.5 Micron
"CM" - Coarse Material (Soils/Dusts) > 2.5 Micron & < 10 Mi
"SO2" - Sulfur Dioxide - Precursor to Sulfate Particles
"NOX" - Oxides of Nitrogen - Precursor to Nitrate Particula
"VOC" - Volitile Organic Carbon Gases - Precursor to "OC"

Appendix A-14b. Table 3.
WRAP Emissions by Year
(Thousands of Tons per Year)

Modeled Pollutants >>>	PM2.5	CM	SOX	NOX	VOC
A. ARIZONA EMISSIONS BY SOURCE CATEGORY	1996	1996	1996	1996	1996
Area Sources	23.0	49.0	3.2	49.3	115.4
Point Sources	11.7	10.6	195.8	108.7	10.5
Mobile Sources - On-Road	4.6	0.6	2.9	140.5	150.4
Mobile Sources - Non-Road	9.0	0.7	9.2	98.6	51.5
Road Dust	4.5	21.2	-	-	-
Sub-Total - Non-Fire Emissions	52.8	82.1	211.2	397.1	327.8
Agricultural Burning	0.2	0.0	0.0	0.1	0.2
Prescribed Fire on Wildlands	65.8	11.8	4.6	49.3	28.0
Wild Fire	29.1	4.8	2.1	7.5	16.4
Sub-Total - Fire Emissions	95.1	16.7	6.7	56.9	44.6
TOTAL EMISSIONS IN ARIZONA	147.9	98.8	217.9	454.0	372.3
B. EMISSIONS IN FIVE 309 STATES (AZ,NM,OR,UT,WY)	1996	1996	1996	1996	1996
Area Sources	148.6	279.7	37.3	158.2	560.6
Point Sources	54.2	41.5	541.3	512.7	83.5
Mobile Sources - On-Road	14.9	1.9	10.7	439.7	424.0
Mobile Sources - Non-Road	27.1	2.2	47.9	388.5	189.9
Road Dust	20.5	96.3	-	-	-
Sub-Total - Non-Fire Emissions	265.3	421.6	637.2	1,499.2	1,258.0
Agricultural Burning	3.2	0.2	0.2	1.2	2.9
Prescribed Fire on Wildlands	230.2	41.4	16.2	178.8	97.3
Wild Fire	111.4	18.5	7.9	28.7	62.9
Sub-Total - Fire Emissions	344.9	60.1	24.3	208.7	163.1
TOTAL EMISSIONS IN FIVE 309 STATES	610.2	481.7	661.4	1,707.9	1,421.1
C. EMISSIONS IN THE NINE GCVTC STATES	1996	1996	1996	1996	1996
Area Sources	304.3	698.2	61.0	297.2	1,094.6
Point Sources	97.9	77.1	770.4	849.4	193.1
Mobile Sources - On-Road	39.8	9.1	20.6	1,458.3	1,268.8
Mobile Sources - Non-Road	67.9	5.7	140.1	984.3	463.2
Road Dust	59.8	272.8	-	-	-
Sub-Total - Non-Fire Emissions	569.7	1,062.9	992.2	3,589.1	3,019.7
Agricultural Burning	15.8	0.8	1.0	8.0	15.3
Prescribed Fire on Wildlands	387.4	69.7	27.3	297.5	164.1
Wild Fire	223.9	37.2	15.8	57.6	126.3
Sub-Total - Fire Emissions	627.0	107.7	44.1	363.0	305.7
TOTAL EMISSIONS IN THE NINE GCVTC STATES	1,196.7	1,170.6	1,036.3	3,952.1	3,325.3
D. EMISSIONS IN THE 13 WRAP STATES	1996	1996	1996	1996	1996
Area Sources	523.2	1,398.2	141.8	352.6	1,411.9
Point Sources	118.1	89.9	1,196.5	1,085.0	224.5
Mobile Sources - On-Road	48.8	10.3	28.3	1,755.7	1,565.5
Mobile Sources - Non-Road	95.0	8.0	213.3	1,367.8	621.3
Road Dust	84.4	399.9	-	-	-
Sub-Total - Non-Fire Emissions	869.5	1,906.3	1,579.9	4,561.0	3,823.2
Agricultural Burning	20.9	1.1	1.4	10.1	20.3
Prescribed Fire on Wildlands	445.5	80.2	31.4	342.3	188.7
Wild Fire	231.5	38.4	16.3	59.6	130.6
Sub-Total - Fire Emissions	698.0	119.7	49.1	412.0	339.6
TOTAL EMISSIONS IN THE 13 WRAP STATES	1,567.4	2,026.0	1,629.0	4,973.0	4,162.9

Data Column Definitions
"1996" is the WRAP Inventory used for model validation
"2018 Base" is the WRAP Inventory w/o 309 Programs
"2018 w/309" is the WRAP Inventory w/ 309 Programs

Pollutant Definitions
"PM2.5" - Fine Particulate Matter < 2.5 Micron
"CM" - Coarse Material (Soils/Dusts) > 2.5 Micron & < 10 Micron
"SO2" - Sulfur Dioxide - Precursor to Sulfate Particles
"NOX" - Oxides of Nitrogen - Precursor to Nitrate Particulate
"VOC" - Volitile Organic Carbon Gases - Precursor to "OC"

Appendix A-14b. Table 3.
WRAP Emissions by Year
(Thousands of Tons per Year)

Modeled Pollutants >>>	PM2.5	CM	SOX	NOX	VOC
A. ARIZONA EMISSIONS BY SOURCE CATEGORY	2018 Base	2018 Base	2018 Base	2018 Base	2018 Base
Area Sources	25.2	48.2	5.3	79.0	140.5
Point Sources	20.1	18.1	131.5	138.6	17.2
Mobile Sources - On-Road	1.7	0.1	0.8	47.3	55.6
Mobile Sources - Non-Road	7.6	0.5	12.6	66.2	27.0
Road Dust	5.2	21.0	-	-	-
Sub-Total - Non-Fire Emissions	59.9	88.0	150.2	331.1	240.1
Agricultural Burning	0.2	0.0	0.0	0.1	0.2
Prescribed Fire on Wildlands	65.8	11.8	4.6	49.3	28.0
Wild Fire	29.1	4.8	2.1	7.5	16.4
Sub-Total - Fire Emissions	95.1	16.7	6.7	56.9	44.6
TOTAL EMISSIONS IN ARIZONA	155.0	104.7	156.9	388.0	284.7
B. EMISSIONS IN FIVE 309 STATES (AZ,NM,OR,UT,WY)	2018 Base	2018 Base	2018 Base	2018 Base	2018 Base
Area Sources	197.0	282.1	46.8	227.8	541.2
Point Sources	72.0	54.7	481.1	587.8	115.1
Mobile Sources - On-Road	5.9	0.3	2.1	132.6	136.7
Mobile Sources - Non-Road	26.0	2.1	74.4	309.9	114.7
Road Dust	25.0	108.5	-	-	-
Sub-Total - Non-Fire Emissions	326.0	447.7	604.4	1,258.2	907.7
Agricultural Burning	3.2	0.2	0.2	1.2	2.9
Prescribed Fire on Wildlands	230.2	41.4	16.2	178.8	97.3
Wild Fire	111.4	18.5	7.9	28.7	62.9
Sub-Total - Fire Emissions	344.9	60.1	24.3	208.7	163.1
TOTAL EMISSIONS IN FIVE 309 STATES	670.8	507.8	628.7	1,466.9	1,070.8
C. EMISSIONS IN THE NINE GCVTC STATES	2018 Base	2018 Base	2018 Base	2018 Base	2018 Base
Area Sources	352.4	698.7	74.7	377.8	1,156.1
Point Sources	127.4	105.4	642.1	885.7	266.2
Mobile Sources - On-Road	23.0	8.6	5.4	407.8	359.0
Mobile Sources - Non-Road	61.1	5.1	175.3	700.3	277.3
Road Dust	66.5	278.2	-	-	-
Sub-Total - Non-Fire Emissions	630.4	1,095.9	897.6	2,371.6	2,058.5
Agricultural Burning	15.8	0.8	1.0	8.0	15.3
Prescribed Fire on Wildlands	387.4	69.7	27.3	297.5	164.1
Wild Fire	223.9	37.2	15.8	57.6	126.3
Sub-Total - Fire Emissions	627.0	107.7	44.1	363.0	305.7
TOTAL EMISSIONS IN THE NINE GCVTC STATES	1,257.4	1,203.7	941.7	2,734.6	2,364.2
D. EMISSIONS IN THE 13 WRAP STATES	2018 Base	2018 Base	2018 Base	2018 Base	2018 Base
Area Sources	578.0	1,403.0	167.4	449.6	1,508.3
Point Sources	149.0	119.4	985.9	1,133.2	303.7
Mobile Sources - On-Road	26.3	8.7	6.5	485.3	444.4
Mobile Sources - Non-Road	84.2	7.1	272.1	949.4	365.1
Road Dust	93.7	410.7	-	-	-
Sub-Total - Non-Fire Emissions	931.3	1,948.9	1,431.9	3,017.5	2,621.5
Agricultural Burning	20.9	1.1	1.4	10.1	20.3
Prescribed Fire on Wildlands	445.5	80.2	31.4	342.3	188.7
Wild Fire	231.5	38.4	16.3	59.6	130.6
Sub-Total - Fire Emissions	698.0	119.7	49.1	412.0	339.6
TOTAL EMISSIONS IN THE 13 WRAP STATES	1,629.3	2,068.6	1,481.0	3,429.5	2,961.1

Data Column Definitions
"1996" is the WRAP Inventory used for model validation
"2018 Base" is the WRAP Inventory w/o 309 Programs
"2018 w/309" is the WRAP Inventory w/ 309 Programs

Pollutant Definitions
"PM2.5" - Fine Particulate Matter < 2.5 Micron
"CM" - Coarse Material (Soils/Dusts) > 2.5 Micron & < 10 Mi
"SO2" - Sulfur Dioxide - Precursor to Sulfate Particles
"NOX" - Oxides of Nitrogen - Precursor to Nitrate Particula
"VOC" - Volitile Organic Carbon Gases - Precursor to "OC"

Appendix A-14b. Table 3.
WRAP Emissions by Year
(Thousands of Tons per Year)

Modeled Pollutants >>>	PM2.5	CM	SOX	NOX	VOC
A. ARIZONA EMISSIONS BY SOURCE CATEGORY	2018 w/309	2018 w/309	2018 w/309	2018 w/309	2018 w/309
Area Sources	25.2	48.2	5.3	79.0	140.5
Point Sources	9.5	17.2	113.9	134.6	10.8
Mobile Sources - On-Road	1.7	0.1	0.8	47.3	55.6
Mobile Sources - Non-Road	7.6	0.5	12.6	66.2	27.0
Road Dust	5.2	21.0	-	-	-
Sub-Total - Non-Fire Emissions	49.3	87.1	132.6	327.1	233.8
Agricultural Burning	0.1	0.0	0.0	0.0	0.0
Prescribed Fire on Wildlands	64.8	11.7	4.6	48.6	27.6
Wild Fire	29.1	4.8	2.1	7.5	16.4
Sub-Total - Fire Emissions	94.0	16.5	6.6	56.1	44.1
TOTAL EMISSIONS IN ARIZONA	143.3	103.6	139.3	383.2	277.8
B. EMISSIONS IN FIVE 309 STATES (AZ,NM,OR,UT,WY)	2018 w/309	2018 w/309	2018 w/309	2018 w/309	2018 w/309
Area Sources	197.0	282.1	46.8	227.8	541.2
Point Sources	54.7	50.4	384.9	556.7	100.3
Mobile Sources - On-Road	5.9	0.3	2.1	132.6	136.7
Mobile Sources - Non-Road	26.0	2.1	74.4	309.9	114.7
Road Dust	25.0	108.5	-	-	-
Sub-Total - Non-Fire Emissions	308.7	443.3	508.2	1,227.1	893.0
Agricultural Burning	1.2	0.1	0.1	0.4	1.0
Prescribed Fire on Wildlands	224.0	40.3	15.8	172.7	94.8
Wild Fire	111.4	18.5	7.9	28.7	62.9
Sub-Total - Fire Emissions	336.7	58.9	23.7	201.8	158.7
TOTAL EMISSIONS IN FIVE 309 STATES	645.3	502.2	532.0	1,428.8	1,051.7
C. EMISSIONS IN THE NINE GCVTC STATES	2018 w/309	2018 w/309	2018 w/309	2018 w/309	2018 w/309
Area Sources	352.4	698.7	74.7	377.8	1,156.1
Point Sources	110.1	101.1	510.0	852.7	251.4
Mobile Sources - On-Road	23.0	8.6	5.4	407.8	359.0
Mobile Sources - Non-Road	61.1	5.1	175.3	700.3	277.3
Road Dust	66.5	278.2	-	-	-
Sub-Total - Non-Fire Emissions	613.1	1,091.6	765.5	2,338.5	2,043.8
Agricultural Burning	6.5	0.4	0.5	3.2	5.8
Prescribed Fire on Wildlands	384.8	69.3	27.1	292.5	163.2
Wild Fire	223.9	37.2	15.8	57.6	126.3
Sub-Total - Fire Emissions	615.2	106.8	43.4	353.3	295.4
TOTAL EMISSIONS IN THE NINE GCVTC STATES	1,228.3	1,198.4	808.9	2,691.8	2,339.2
D. EMISSIONS IN THE 13 WRAP STATES	2018 w/309	2018 w/309	2018 w/309	2018 w/309	2018 w/309
Area Sources	578.0	1,403.0	167.4	449.6	1,508.3
Point Sources	132.0	115.1	763.8	1,104.2	289.3
Mobile Sources - On-Road	26.3	8.7	6.5	485.3	444.4
Mobile Sources - Non-Road	84.2	7.1	272.1	949.4	365.1
Road Dust	93.7	410.7	-	-	-
Sub-Total - Non-Fire Emissions	914.3	1,944.6	1,209.8	2,988.5	2,607.1
Agricultural Burning	9.4	0.5	0.7	4.3	8.5
Prescribed Fire on Wildlands	442.7	79.7	31.2	336.7	187.8
Wild Fire	231.5	38.4	16.3	59.6	130.6
Sub-Total - Fire Emissions	683.6	118.6	48.3	400.5	327.0
TOTAL EMISSIONS IN THE 13 WRAP STATES	1,597.8	2,063.2	1,258.1	3,389.0	2,934.1

Data Column Definitions
"1996" is the WRAP Inventory used for model validation
"2018 Base" is the WRAP Inventory w/o 309 Programs
"2018 w/309" is the WRAP Inventory w/ 309 Programs

Pollutant Definitions
"PM2.5" - Fine Particulate Matter < 2.5 Micron
"CM" - Coarse Material (Soils/Dusts) > 2.5 Micron & < 10 Mi
"SO2" - Sulfur Dioxide - Precursor to Sulfate Particles
"NOX" - Oxides of Nitrogen - Precursor to Nitrate Particula
"VOC" - Volitile Organic Carbon Gases - Precursor to "OC"

Appendix A-14b. Table 4.
WRAP Emissions County State
(Thousands of Tons Per Year)

	Soil and Dust Particulate Emissions					
Modeled Pollutants >>>	Fine Material < 2.5 Micron (PM2.5)			Coarse Material (> 2.5 micron) (CM)		
A. ARIZONA EMISSIONS BY COUNTY	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Apache Co	12.8	12.9	13.3	4.1	4.3	4.4
Cochise Co	2.8	3.0	2.9	4.0	4.2	4.1
Coconino Co	31.5	31.8	31.6	8.4	8.7	8.7
Gila Co	14.0	14.7	14.8	4.8	5.3	5.4
Graham Co	8.9	8.9	8.7	3.5	3.4	3.4
Greenlee Co	5.6	6.0	6.1	2.3	2.6	2.6
La Paz	0.9	0.9	0.8	1.9	1.9	1.9
Maricopa Co	18.4	16.7	16.6	27.0	26.2	26.1
Mohave Co	8.9	8.9	8.3	3.7	3.7	3.6
Navajo Co	13.5	13.6	13.7	5.7	5.6	5.6
Pima Co	14.2	20.2	9.4	12.7	17.3	16.3
Pinal Co	4.6	5.5	5.5	9.6	10.8	10.7
Santa Cruz Co	0.6	0.6	0.6	1.3	1.3	1.3
Yavapai Co	8.1	8.3	8.1	4.7	4.8	4.8
Yuma Co	3.1	3.0	2.8	5.1	4.7	4.7
TOTAL EMISSIONS IN ARIZONA	147.9	155.0	143.3	98.8	104.7	103.6
B. EMISSIONS IN 309 SIP STATES	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Arizona	147.9	155.0	143.3	98.8	104.7	103.6
New Mexico	131.9	133.7	125.4	107.6	116.6	115.2
Oregon	185.5	229.8	227.7	148.0	147.0	146.8
Utah	85.4	92.5	87.3	63.7	74.7	71.6
Wyoming	59.5	59.9	61.6	63.7	64.8	65.1
SUB-TOTAL EMISSIONS IN 309 SIP STATES	610.2	670.8	645.3	481.7	507.8	502.2
C. EMISSIONS IN OTHER GCVTC STATES	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
California	316.5	315.3	314.9	302.7	298.4	298.8
Colorado	110.6	113.8	112.7	219.0	234.8	234.6
Idaho	124.1	119.3	116.6	120.0	111.7	111.6
Nevada	35.3	38.1	38.7	47.2	51.0	51.1
SUB-TOTAL EMISSIONS IN OTHER GCVTC STATES	586.5	586.6	582.9	688.9	695.9	696.2
TOTAL EMISSIONS IN GCVTC NINE STATE REGION	1,196.7	1,257.4	1,228.3	1,170.6	1,203.7	1,198.4
D. EMISSIONS IN OTHER WRAP STATES	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Montana	94.7	94.3	95.1	166.0	170.9	171.1
Norht Dakota	74.8	73.0	71.3	253.3	254.7	255.0
South Dakota	66.6	66.2	65.8	234.5	240.5	240.4
Washington	134.6	138.3	137.4	201.6	198.9	198.3
TOTAL EMISSIONS IN OTHER WRAP	370.7	371.8	369.6	855.4	865.0	864.8
TOTAL EMISSIONS IN 13 WRAP STATE REGION	1,567.4	1,629.3	1,597.8	2,026.0	2,068.6	2,063.2

Data Column Definitions
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"2018 Base" is the WRAP Inventory w/o 309 Programs
"2018 w/309" is the WRAP Inventory w/ 309 Programs

Pollutant Definitions
"PM2.5" - Fine Particulate Matter < 2.5 Micron
"CM" - Coarse Material (Soils/Dusts) > 2.5 Micron & < 10 Micron
"SO2" - Sulfur Dioxide - Precursor to Sulfate Particles
"NOX" - Oxides of Nitrogen - Precursor to Nitrate Particulate
"VOC" - Volitile Organic Carbon Gases - Precursor to "OC"

Appendix A-14b. Table 4.
WRAP Emissions County State
(Thousands of Tons Per Year)

	Precursor Gases Forming Sulfate and Nitrate Particles					
Modeled Pollutants >>>	Sulfur Dioxide (SOX)			Oxides of Nitrogen (NOX)		
A. ARIZONA EMISSIONS BY COUNTY	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Apache Co	36.1	43.7	27.8	43.5	43.3	42.9
Cochise Co	9.5	7.9	7.9	20.7	13.3	13.1
Coconino Co	66.4	7.6	7.7	54.5	63.9	62.8
Gila Co	40.1	30.5	31.6	12.6	11.9	12.0
Graham Co	0.7	0.7	0.7	6.6	5.0	4.8
Greenlee Co	0.5	0.6	0.6	5.8	6.2	6.3
La Paz	0.1	0.2	0.2	2.0	1.1	1.1
Maricopa Co	6.7	7.5	7.4	165.0	116.3	115.5
Mohave Co	1.0	1.2	1.1	11.3	9.4	9.0
Navajo Co	13.5	24.2	24.1	32.2	33.9	32.7
Pima Co	11.9	14.3	11.1	52.6	46.2	45.9
Pinal Co	29.3	16.1	16.6	18.4	15.8	15.8
Santa Cruz Co	0.2	0.2	0.2	2.5	1.4	1.4
Yavapai Co	1.3	1.5	1.6	16.6	14.7	14.6
Yuma Co	0.6	0.8	0.8	9.5	5.6	5.4
TOTAL EMISSIONS IN ARIZONA	217.9	156.9	139.3	454.0	388.0	383.2
B. EMISSIONS IN 309 SIP STATES	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Arizona	217.9	156.9	139.3	454.0	388.0	383.2
New Mexico	180.0	173.8	157.9	330.2	286.7	274.3
Oregon	44.5	64.8	46.3	369.7	282.2	279.8
Utah	66.8	72.7	65.6	269.6	221.1	202.7
Wyoming	152.2	160.5	122.9	284.5	288.9	288.8
SUB-TOTAL EMISSIONS IN 309 SIP STATES	661.4	628.7	532.0	1,707.9	1,466.9	1,428.8
C. EMISSIONS IN OTHER GCVTC STATES	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
California	122.8	91.1	90.4	1,497.1	738.5	737.5
Colorado	136.1	128.7	94.6	421.3	271.3	268.9
Idaho	46.1	41.6	40.6	144.9	105.2	103.9
Nevada	69.7	51.5	51.4	181.1	152.7	152.7
SUB-TOTAL EMISSIONS IN OTHER GCVTC STATES	374.8	313.0	276.9	2,244.3	1,267.7	1,263.0
TOTAL EMISSIONS IN GCVTC NINE STATE REGION	1,036.3	941.7	808.9	3,952.1	2,734.6	2,691.8
D. EMISSIONS IN OTHER WRAP STATES	1996	2018 Base	2018 w/309	1996	2018 Base	2018 w/309
Montana	62.9	58.3	48.7	191.1	147.2	147.6
Norht Dakota	318.6	336.7	268.2	251.9	197.2	201.4
South Dakota	49.0	60.2	56.3	120.6	73.9	73.3
Washington	162.3	84.0	75.9	457.3	276.5	275.0
TOTAL EMISSIONS IN OTHER WRAP	592.7	539.3	449.2	1,020.8	694.9	697.2
TOTAL EMISSIONS IN 13 WRAP STATE REGION	1,629.0	1,481.0	1,258.1	4,973.0	3,429.5	3,389.0

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"1996" is the WRAP Inventory used for model validation
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Pollutant Definitions
"PM2.5" - Fine Particulate Matter < 2.5 Micron
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Appendix A-14b. Table 4.
WRAP Emissions County State
(Thousands of Tons Per Year)

	Gases Forming Organic Particles		
Modeled Pollutants >>>	Volatile Organic Carbon (VOC)		
A. ARIZONA EMISSIONS BY COUNTY	1996	2018 Base	2018 w/309
Apache Co	15.0	11.9	12.0
Cochise Co	9.6	6.5	6.4
Coconino Co	26.3	23.7	23.7
Gila Co	11.0	9.3	9.3
Graham Co	7.8	6.4	6.3
Greenlee Co	3.2	2.8	2.8
La Paz	2.3	1.6	1.6
Maricopa Co	167.6	128.5	122.1
Mohave Co	10.4	9.0	8.8
Navajo Co	18.2	13.5	13.6
Pima Co	55.5	39.8	39.7
Pinal Co	15.7	10.9	10.9
Santa Cruz Co	3.7	2.6	2.6
Yavapai Co	14.0	9.6	9.6
Yuma Co	12.2	8.5	8.3
TOTAL EMISSIONS IN ARIZONA	372.3	284.7	277.8

B. EMISSIONS IN 309 SIP STATES	1996	2018 Base	2018 w/309
Arizona	372.3	284.7	277.8
New Mexico	200.0	157.0	153.5
Oregon	588.7	425.0	423.5
Utah	172.2	130.3	122.4
Wyoming	87.8	73.8	74.4
SUB-TOTAL EMISSIONS IN 309 SIP STATES	1,421.1	1,070.8	1,051.7

C. EMISSIONS IN OTHER GCVTC STATES	1996	2018 Base	2018 w/309
California	1,332.6	883.2	880.8
Colorado	297.2	203.9	203.4
Idaho	167.7	125.9	122.6
Nevada	106.7	80.5	80.7
SUB-TOTAL EMISSIONS IN OTHER GCVTC STATES	1,904.2	1,293.4	1,287.5

TOTAL EMISSIONS IN GCVTC NINE STATE REGION	3,325.3	2,364.2	2,339.2

D. EMISSIONS IN OTHER WRAP STATES	1996	2018 Base	2018 w/309
Montana	126.3	96.2	96.5
Norht Dakota	102.7	90.7	89.4
South Dakota	82.7	63.1	62.6
Washington	525.9	347.0	346.4
TOTAL EMISSIONS IN OTHER WRAP	837.5	597.0	594.9

TOTAL EMISSIONS IN 13 WRAP STATE REGION	4,162.9	2,961.1	2,934.1

Data Column Definitions
"1996" is the WRAP Inventory used for model validation
"2018 Base" is the WRAP Inventory w/o 309 Programs
"2018 w/309" is the WRAP Inventory w/ 309 Programs

Pollutant Definitions
"PM2.5" - Fine Particulate Matter < 2.5 Micron
"CM" - Coarse Material (Soils/Dusts) > 2.5 Micron & < 10 Mi
"SO2" - Sulfur Dioxide - Precursor to Sulfate Particles
"NOX" - Oxides of Nitrogen - Precursor to Nitrate Particula
"VOC" - Volitile Organic Carbon Gases - Precursor to "OC"

APPENDIX A-18. PUBLIC PARTICIPATION

This appendix contains work products and references relied upon by Arizona in the development of Chapter 18 of the Regional Haze SIP.

Janet Napolitano
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

1110 W. Washington Street • Phoenix, Arizona 85007
(602) 771-2300 • www.adeq.state.az.us

Stephen A. Owens
Director

MEMORANDUM

DATE: October 24, 2003

TO: Regional Haze Stakeholders

FROM: Nancy C. Wrona, Director
Air Quality Division

SUBJECT: Public Comment Period and Public Hearing Dates
Proposed Regional Haze State Implementation Plan

On Friday, October 24, 2003, Arizona's proposed Regional Haze State Implementation Plan (SIP) will be available for public review and comment. The proposed SIP will be available in electronic format via the ADEQ Web page at www.adeq.state.az.us/environ/air/haze/html. It will also be available for review in hard copy format at both the ADEQ library and the Flagstaff City/Coconino County Library.

Two public hearings are scheduled: Monday, November 24, 2003, 5:00 p.m., Room 250, ADEQ, 1110 W. Washington Street, Phoenix; and Monday, November 24, 2003, 4:30 p.m., Flagstaff City/Coconino County Library, Program Room, Flagstaff. The close of public comment is 5:00 p.m., Wednesday, December 3, 2003.

ADEQ greatly appreciates the sustained and valued input many stakeholders contributed to the development of the Regional Haze SIP, and we look forward to your continued involvement with the Regional Haze SIP development under Section 309(g) of the Regional Haze Rule.

If you have any questions, please call me at (602) 771-2308 or Corky Martinkovic at (602) 771-2372; (800) 234-5677, extension 771-2372, or martinkovic.deborrah@ev.state.az.us. Comments on the proposed SIP should be sent directly to Corky Martinkovic at the above e-mail or by fax at (602) 771-2366.

Public Notice

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
PUBLIC HEARING
ON ARIZONA'S REGIONAL HAZE STATE IMPLEMENTATION PLAN

The Arizona Department of Environmental Quality (ADEQ) will hold a public hearing to receive comments on Arizona's proposed Regional Haze State Implementation Plan (SIP) to address visibility impairment at four of Arizona's Class I areas (e.g., national parks and wilderness areas) as part of the 16 Class I areas on the Colorado Plateau. This SIP specifically addresses the requirements under the federal Regional Haze Rule, 40 CFR 51.309.

A public hearing on the proposed Regional Haze SIP will be held on Monday, November 24, 2003, at 5:00 p.m., ADEQ, Room 250, 1110 W. Washington Street, Phoenix, Arizona (602-254-5790). All interested parties will be given an opportunity at the public hearing to submit relevant comments, data, and views, orally and in writing. Written comments must be received at ADEQ by 5:00 p.m. on Wednesday, December 3, 2003. ADEQ anticipates completion of the final SIP by early December. The deadline for submittal to EPA is December 31, 2003.

All written comments should be addressed, faxed, or e-mailed to:

Corky Martinkovic
Air Quality Planning Section
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85007
FAX: (602) 771-2366
E-Mail: dam@ev.state.az.us

Copies of the proposal are available for review beginning Friday, October 24, 2003, at the following locations:

Arizona Department of Environmental Quality Library
First Floor – General Services
1110 W. Washington Street
Phoenix, AZ 85007
Lorraine Cona, (602) 771-2217; 771-4389 (fax)

The proposed SIP is also available at ADEQ Web page for Regional Haze at
www.adeq.state.az.us/environ/air/plan/haze.html

Public Notice

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
PUBLIC HEARING
ON ARIZONA'S REGIONAL HAZE STATE IMPLEMENTATION PLAN

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A public hearing on the proposed Regional Haze SIP will be held on Monday, November 24, 2003, at 4:30 p.m., Flagstaff City/Coconino County Library, Program Room, Flagstaff, Arizona (928-779-7670). All interested parties will be given an opportunity at the public hearing to submit relevant comments, data, and views, orally and in writing. Written comments must be received at ADEQ by 5:00 p.m. on Wednesday, December 3, 2003. ADEQ anticipates completion of the final SIP by early December. The deadline for submittal to EPA is December 31, 2003.

All written comments should be addressed, faxed, or e-mailed to:

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Air Quality Planning Section
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85007
FAX: (602) 771-2366
E-Mail: dam@ev.state.az.us

Copies of the proposal are available for review beginning Friday, October 24, 2003, at the following locations:

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First Floor – General Services
1110 W. Washington Street
Phoenix, AZ 85007
Lorraine Cona, (602) 771-2217; 771-4389 (fax)

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ADEQ
Arizona Department of Environmental Quality

Public Notice

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A public hearing on the proposed Regional Haze SIP will be held on Monday, November 24, 2003, at 4:30 p.m., Flagstaff City/Coconino County Library, Program Room, **Flagstaff**, Arizona (928-779-7670). Concurrently, a public hearing will be held on Monday, November 24, 2003, at 5:00 p.m., ADEQ, Room 250, 1110 W. Washington Street, **Phoenix**, Arizona (602-254-5790). All interested parties will be given an opportunity at the public hearing to submit relevant comments, data, and views, orally and in writing. Written comments must be received at ADEQ by 5:00 p.m. on Wednesday, December 3, 2003. ADEQ anticipates completion of the final SIP by early December. The deadline for submittal to EPA is December 31, 2003.

All written comments should be addressed, faxed, or e-mailed to:

Corky Martinkovic
Air Quality Planning Section
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85007
FAX: (602) 771-2366
E-Mail: dam@ev.state.az.us

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First Floor – General Services
1110 W. Washington Street
Phoenix, AZ 85007
Lorraine Cona, (602) 771-2217; 771-4389 (fax)

The proposed SIP is also available at ADEQ Web page for Regional Haze at
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ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY PUBLIC HEARING ON ARIZONA'S REGIONAL HAZE STATE IMPLEMENTATION PLAN

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All written comments should be addressed, faxed, or e-mailed to:

Corky Martinkovic
Air Quality Planning Section
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85007
FAX: (602) 771-2366
E-Mail: dam@ev.state.az.us

Copies of the proposal are available for review beginning Friday, October 24, 2003, at the following locations:

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1110 W. Washington Street
Phoenix, AZ 85007
Lorraine Cona, (602) 771-7217; 771-4389 (fax)

The proposed SIP is also available at ADEQ Web page for Regional Haze at www.adeq.state.az.us/environ/air/plan/haze.html

03659-October 24, 2003.

AFFIDAVIT OF PUBLICATION

THE ARIZONA REPUBLIC

STATE OF ARIZONA
COUNTY OF MARICOPA } SS.

Gloria Saldivar, being first duly sworn, upon oath deposes and says: That she is a legal advertising representative of the Arizona Business Gazette, a newspaper of general circulation in the county of Maricopa, State of Arizona, published at Phoenix, Arizona, by Phoenix Newspapers Inc., which also publishes The Arizona Republic, and that the copy hereto attached is a true copy of the advertisement published in the said paper on the dates as indicated.

The Arizona Republic

October 24, 2003

Gloria Saldivar

Sworn to before me this
28TH day of
October A.D. 2003

OFFICIAL SEAL
MARILYN GREENWOOD
NOTARY PUBLIC-ARIZONA
MARICOPA COUNTY
My Comm. Expires May 23, 2007

Marilyn Greenwood
Notary Public

ADEQ
AIR QUALITY DIVISION
03 NOV 21 AM 10:38

AFFIDAVIT/PROOF OF PUBLICATION

STATE OF ARIZONA

} ss.

County of Coconino

Bobbie Crosby being duly sworn, deposes and says:

That she is the legal clerk of the Arizona Daily Sun

a newspaper published at Flagstaff, Coconino County, Arizona; that the Legal 5054 a copy of which is hereunto attached, was first published in said newspaper in its issue dated the 24 day of October, 2003, and was published in each one issue of said newspaper for one consecutive day the last publication being in the issue dated the 24 day of October, 2003.

BCC

"OFFICIAL SEAL"
Joeyanne Jaimes
Notary Public-Arizona
Coconino County
My Commission Expires 9/2/2006

Subscribed and sworn to before me this 12th day of Nov, 2003

Joeyanne Jaimes
Notary Public

My Commission expires 9/2/2006

Legal No. 5054
ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY PUBLIC HEARING ON ARIZONA'S REGIONAL HAZE STATE IMPLEMENTATION PLAN

The Arizona Department of Environmental Quality (ADEQ) will hold a public hearing to receive comments on Arizona's proposed Regional Haze State Implementation Plan (SIP) to address visibility impairment of four of Arizona's Class 1 areas (e.g., national parks and wilderness areas) as part of the 16 class I areas on the Colorado Plateau. This SIP specifically addresses the requirements under the federal Regional Haze Rule, 40 CFR 51.309.

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Corky Martinkovic
Air Quality Planning Section
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85007
FAX: (602) 771-2366
E-Mail: dam@ev.state.az.us
Copies of the proposal

<u>Appendix A-18b. Hearing Agendas, Sign-in Sheets, Transcripts, and Certifications</u>

Public Hearing Agenda

Pursuant to [cite 40 CFR § 51.102 for SIP hearings and ARS § 49-425 for air quality rule hearings], notice is hereby given that the above referenced meeting is open to the public.

<u>Public Hearing</u>
Arizona Proposed Regional Haze State Implementation Plan
Monday, November 24, 2003, 5:00 p.m.
Arizona Department of Environmental Quality, Room 250
1110 W. Washington Street, Phoenix, Arizona

AGENDA

1. Welcome and Introductions
2. Purposes of the Oral Proceeding
3. Procedure for Making Public Comment
4. Brief Overview of the Arizona Proposed Regional Haze State Implementation Plan
5. Question and Answer Period
6. Oral Comment Period
7. Adjournment of Oral Proceeding

Order of agenda items is subject to change. For additional information regarding the meeting, please call Corky Martinkovic, ADEQ Air Quality Division, at (602) 771-2372 or 1-800-234-5677, Ext. 771-2372.

Persons with a disability may request a reasonable accommodation such as a sign language interpreter, by contacting Katie Huebner at (602) 771-4794 or 1-800-234-5677, Ext. 4794. Requests should be made as early as possible to allow sufficient time to make the arrangements for the accommodation. This document is available in alternative formats by contacting ADEQ TDD phone number at (602) 771-4829.

Arizona Department of Environmental Quality
Air Quality Division

Please Sign In

SUBJECT ______________________ DATE

	NAME	ORGANIZATION	PHONE	FAX	E-MAIL
1.	Gay Knights	Phoenix	no change		
2.	Jo Crumbaker	MCESD	"		
3.	Wayne Leipold	Phelps Dodge Miami	"		
4.	Duane Yantorno	ADWR	623-463-9942		
5.	Shawn Kendall	The Kendall Group Inc	480-513-3030		

6. [illegible] Pelle, ADEQ 602.771.2335

7. Chris Janick, SEP, 602 236 5574

8. Natacha Sc[illegible] 602 [illegible]

9. tammy meier

10. C Butler, ACC, legal Div. 602-542-6021

11. Nancy [illegible]ona, ADSA, (602) 771-2308

12. Liz Foster AZFB 480 635-3611

13. Amanda [illegible] [illegible] Group 480-491-3305

14. Jeff Schlegel SWEEP 520-797-4392

15. [illegible] 602-542-5555

16.	Bill Wiley	APS	william.wiley@APS.com
17.	JEANNETTE FISH	MCFB	mcfb@msn.com
18.	Cassius McChesney	APS	cassius.mcchesney@APS.com
19.	Russell Betn	GRIC	
20.	Tom Dorn		tom@dornpolicygroup.com
21.	Doug Fant		dsfant@gowebway.com
22.	Ginny Dickey	DEQ - Legisl. Office	771-2257
23.	Jim Buster	"	771-2219

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE MATTER OF ARIZONA'S PROPOSED REGIONAL HAZE STATE IMPLEMENTATION PLAN.) **PUBLIC HEARING**

At: Phoenix, Arizona

Date: November 24, 2003

Filed: DEC 10 2003

REPORTER'S TRANSCRIPT OF PROCEEDINGS

DISK ENCLOSED

ARIZONA REPORTING SERVICES, INC.
Court Reporting
Suite Three
2627 North Third Street
Phoenix, Arizona 85004-1103

By: MICHELE E. BALMER, RPR
Certified Court Reporter
Certificate No. 50489

Prepared for:

ADEQ

CERTIFIED COPY
(When in red)

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

IN THE MATTER OF ARIZONA'S PROPOSED REGIONAL HAZE STATE IMPLEMENTATION PLAN.) PUBLIC HEARING

At: Phoenix, Arizona

Date: November 24, 2003

Filed:

REPORTER'S TRANSCRIPT OF PROCEEDINGS

ARIZONA REPORTING SERVICES, INC.
Court Reporting
Suite Three
2627 North Third Street
Phoenix, Arizona 85004-1103

By: MICHELE E. BALMER, RPR
Certified Court Reporter
Certificate No. 50489

Prepared for:

ADEQ

BE IT REMEMBERED that the above-entitled and numbered matter came on regularly to be heard before the Arizona Department of Environmental Quality at 1110 West Washington Street, Room 250, Phoenix, Arizona, commencing at 5:00 p.m. on the 24th day of November, 2003.

BEFORE: CATHY O'CONNELL, HEARING OFFICER

APPEARANCES:

THERESA A. PELLA, Environmental Program Manager, Air Quality Planning Section on behalf of ADEQ;

IRA DOMSKY, Air Quality Division on behalf of ADEQ;

MICHELE E. BALMER
Certified Court Reporter
Certificate No. 50489

HEARING OFFICER O'CONNELL: Good evening, ladies and gentlemen. I now open this oral proceeding. The subject of this oral proceeding is the Arizona Proposed Regional Haze State Implementation Plan.

It is Monday, November 24, 2003 at 5:01 p.m. The location is room 250, Arizona Department of Environmental Quality, 1110 West Washington Street, Phoenix, Arizona.

My name is Cathy O'Connell, and I have been appointed by the Director of the Arizona Department of Environmental Quality to preside at this proceeding.

The purposes of this proceeding are to provide the public an opportunity, one, to hear about the substance of the proposed State Implementation Plan; two, to ask questions regarding the proposed plan; and three, to present oral argument, data and views regarding the proposed plan in the form of comments on the record.

Representing the Department are myself, Theresa Pella of the Air Quality Planning Section, and Ira Domsky of the Air Quality Division.

The procedure for making a public comment on the record is straightforward. If you wish to comment, you need to fill out a speaker slip, which is available at the sign-in table, and give it to me. Using speaker slips allows everyone an opportunity to be heard, and allows us to match the name on the official record with the comments.

You may also submit written comments to me today in person or by mail, e-mail, or fax, to Corky Martinkovic -- and I'm going to spell that for you. The first name is Corky, C-O-R-K-Y. The last name is Martinkovic, M-A-R-T-I-N-K-O-V-I-C -- by the end of the comment period.

The comment period ends at 5:00 p.m. on Wednesday, December 3, 2003. If mailed, e-mailed or faxed, written comments must be postmarked no later than December 3, 2003.

Submit your comments to Corky Martinkovic, Air Quality Planning Section, Arizona Department of Environmental Quality, 1110 West Washing Street, Phoenix, Arizona, 85007. The fax number is area code (602) 771-2366. Corky's e-mail address is -- and I'll spell this all out for you -- Martinkovic, M-A-R-T-I-N-K-O-V-I-C, period, Deborrah, D-E-B-O-R-R-A-H, @ev.state.az.us.

Her business cards are also at the table up there, and it includes her e-mail address if you did not get that.

Comments made during the formal comment period are required by law to be considered by the Department in the preparation of the final State Implementation Plan. This is done through the preparation of a responsiveness summary in which the Department responds in writing to written and oral comments made during the formal comment period.

The agenda for this hearing is simple. First, Theresa will present a brief overview of the proposed State Implementation Plan.

Next, I will conduct a question and answer period. The purpose of the question and answer period is to provide information that may help you in making comments on the State Implementation Plan.

Thirdly, I will conduct the oral comment period of this proceeding. At that time, I will begin to call speakers in the order in which I have received speaker slips.

Please be aware that any comments you make at today's hearing that you want the Department to formally consider must be given either in writing or on the record during the oral comment period of this proceeding.

At this time, Theresa Pella will give a brief overview of the proposed State Implementation Plan.

MS. PELLA: Thank you, Cathy.

Can you hear me in the back? Okay.

What I'm going to briefly do is kind of talk about the purpose of the plan in general, and then what each of the specific chapters are so folks who are not familiar with the process we've been going through kind of know what is in what chapter.

So if you're interested in making a comment on a particular subject, hopefully this will help direct you as to where to go look for that particular issues or items that you're looking for.

So I'm going to take about 15, 20 minutes, and I would appreciate it if you have questions, jot them down on the little handout slips that you have, and hold them until the question/answer session so we can kind of keep the flow moving here.

But anyway, to get us started, this is -- as was indicated, this is the proposed State Implementation Plan for Arizona's Regional Haze SIP developed under 40 CFR Section 309.

And this SIP has a specific purpose, and that specific purpose is to address -- is to address things that the Grand Canyon Visibility Transport Commission, which was formed as part of the Clean Air Act Section 169(B), developed as recommendations and submitted to EPA back in 1996.

And as a result of that, EPA came out with a regional haze rule, which was basically a two-phase regional haze rule, with Phase One being Section 309. And that section is basically taking a look at the Grand Canyon Visibility Transport Commission's 1996 report, and giving a status on what the state and what has happened at the regional level since 1996.

And so that's kind of what this plan really is. And so the initial slide said that there were -- in addition to Arizona, there's four other states who are doing SIPs under Section 309. Those four states are Utah, Wyoming, New Mexico, and Oregon.

In addition, there is a local air quality control district in New Mexico, Bernalillo County, which has statutory authority in that state to do a regional haze SIP, and they've also done a regional haze SIP. So there's six of these plans that are out there, and we're actually the last state to do our public hearing. All of the others have gone through theirs.

So what is in our plan? The first part of it, the first three chapters, are kind of just background. Mostly background information. It does state in the Executive Summary that this plan is only for Arizona's four Grand Canyon plateau areas, and only for areas that are under the State's jurisdiction. We do not have jurisdiction to do controls or regulations on tribal lands, so nothing in this plan relates to tribal lands. It also includes a description of those four Class I areas and lists the other -- all of the 16 ones.

The four areas that we're talking about in this plan are, of course, the Grand Canyon, Mount Baldy, Sycamore Canyon Wilderness and -- I just lost it. The fourth one is the Petrified Forest. Thank you.

So after the introductory chapters, Chapter 4 is kind of an initial technical chapter. What we tried to do in 4 was take the technical science, the science of regional haze, and put it into layman terms so the average reader could understand what regional haze is, what are the types of sources that emit the pollutants that form regional haze, and kind of as background information.

So, of course, your types of sources are similar to the types of sources that we need to address in this plan via the Transport Commission's Report are stationary sources, most notably SO2 from large stationary sources. We needed to take a look at mobile sources. We needed to take a look at fire. We needed to take a look at road dust, and then we also needed to look at pollution prevention. So those are the five main categories that this particular plan addresses.

And pollutants that cause haze, that contribute to haze, some that we're all very familiar with as criteria pollutants, most notably particulates, both fine particulates and course particulates. Again, S02, NOX, and ammonia.

So we start getting into -- Chapter 5 starts moving into the specific measures and kind of what we're doing. Actually, Chapter 5 is kind of a cleanup. For us it's a cleanup chapter to remove a Federal Implementation Plan that's been on the books in Arizona since the mid-1980s.

This, again, goes back to a requirement of 169 of the Clean Air Act that required states to actually do a visibility state implementation plan and submit that to EPA in the early '80s. Arizona, along with 30 some other states, failed to submit those SIPs, and so ultimately we all got FIP'd. We got issued with Federal Implementation Plans.

This particular chapter addresses the main component of what Arizona needs to do to request from EPA the removal of that particular FIP. So it's kind of taking away a long-term FIP there.

And it's connected to regional haze, because the term -- and it actually should be reasonably. That should be a "Y," not an "E" -- Reasonably Attributable Visibility Impairment is a situation where a federal land manager who has control over a federal area, a park or a forest, can actually certify that there is visibility impairment at that park or forest, or whatever national land.

And then that federal land manager notifies the agency that has jurisdiction over that, and the agency then has to set into motion some plan to do an analysis of, number one, is there really some impairment; number two, if there is impairment, can it be attributed to a single source or small group of sources; and number three, if that is correct, then what is going to be done to resolve that impairment or improve the visibility for that particular area.

So DEQ started on a stakeholder process 2000 -- a few years ago to actually develop a state rule to establish a process on what would happen if a federal land manager does certify impairment at a particular Class I area. And what this rule does is actually promulgates those specific requirements. And it has gone through the rulemaking process. We finished the stakeholder process. It's gone before the Governor's Regulatory Review Counsel. In September I think it was approved by GRRC, and so right now we're waiting for the notice of final rulemaking to be published in the Arizona Administrative Register.

And we're anticipating that that publish date -- or it's actually been published. It's been published. We're doing -- under a new law, a rule becomes effective 60 days after it's been published in the register. So it has been published in the register 60 days before December 2nd. So we've got a rule that will be a final rule, and so we're going to include that final version in the plan that goes to EPA.

So one of the other things that the federal rule requires and required the Grand Canyon Commission to do is to take a look at a clean air corridor. And the Commission itself had actually identified a clean air -- one clean air corridor on the plateau. And this is a map of what that corridor looks like.

And you'll see that it actually stops at the Northern Arizona border. So no part of Arizona is included in that clean air corridor. So as it relates to what we needed to put in our regional haze SIP, it was pretty much minimal. We could put in just the regional analysis that explained that there is one clear air corridor, but none of that part is in the state of Arizona. So that's what Chapter 6 pretty much contains.

Chapter 7 starts getting into one of the source categories of specifics that we needed to address, and that is the stationary sources. And what that chapter includes in it is specific for S02. It talks about the showing of the 13 percent S02 reduction that came from stationary sources in the region from 1990 to the 2000 time frame.

It also talks about -- it includes a summary of NOX and PM stationary source report that's recently been completed by the WRAP, which is the Western Regional Air Partnership. And it includes a commitment from the state to continue to further study NOX and PM as we move forward in the planning process.

And it also includes a trading commitment from Arizona to complete a trading rule program. And Chapter 8 actually gets into more details about that particular trading program.

And what's in the proposed SIP is a regional -- is the model rule that was developed by a regional group of state folks and EPA folks. And what we're doing now is we're actually hoping to have an Arizona specific trading rule to include with the final SIP when it goes to EPA. The model rule was used as a placeholder. EPA would like us to include our own state rule as much as possible. So we've been working with the stationary source work group that was formed to develop these particular two chapters, had been involved in review of the model rule, the regional model trading rule, and so they're familiar with what that says. And we'll be probably going back to them for a final read through before we finish that particular process for Arizona's rule.

So it also includes the bottom line there, geographical enhancement. One of the requirements is that you need to look at beyond kind of the region where you're at. And if you identify sources that may be contributing to problems outside of a particular Class I area, then you need to look at potential control strategies for those sources.

So this particular part of this chapter actually goes back to -- points a finger back to the Chapter 5 which is the Reasonably Attributable Visibility Impairment chapter. So we figure we can use what we call the RAVI rule to help us comply with any requirements under the geographical enhancement portion of the EPA rule.

Chapter 9 is mobile sources. And mobile sources was one of those subjects that was of great interest to our stakeholders and our work group. And that was one of those issues that kind of midstream EPA came out with a proposed rule which ultimately, if it goes final, will kind of make this chapter a lot easier than what it reads now.

What you see in the proposed SIP, we've got two versions of that chapter. Version number one is what will be in the final SIP if EPA's proposed rule to basically -- decision that says that mobile sources were not a significant category for the 309 SIP, and, therefore, that's what we will put in there is and give the date of EPA's final rule.

The other version that's in there is a version that says if the EPA rule does not go final before the Arizona SIP gets submitted to EPA, we're going to include the version in there that commits Arizona to look at mobile sources and potential necessary controls if the emissions trend for mobile sources does not continue to go down. Right now there is a downward trend for all mobile sources both on road and off road if you group them together.

And so we've got a commitment in there to look at that if EPA's rule that's pending before them doesn't get finalized. So that's why you see two versions in there.

Chapter 10 is where we address the rule

requirements for fire, and that includes -- basically there were a lot of new things that we had to look at for our prescribed fire program that we've got and we've had in place for several, several years.

But we looked at ways on how we could enhance that program by revising our rules and including some specific emission reduction techniques, and also committing to participating in the emissions tracking system that's being developed at the regional level to better track fire emissions. It's one of the great unknowns in the world of haze right now, and so this is one way that we're trying to get a handle on what occurs in Arizona and also report that at the federal level.

So the crux of this chapter is the rule revisions that we're making not only to our open burning rules, but also to our range management fire and range management rules. And those particular set of rules have gone to the Governor's Arizona Regulatory Review Counsel.

Again, these rule revisions were developed by our stakeholder work group, which we had a lot of great support. And so we're getting to the final stages of that.

So the rules themselves are scheduled to hopefully be on the GRRC's calendar for action in their January meeting. I think it's January 6th is their date. And following that, assuming that the GRRC approves those rules, they'll go final, get published. Or they'll get published in the Arizona Administrative Register, and then be final 60 days after that. So we're probably looking at an effective date for those rule revisions to be about end of March, first part of April.

Chapter 11 in the SIP is the road dust issue. And this was one of those things that at the regional level as well as the state level it was rather difficult to get a handle on road dust. There's just a whole lot of technical issues out there and just work that needs to be done that we're trying to figure out how to do in order to adequately capture road dust.

And this is the -- the in-and-near approach refers to the fact that road dust is one of those things that because it's mostly large particulates, you will have your emissions most closely to individual Class I areas. You don't get a lot of transport from large, large particles. And so there is a WRAP group, the in-and-near group, that has been looking at how to better get a handle on road dust.

So this chapter, the bottom line is that we commit to continue to working and studying that particular issue along with other states and interested stakeholders.

The pollution prevention chapter, Chapter 12, was another one that was a lively stakeholder process that we went through as this chapter was developed by the stakeholders. What's in there now is the list of those renewable energy and energy efficient programs that have been identified as being implemented now within the state, throughout the state, or also programs that have funding, they are funded, and have some start date on them.

The primary component, the standard that we looked at and the work group used was the Environmental Portfolio Standard which is already being managed by the Arizona Corporate Commission.

There were some nonconsensus items that this particular work group came up with that were eventually submitted up to the ADEQ Director Steve Owens for further consideration.

And we just heard Director Owens has reviewed those recommendations. And because he doesn't want to slow up the SIP process, you know, he's not suggesting or recommending or directing the Air Quality Division to change what's in the proposed SIP at this point in time. So if there are questions or there's specific comments that anybody wants to make related to what's in the proposed SIP, you're encouraged to make them during the public comment period.

The remaining chapters is other GCVTC recommendations. In addition to those five main categories, there were several other recommendations that were included in that 1996 report. And what this chapter is is just kind of a list of what those others are and a status check on the various measures that were not addressed elsewhere in the SIP.

Projection of Visibility Improvement. Again, this one is kind of one of the technical chapters. One of the things that we need to do is to actually show for each of those Class I areas what is the projected visibility improvement between the base year of 1996 and the projected year for the planning period, which is out to 2018. So this chapter includes a table and lists all of the 16 areas, and how much the visibility is expected to improve based upon the control measures that had been identified earlier in the SIPs.

15 and 16, these are kind of just catch-all chapters. Because this is a regional haze plan and we put the SIPs together using a regional process as opposed to kind of going our own route as a state, this

chapter contains a commitment for Arizona to continue to work with other states and other stakeholders via the WRAP process. And so it also, again, acknowledges that the SIP is not applicable to tribes per the Clean Air Act and the regional haze rule and others. The tribal authority rule has the option of submitting their own regional haze SIPs.

The Chapter 16 is a commitment to periodic review. This particular SIP goes to EPA the end of 2003. We have to take a look and review in 2008. We also have to review it in 2013. And then we have to do a final review in 2018.

So I guess the message here is, you know, this is not a plan that we submit to EPA and falls in a black hole. We have to continue to pay attention to what's in it and periodically go back and check on the measures that we include in there and give a status check on whether or not they're working, how they're working, should we do more type stuff. So that will be in 2008 is the first one.

This particular chapter is just a commitment that Arizona will submit a second or a follow-up SIP for all of the other Class I areas that we've got in this state. So this map shows you the four Class I areas that this December SIP is being submitted to EPA for. Then the next stage -- one of the next stages that we'll be working on is putting together -- we have to do a regional haze SIP for those other eight particular areas. And we will be working with stakeholders starting next year on putting together plans for those particular areas.

And this just gives you -- if you haven't found them yet, or you haven't seen the technical supporting document in the appendices or the two big binders that are over there. So we didn't -- we only brought one copy. So if you're interested, you can go over there. But this just gives you the websites of information on where you can find additional documents.

And a reminder that the public comment period closes at 5:00 p.m. on December 3. Comments go to Corky Martinkovic as Cathy mentioned. And that's it.

So thank you very much for listening.

HEARING OFFICER O'CONNELL: Well, that concludes the explanation period of this proceeding on the proposed State Implementation Plan.

Are there any questions before we move to the oral comment period?

Sir, could you give us your name for the court reporter.

MR. SCHLEGEL: Sure. Jeff Schlegel.

S-C-H-L-E-G-E-L.

On the slide on Chapter 7, stationary sources, the second bullet, what caused the -- what largely caused the 13 percent S02 reduction during that decade?

MS. PELLA: Ira, can you fill that in, please?

MR. DOMSKY: I would say most of it related to the cleanup of the smelters to get into compliance with sulphur dioxide national ambient air quality standard. There are other improvements that were made at other sulphur dioxide sources throughout the West in addition to that. And Navajo generating station, that was -- scrubbed it 90 percent starting in October 1999 for all of its units.

MS. ORMOND: Amanda Ormond. O-R-M-O-N-D.

You talked about the recommendations that were afforded by the pollution prevention work group. There were four specific recommendations.

Can you comment on each recommendation and what exactly was the outcome of each recommendation? I can tell you what they are if you like. I'm just curious. Because to say, well, we're not doing anything in this SIP, I don't know what that means. I don't know. These were very specific recommendations.

MS. PELLA: Right. Okay. If you wouldn't mind, Amanda, because I don't have them in front of me right now.

MS. ORMOND: The first one was to advocate for an energy policy where it has a direct effect on regional haze. And the example was given at the state legislature at the Corporation Commission or with the Governor's office for DEQ to provide technical information on policies that would affect either positively or negatively regional haze.

So the question is is the Department not going to do that function between now and, I guess, the first reporting period in 2008?

MR. DOMSKY: Can I help you?

MS. PELLA: You sure can.

MR. DOMSKY: Okay. The status right now is that the Director is reviewing the recommendations. And he has not made a decision on what specifically we will do, including what changes he would like to see in the regional haze SIP.

So we will be discussing that with him over the next two to three weeks in order to weigh exactly what it was -- what it will be that he thinks ought to be in the regional haze SIP. And then if the recommendations are not something that he believes should be in the regional haze SIP, what else the Department might do to implement portions or all of the specific recommendations.

And that's the status. That's all we can say at this point.

MS. ORMOND: And that was my concern was that these were submitted in July, and we've never found out what happened with them.

So the answer is that they're still under consideration; is that right?

MR. DOMSKY: That's the answer. Yes.

MS. ORMOND: Will there be an opportunity, since the public comment period ends December 3rd which is next Wednesday, is this -- whatever decisions are made by the Department then will go into the plan and then there's no opportunity for public comment after that? I'm just trying to get an idea of process.

MR. DOMSKY: That would be correct. We have to respond to comments that we receive, and we're authorized to make changes to the SIP in response to those comments. Just because the plan is going to be submitted by December 31st of this year, this is a process that really takes us through the year 2064.

And even for this first planning period that ends in 2018, there will ample opportunity to make amendments to the plan, to add additional policies, statutes, whatever is appropriate that will shore up the regional haze program that the State will be implementing.

MS. ORMOND: Okay.

MS. KNIGHT: A follow-up. This is Gaye Knight, G-A-Y-E, K-N-I-G-H-T, with the City of Phoenix.

Just a clarification then. When I read the plan, I won't see those four recommendations because they have not been included in the plan?

MR. DOMSKY: They have not been included in this draft plan.

MS. KNIGHT: But there's a subcommittee report someplace?

MR. DOMSKY: Right.

MS. ORMOND: They're not on the web. They're nowhere.

MS. PELLA: Aren't they under the work group meetings? Yeah.

MS. ORMOND: I don't think so. Okay. Yeah.

MS. PELLA: I thought those --

MR. DOMSKY: They should have been posted.

MS. PELLA: Yeah.

MS. ORMOND: And so just a follow-up on that follow-up, one of the questions I have, too, is that how does an average citizen or a person monitor, especially in the pollution prevention section, that

DEQ is doing some things so when it comes to 2018 they can show progress?

What I heard you say was that there will be potentially additions and changes to the plan. My understanding I thought was that you wouldn't really report on the plan until 2008. You're saying that there is possible changes between now and 2008 with updates, revisions, all kinds of different things possible.

MR. DOMSKY: We can reopen the SIP at any time that it's appropriate, whether we get instructions from the Governor, from the legislature, if there are other things that -- changes that EPA requires us to put in.

We have to in 2008 do a full review and what we call a true-up to the State Implementation Plan. But that doesn't bar us from taking additional actions in the intervening years.

MS. ORMOND: Okay. Thank you.

HEARING OFFICER O'CONNELL: Any other questions?

Gaye.

MS. KNIGHT: Gaye Knight with the City of Phoenix again. Just I wanted to see her four recommendations. How does the public see her four recommendations? She said that the subcommittee made some --

MS. PELLA: I will verify, but I think they're up on the website under the work groups. They should be under the pollution prevention work group section of the regional haze SIP. I'm pretty sure they were. I'll verify that, and if they're not we'll get them loaded. But these are the papers that were presented to the SAC, to the Stakeholders Advisory Committee. But they should be up there.

MS. KNIGHT: Okay. Thank you.

HEARING OFFICER O'CONNELL: Any other questions before we move on?

(No response.)

HEARING OFFICER O'CONNELL: All right. Then this concludes the question and answer period of this proceeding.

I'm going to now open the proceeding for oral comments. And I'm going to call speakers in the order in which I have received speaker slips.

I've only received two speaker slips. Speaker slips are on the table right in the front. If you wish to speak, I need a speaker slip.

The first speaker is Wayne Leipold. L-E-I-P-O-L-D. The floor is yours, sir.

MR. LEIPOLD: Madam Hearing Officer, I'm going to be brief. I have written comments that I will submit to you.

HEARING OFFICER O'CONNELL: Thank you, sir.

MR. LEIPOLD: My name is Wayne Leipold. I'm Chief Environmental Engineer at Phelps Dodge Miami facility which -- and there's a copper smelter located at that facility.

My comments are being offered in support of the Regional Haze State Implementation Plan for the State of Arizona that ADEQ is proposing to submit. Most of my comments relate specifically to the smelter set-aside portion. And one of my comments answers a question that was asked during the question and answer period, so I would just like to read that part.

To show the commitment from these two sectors, the two sectors being the utility sector, the coal-fired utility sector and the smelting sector, I would like to review their emissions for the years 1990 and 2000. In 1990, the smelters and coal-fired power plants emitted approximately 611,000 tons of sulphur dioxide, or approximately 74 percent of the 829,000 tons emitted by all of the sources that emitted at least 100 tons in the nine state region.

In the year 2000, the total emissions had been reduced to 622,000 tons, or a 25 percent reduction, with 112,000 tons of that coming from the copper smelters. Some of them were due to the temporary cessation of two smelters. But even without -- but even with them taken out, the reduction would have been in the order of 70,000 tons. The electric utility sector reduction was approximately 54,000 tons.

HEARING OFFICER O'CONNELL: Thank you.

Second speaker, Mr. Schlegel. Jeff Schlegel. Did I pronounce it correctly?

MR. SCHLEGEL: Yes, you did. Thank you. This is Jeff Schlegel from the Southwest Energy Efficiency Project.

First I would like to thank ADEQ for preparing the SIP and note our support for the SIP. I want to speak to one recommendation that was already discussed from the pollution prevention work group, and that was recommendation number 4.

A group of --- a majority group of the work groups supported a nonconsensus recommendation that ADEQ should increase its support to preserve and expand energy conservation and energy efficiency efforts. There were two parts to this. One was to preserve and expand existing efforts. The other part was to expand energy efficiency efforts based on new activities, new efforts.

Section 309 noted that the SIP must provide for programs to preserve and expand energy conservation efforts, but it stopped there. What was unclear was that the section did not say existing, planned, future, or other words that may have made that section clearer. And it did not state a goal explicitly for energy efficiency as it did for renewables. The Grand Canyon Visibility Transport Commission had set a goal for renewables, the 20 percent goal, but it did not set a similar goal for energy efficiency.

The work group discussed this at some length, as work group members will remember. And the majority of the group felt that simply listing existing programs is not enough, and it does not meet the requirement of preserving and expanding energy efficiency. Therefore, that group went forward and made some recommendations, again, majority recommendations, that would preserve and expand energy conservation, both existing efforts and additional efforts.

The reason that the group made this recommendation was that Arizona is a high load growth state, meaning that it's a state that has both population growth and electricity usage growth. And as all of us know, the more electricity is used, the more emissions there will be, all else being equal. And we recommended a significant portfolio of energy efficiency efforts that we recommended ADEQ support.

The bottom line is that now -- now there are opportunities before the Arizona Corporation Commission for ADEQ to actually begin to take action. The Arizona Corporation Commission is reviewing energy efficiency programs and renewables programs. And the recommendations that we made to ADEQ could be implemented today if ADEQ would take such action.

And we again reiterate our recommendation number 4, and encourage ADEQ to increase its support for energy efficiency efforts. Thank you.

HEARING OFFICER O'CONNELL: Thank you, sir. The third speaker slip, Amanda Ormond.

MS. ORMOND: As Jeff Schlegel mentioned, the majority of the pollution prevention work group members came up with four recommendations which heretofore have not been addressed by the Arizona Department of Environmental Quality related to the State Implementation Plan.

Number one was to advocate for energy policies which have a direct effect on reducing regional haze. And this is at the Corporation Commission, at the legislature, or the Governor's office.

The second one was that ADEQ should directly support the Environmental Portfolio Standard, because that was identified by the group as the number one thing that would address -- or the number one policy that would address the regional haze 10/20 goal.

The third one is that the Department of Environmental Quality should quantify the impacts and benefits of energy efficiency and renewable energy in compliance. This is especially important given the fact that in 2008 the State is going to be responsible for coming back and showing progress in energy efficiency and renewable energy.

Without having quantified what are the reductions and costs and benefit of doing this program, the Department is going to have a very difficult time in coming back and saying what progress has been achieved. Because if no baseline information is collected, they'll have nothing to benchmark off of.

So I would encourage the Department to look carefully at those recommendations and incorporate as they see fit those recommendations into this current State Implementation Plan which is to be submitted in 2003.

I would also like to say that I believe that the plan is incomplete in the fact that it proposes no future actions, nor any kind of strategies that the

State will make between now and 2008 to achieve the 10/20 goal. There is not anything beyond a listing of programs, as Mr. Schlegel stated.

Also, I would like to caution the Department. Because in the energy efficiency section, there is a comprehensive listing of programs that are operated by the Arizona Department of Commerce and Energy office. That office does not have secure funding through 2008. In fact, they're funding may only go through the next couple of years.

If the State of Arizona relies upon those energy efficiency programs in this particular SIP, then when it comes to 2008 either you're going to need to report on what happened to those. And I would recommend that you only include those programs that you have a reasonable certainty that will be around when 2008 comes around.

Thank you.

HEARING OFFICER O'CONNELL: Thank you. Speaker number four, Douglas V. Fant. F-A-N-T. Mr. Fant.

MR. FANT: Yes, ma'am. Thank you. Speaking on behalf of myself.

I would like to talk about some renewables issues that might be incorporated into the draft SIP revisions. You're probably familiar with the effort by the Western Governor's Association to create a regional renewable energy credit trading system. It's moving into high gear, and it's slated for completion and -- completion in early 2005, implementation by June 2005.

And what it will allow, of course, are renewable energy credits to trade regionally in the Western -- probably in the Western Grid. It may include some of the what I call eastern interconnect territories on the far east side of the states like Montana, Colorado. That's an issue to be handled in the future.

But the Western Governor's Association -- and this program will probably end up at the Western Electricity Coordinating Council, WECC, will set up a system to track, verify, and authorize RECs on a regional basis.

It might be worthwhile, even though it's late in the game. All of the programs in the SIP, of course, are nonbinding in terms of renewable energy currently, but at least incorporating this thought into the final SIP that this effort is underway.

Along those lines it might be worthwhile, and it might be an adjunct or a product that grows from the SIP, it may be worthwhile for the Arizona Department of Environmental Quality to quantify the values of the offsets in these RECs for haze for particulate matter, with potential credits to trade for on a regional basis in terms of satisfying the regional haze SIP requirements. And that might be a way to encourage renewable energy, to allow actual offsets to qualify under the SIP.

On December 15, here in about two or three weeks, the Western Governor's Association is sponsoring a series of meeting on the first steps on implementing the WREGIS. That's the actual physical tracking system for the regional program.

I might encourage the Arizona Department of Environmental Quality to come to the meetings and try and get individuals on these various committees so they potentially can push the regional program in the direction which would be positive for the State of Arizona in terms of satisfying its SIP requirements for regional haze or, of course, NOX, S02, NOX, SOX, C02, if that becomes an issue in the future. It's tradeable currently already on a commercial basis, and it may have an enforcement value too.

So I just wanted to raise those points and suggest that perhaps a reference to the WGA's regional REC program might be incorporated into Chapter 12, or a least the appendix. I think it's A-12 in the appendix for Chapter 12 in the SIP. Just a thought.

HEARING OFFICER O'CONNELL: Thank you.

Speaker number five, Gaye Knight. The floor is yours.

MS. KNIGHT: Gaye Knight with the City of Phoenix again.

On page 99 of the draft plan, it mentions that the City of Phoenix Park & Ride Photovoltaic project is in the planning process or in a planning stage.

I've had recent discussions with our legal staff, and it's very important that anything that is included in the SIP must be approved by our counsel in order for it to be acceptable, even if it's something that's well underway.

And so we can't legally include anything that a city or any government agency has done unless they pass a resolution recognizing -- giving you the blessing to say, yes, you can mention that in your SIP.

Even though the language on page 99 is somewhat tempered by the text above it, I don't believe our counsel -- no one contacted me. I don't believe we had a representative on that P-2 subcommittee. And so -- and I see other things from, like, the City of Scottsdale.

I just wondered if all of those cities where you mentioned some project either existing or planned for the future have to be approved and be accompanied by a resolution. So that needs some further legal review and we can discuss it in additional detail later.

HEARING OFFICER O'CONNELL: Thank you. Any other speakers wishing to make formal comments on the record?

(No response.)

HEARING OFFICER O'CONNELL: Therefore, I conclude the oral comment period of this proceeding.

I encourage everyone to submit written comments on the proposed State Implementation Plan. Your participation is an essential part of the process.

MR. FANT: Excuse me. I'm sorry. I didn't mean to interrupt. When are the written comments due?

HEARING OFFICER O'CONNELL: I was just coming to that.

Again, you may submit written comments by mail, e-mail or fax to Corky Martinkovic. And her business card is on the table here. That will give you her correct address and e-mail.

The end of the comment period is 5:00 p.m., Wednesday, December, 3, 2003. Please make sure your comments if mailed, e-mailed, or faxed are postmarked no later than December 3, 2003.

I want to thank you all for attending this hearing. The time is now 5:50. I now close this oral proceeding.

(The Public Hearing concluded at 5:50 p.m.)

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, MICHELE E. BALMER, Certified Court Reporter No. 50489 for the State of Arizona, do hereby certify that the foregoing printed pages constitute a full, true and accurate transcript of the proceedings had in the foregoing matter, all done to the best of my skill and ability.

WITNESS my hand this 8th day of December, 2003.

MICHELE E. BALMER
Certified Court Reporter
Certificate No. 50489

Arizona Department of Environmental Quality
Air Quality Division

Public Hearing Presiding Officer Certification

I, Cathy O'Connell, the designated Presiding Officer, do hereby certify that the public hearing held by the Arizona Department of Environmental Quality was conducted on November 24, 2003, at Arizona Department of Environmental Quality, Phoenix, Arizona, in accordance with public notice requirements by publication in Arizona Administrative Register and other locations beginning October 24, 2003. Furthermore, I do hereby certify that the public hearing was recorded from the opening of the public record through concluding remarks and adjournment, and the transcript provided contains a full, true, and correct record of the above-referenced public hearing.

Dated this 9th day of December 2003.

Cathy O'Connell
Cathy O'Connell

State of Arizona)
) ss.
County of Maricopa)

Subscribed and sworn to before me by Cathy O'Connell this 9th day of December 2003

DENEE N. WOODARD
Notary Public - Arizona
Maricopa County
Expires 12/30/05

Denee N. Woodard

Notary Public

My commission expires: 12/30/05

ADEQ
Arizona Department
of Environmental Quality

Public Hearing Agenda

Pursuant to [cite 40 CFR § 51.102 for SIP hearings and ARS § 49-425 for air quality rule hearings], notice is hereby given that the above referenced meeting is open to the public.

<u>Public Hearing</u>
Arizona Proposed Regional Haze State Implementation Plan
Monday, November 24, 2003, 4:30 p.m.
Program Room, Coconino Library
300 West Aspen Avenue, Flagstaff, Arizona

AGENDA

1. Welcome and Introductions
2. Purposes of the Oral Proceeding
3. Procedure for Making Public Comment
4. Brief Overview of the Arizona Proposed Regional Haze State Implementation Plan
5. Question and Answer Period
6. Oral Comment Period
7. Adjournment of Oral Proceeding

Order of agenda items is subject to change. For additional information regarding the meeting, please call Corky Martinkovic, ADEQ Air Quality Division, at (602) 771-2372 or 1-800-234-5677, Ext. 771-2372.

Persons with a disability may request a reasonable accommodation such as a sign language interpreter, by contacting Katie Huebner at (602) 771-4794 or 1-800-234-5677, Ext. 4794. Requests should be made as early as possible to allow sufficient time to make the arrangements for the accommodation. This document is available in alternative formats by contacting ADEQ TDD phone number at (602) 771-4829.

Arizona Department of Environmental Quality
Air Quality Division

Please Sign In

SUBJECT Regional Haze Public Hearing - Flagstaff DATE 11-24-03

	NAME	ORGANIZATION	PHONE	FAX	E-MAIL
1.	Doug Lawrenny	APS	928-250-1394	928-288-1454	DLawrenny@APSC.com
2.	Carl Bowman	NPS	928.638.7817	928.638.7755	carl_bowman@nps.gov
3.					
4.					
5.					

X3043

TRANSCRIPT OF PUBLIC HEARING

ARIZONA'S REGIONAL HAZE STATE IMPLEMENTATION PLAN

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Flagstaff, Arizona

November 24, 2003

4:36 p.m.

ORIGINAL

NORTHERN ARIZONA REPORTERS
413 NORTH SAN FRANCISCO, SUITE 2
FLAGSTAFF, ARIZONA 86001
TELEPHONE: (928) 774-0442
1-800-544-4313
FAX: (928) 779-3624

REPORTED BY:
JOHN A. DALSIN, RPR
AZ CCR NO. 50270

TRANSCRIPT OF PUBLIC HEARING

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JOHN A. DALSIN, RPR
AZ CCR NO. 50270

NORTHERN ARIZONA REPORTERS

2

Transcript of public meeting on Arizona's Regional Haze State Implementation Plan, held by the Arizona Department of Environmental Quality, on Monday, November 24, 2003, in the Jan Romero Stevens Community Room of the Flagstaff City - Coconino County Public Library, 300 West Aspen Street, Flagstaff, Arizona, called to order at 4:36 p.m., reported by John A. Dalsin, a Registered Professional Reporter and a Certified Court Reporter in and for the State of Arizona.

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ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY PERSONNEL:

ERIC C. MASSEY, Environmental Program Manager, Air Quality Division; Meeting Chairperson

DEBORRAH "CORKY" MARTINKOVIC, Environmental Program Specialist, Air Quality Division

I N D E X

P R O C E E D I N G S

CHAIRPERSON MASSEY: I now open this oral proceeding.

WELCOME AND INTRODUCTIONS

CHAIRPERSON MASSEY: Good afternoon, and thank you for coming.

This oral proceeding is on the Arizona Proposed Regional Haze State Implementation Plan. This is a proposed plan to direct the State of Arizona.

It is now Monday, November 24th, 2003, 4:36 p.m. The location is Coconino Library, 300 West

Aspen Avenue, Flagstaff, Arizona. My name is Eric Massey, and I have been appointed by the Director of the Arizona Department of Environmental Quality to preside at this hearing.

PURPOSES OF THE ORAL PROCEEDING

CHAIRPERSON MASSEY: The purposes of this proceeding are to provide the public an opportunity to do three things today.

The first is to hear about the substance of the proposed State Implementation Plan; second is to ask questions regarding the proposed plan; and the third is to present oral arguments, data and views regarding the proposed plan in the form of comments on the record.

Representing the Department are myself and Corky Martinkovic of the Air Quality Planning Section.

PROCEDURE FOR MAKING PUBLIC COMMENTS

CHAIRPERSON MASSEY: The procedure for making a public comment on the record is straightforward. If you wish to comment, you need to fill out a speaker slip, which are available at the sign-in table, and give it to me. Using speaker slips allows everyone an opportunity to be heard and allows us to match the name on the official record with the comments.

You may also want to submit written comments to me today in person; or by mail, e-mail or fax, to Corky Martinkovic by the end of the comment period. The end of the comment period is 5:00 o'clock on Wednesday, December 3rd, 2003. And that is 5:00 o'clock p.m. If mailed, e-mailed or faxed, written comments must be "postmarked" no later than December 3rd of 2003.

Submit your written comments to: Corky Martinkovic, Air Quality Planning Section, Arizona Department of Environmental Quality, 1110 West Washington street, Phoenix, Arizona, 85007, or by fax at 602 - 771-2366, or by e-mail at martinkovic. deborrah@ev.state.az.us

For additional information, I would recommend that you pick up one of Corky's business cards in the back.

Comments made during the formal comment period are required by law to be considered by the Department in the preparation of the final State Implementation Plan. This is done through the preparation of a responsiveness summary in which the Department responds in writing to written and oral comments made during the formal comment period.

The agenda for this is simple. First, we

will present a brief overview of the proposed State Implementation Plan.

Next, I will conduct a question-and-answer period. The purpose of the question-and-answer period is to provide information that may help you in making comments on the proposed State Implementation Plan.

Third, I will conduct the oral comment period. At that time I will begin to call speakers in the order that I have received speaker slips.

Please be aware that any comments you make at today's hearing that you want the Department to formally consider must given either in writing or on the record during the oral comment period of this proceeding.

At this time Corky Martinkovic will give a brief overview of the proposed State Implementation Plan.

BRIEF OVERVIEW OF THE ARIZONA PROPOSED RHSIP

PROGRAM SPECIALIST MARTINKOVIC: For the overview of the Arizona Proposed State Implementation Plan, today what I am going do is take you through basically what is in the State's Implementation Plan chapter by chapter.

The purpose of the State Implementation

Plan, the purpose of "the Plan", is to address the Clean Air Act Section 169, the National Visibility Goal requirements.

Basically, the National Visibility Goal asks for all states to protect visibility in the national parks and wilderness areas and remedy any existing visibility impairments and prevent any future impairment.

It is also to fulfill the requirements of the federal Regional Haze Rule.

Arizona and four other western states are doing a plan under Section 309 of the Regional Haze Rule.

And for your information, the four other states are Utah, New Mexico, Wyoming and Oregon.

The Executive Summary & Background, Chapters 1 through 3.

The Executive Summary, which is a normal stage of the Implementation Plan, provides a general overview of the State Implementation Plan, or SIP for short.

Chapter 1 gives the background and regulatory history.

Chapter 2 gives the physical, demographic and economic descriptions of the state of Arizona.

And Chapter 3 gives descriptions of the four Class I areas and a list of the 16 Colorado Plateau areas.

The four Class I areas in this particular system we are dealing with are: the Grand Canyon National Park; Mount Baldy; Petrified Forest; and Sycamore Canyon.

Chapter 4 is basically what we call our "technical chapter". It deals with "What Is Haze" and discusses what pollutants contribute and how they contribute to regional haze; what types of sources emit those pollutants; what visibility is like at the 16 Grand Canyon Visibility Transport Commission Class I areas; and then the summary of Arizona's visibility monitoring strategy.

Chapter 5 we call the "RAVI chapter". It stands for Reasonable Attributable Visibility Impairment. Visibility in specific stationary sources. "Stationary sources" are utilities, or smelters or other sources that are permanently located in specific areas and do not move around.

This chapter also contains commitments to fulfill Sections 51.302 through 307 of the Regional Haze Rules to remove the Federal Implementation Plan, which now exists in the state of Arizona.

It also contains Arizona's RAVI rule, which will be effective December 2nd, '03, that establishes the procedures to determine controls should a stationary source be certified and found attributable.

Chapter 6 deals with "Clean Air Corridor".

This chapter contains a summary of the Grand Canyon Visibility Transport Commission's conclusion that there is one clean air corridor on the Colorado Plateau. And Arizona does not have any part of the clean air corridor held within the state.

It also contains a commitment for Arizona to cooperate in regional emissions tracking program for clean air corridors.

This is a map of the clean air corridor. It's not too clear here, but Arizona is down to the Grand Canyon (indicating on projection). Arizona is the lowest state there. That shows where the clean air corridor is located.

Chapter 7 is the "Stationary Sources" chapter, which contains a brief history of the stationary sources approach and rationale for the backstop market trading program, otherwise known as the "Annex" under the Regional Haze Rule.

It also contains the monitoring requirements, the showing of thirteen percent sulfur dioxide, or SO-2, reduction, and a summary of the NOx and PM Report.

It also contains a commitment to complete the Arizona rule for the trading program as soon as practicable.

Chapter 8 is "WEB Trading Program for

Stationary Sources". This is the actual trading program.

The SO-2 Milestones and Backstop Trading Program contains milestones, the default allocation process, pre-trigger and post-trigger requirements for monitoring and record keeping and geographical en- hancement.

I should say at this point: If anybody has some questions about these specific things, feel free to ask them during the presentation.

Chapter 9, "Mobile Sources".

Chapter 9 contains an explanation of the GCVTC's work, WRAP's subsequent technical analysis and federal regulatory actions.

And "GCVTC" stands for Grand Canyon Visibility Transport Commission, and "WRAP" is the Western Regional Air Partnership.

This also contains a summary of Arizona's approach and conclusions to non-significance deter- mination issue for multiple sources.

And it contains two versions to account for probable federal rule revision, which was proposed on July 3rd -- That should be "03". Excuse me. It says "02", but it should read "03".

And it is my understanding that that rule should be becoming final shortly. We have not received any further information at this point.

Chapter 10 is the "Fire" chapter, which contains the Enhanced Smoke Management Plan, including emission reduction techniques, or "ERTs", for short, and the tracking system to track emissions from various types of fires.

It contains commitment to develop a process for dealing with administrative barriers to nonburning activities, and contains revisions to R18-2-602, which is Arizona's open burning rule, and Article 15, which is Arizona's range management rule submitted to the Governor's Regulatory Review Council for final action this past November 17, 2003.

Chapter 11 is the chapter on "Road Dust", which contains GCVTC's acknowledgment that dust requires additional tracking and modeling.

It also contains a commitment to track emissions from paved and unpaved road dust.

It discusses the "In & Near" approach, suggested as a way to address road dust under 309(g), which is a supplemental section, and future SIP revisions as modeling and inventories improve.

Chapter 12 is the "Pollution Prevention" chapter, which contains a list of current renewable energy and energy efficient programs in Arizona.

The primary component in this chapter is the Environmental Portfolio Standard, administered by the Arizona Corporation Commission.

And it also has ADEQ considering the future role in energy programs and how best to contribute to the regional energy goal, which is a ten-point goal, outlined in the Regional Haze Rule.

Chapter 13 is a section in the GCVTC

recommendations called "Other GCVTC Recommendations", and we opted to put this in a separate chapter for clarity. It provides a review of recommendations from the 1996 report not addressed elsewhere in the SIP.

And categorical by stationary, mobile, area and multi-sector.

It includes a summary of the federal land managers' information provided for the four Class I

areas covered by this SIP.

Chapter 14 is what we call the "Projection chapter". "Projection of Visibility Improvement".

It includes the 1996 and 2018 emission inventory information for the following source categories: area, stationary point, mobile (on- and non-road), road dust (paved and unpaved), fire emissions (prescribed, agricultural and wildfire) and biogenic.

It also includes projected improvement from 1996 to 2018 for each of the 16 Colorado Plateau Class I areas, considering identified control strategies.

Chapters 15 and 16 are part of the "Coordination and Review" that are contained in almost all Arizona's SIP, and includes two things: Arizona's commitment to participate in regional planning via the WRAP, and coordinate with other stakeholders; acknowledgement that Arizona's SIP is not applicable to tribes; and a commitment, within Chapter 16, to periodically review for determination of reasonable progress.

Chapter 17 is the "309(g) Commitment". Declaration of Arizona's commitment to

address the remaining eight Class I areas in a SIP revision under the requirements of 40 CFR 51.309(g).

Briefly, what this means is: There are twelve Class I areas in Arizona. We are tackling the first four in the 309 SIP. What we need to address are the remaining eight. And the Regional Haze Rule allows us to do that under 309, Section (g), of the Regional Haze Rule. And we will be working on that SIP within the year 2004.

This is just a map of the Arizona Class I Area. You will see the red ones. They are the ones we are dealing with right now. And the remaining blue ones are the eight that we will be addressing in the 309(g) SIP.

Along with the base SIP, the actual SIP document itself, there are two other major documents that come along with the SIP. One is the Western Regional Air Partnership Technical Support Document, which is also listed on their WRAP web page, which is wrapair.org.

We also have it posted on the ADEQ web page. And the appendices are referenced for the 309 states. They also are on the WRAP web page.

We have the SIP, the TSD and the appendices for Arizona also on the Arizona Regional

Haze website, which is listed there.

And again, I remind you that the public comment period closes at 5:00 p.m. on December 3rd.

CHAIRPERSON MASSEY: This concludes the explanation period of this proceeding on the proposed State Implementation Plan.

QUESTION AND ANSWER PERIOD

CHAIRPERSON MASSEY: Are there any questions before we go to the oral comment period?

(No audible response.)

CHAIRPERSON MASSEY: OK. Hearing none, this concludes the question-and-answer period of this proceeding on the proposed State Implementation Plan.

ORAL COMMENT PERIOD

CHAIRPERSON MASSEY: I now open this proceeding for oral comments.

Mr. Carl Bowman?

MR. BOWMAN: My name is Carl Bowman. I am the Air Quality Specialist with the National Park Service at Grand Canyon National Park.

I am very glad to be here this afternoon. In fact, I have been looking forward to it since August 15th, 1991. That afternoon I was a somewhat bewildered participant at the first formative meeting of some "thing" called the "Grand Canyon Visibility Transport

Commission".

Since that time, we in the National Park Service have been working with hundreds of others through the Commission and its successor organization, the Western Regional Air Partnership, to develop a regional plan to address the haze that can obscure the magnificent vistas of the Grand Canyon as well as the other Class I areas of the Colorado Plateau. Today we see this work coming to fruition here in Arizona with the draft State Implementation Plan for Regional Haze before us.

As a participant in the plan's development process, I would like to commend the Arizona Department of Environmental Quality for their effort in developing this plan with an open, stake-holder - based process. This process relies heavily on the various groups affected by this plan. Government, industry and environmental groups were all welcome at the table. I am sure it wasn't easy for ADEQ leading this process, considering and consolidating the many viewpoints offered and producing this plan. In the end, though, I believe we have a plan that will guide us along the path to reduce the haze of air pollution in our parks and wilderness areas.

The draft plan meets our expectations and

appears to meet the requirements under the Regional Haze Rule promulgated by the EPA. We do have a few comments that we believe will clarify some portions of the plan.

The provisions regarding future emission milestones for nitrogen oxides and particulate matter in Section 7.3 can still use a bit of tweaking. This should avoid any inadvertent impressions that decisions have already been made regarding future options and best available retrofit technology for these pollutants.

Section 8.5 discusses the criteria the National Park Service intends to follow for certification of visibility impairment by sources of sulfur dioxide. A memorandum of agreement regarding these criteria has not been formally completed between the National Park Service and the State of Arizona; however, we are prepared to move forward on the basis of the existing draft agreement used for Section 8.5.

We will address these issues in more detail and some other minor points in our written comments, which we will submit before the close of the comment period on December 3rd. We have worked long and hard to get to this point, and I look forward to seeing the difference we can make.

CHAIRPERSON MASSEY: Thank you.

I have no other speaker slips at this time. Are there any others that would like to make oral comments?

(No audible response.)

ADJOURNMENT OF ORAL PROCEEDING

CHAIRPERSON MASSEY: Seeing no additional speaker slips, this concludes the oral comment period of this proceeding.

I encourage everyone to submit written comments on the proposed State Implementation Plan. Your participation is an essential part of this process.

Again, you may also submit written comments by mail, e-mail or fax to Corky Martinkovic by the end of the comment period. The end of the comment period is 5:00 p.m. on Wednesday, December 3rd, 2003. If mailed, e-mailed or faxed, written comments must be "postmarked" no later than December 3rd, 2003.

Please submit your written comments to: Corky Martinkovic, Air Quality Planning Section, Arizona Department of Environmental Quality, 110 West Washington Street, Phoenix, Arizona 85007; or by fax at 602 - 771-2366; or by e-mail at martinkovic. deborrah@ev.state.az.us

Thank you all for attending.

The time is 4:54 p.m., and I now close this oral proceeding.

(The public hearing concluded at 4:54 p.m., November 24, 2003.)

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NORTHERN ARIZONA REPORTERS

20

STATE OF ARIZONA)
) REPORTER'S CERTIFICATE
COUNTY OF COCONINO)

I, John A. Dalsin, do hereby certify that I am a Certified Court Reporter within the State of Arizona and a Registered Professional Reporter;

I further certify that the foregoing proceedings were taken in stenotypy by me at the time and place herein set forth and were thereafter reduced to typewritten form, and that the foregoing constitutes a true and correct transcript of the notes taken at that time;

I further certify that I am not related to nor employed by or for any of the parties or attorneys herein nor in any way interested in the outcome of the within action;

In witness whereof I have hereto affixed my signature this 5th day of December, 2003.

JOHN A. DALSIN
Arizona Certified

NORTHERN ARIZONA REPORTERS

Arizona Department of Environmental Quality
Air Quality Division

Public Hearing Presiding Officer Certification

I, Eric Massey, the designated Presiding Officer, do hereby certify that the public hearing held by the Arizona Department of Environmental Quality was conducted on November 24, 2003, at the Coconino Public Library, Flagstaff, Arizona, in accordance with public notice requirements by publication in Arizona Administrative Register and other locations beginning October 24, 2003. Furthermore, I do hereby certify that the public hearing was recorded from the opening of the public record through concluding remarks and adjournment, and the transcript provided contains a full, true, and correct record of the above-referenced public hearing.

Dated this 4th day of December, 2003.

Eric Massey

State of Arizona)
) ss.
County of Maricopa)

Subscribed and sworn to before me by Eric Massey this 4th day of December, 2003

DENEE N. WOODARD
Notary Public - Arizona
Maricopa County
Expires 12/30/05

Denee N. Woodard

Notary Public

My commission expires: 12/30/05

Appendix A-18c. Written Comments Received During Comment Period

Arizona Electric Power Cooperative, Inc.

November 26, 2003

Corky Martinkovic
Air Quality Planning Section
Arizona Department of Environmental Quality
1110 W. Washington St.
Phoenix, AZ 85007

RE: COMMENTS ON REGIONAL HAZE STATE IMPLEMENTATION PLAN

Arizona Electric Power Cooperative, Inc. (AEPCO) is a customer-owned, nonprofit, electric utility with approximately 300 employees headquartered in Benson, Arizona. We are the owner/operator of Apache Generating Station (Apache Station), a 560 MW generating station with two gas/coal-fired steam electric generation units, one gas/oil-fired combined cycle steam generation unit, and three gas/oil-fired turbine units. Apache Station supplies power to six electric distribution cooperatives, which serve more than 270,000 people in portions of Arizona, California and New Mexico.

As you are aware, AEPCO has participated as a stakeholder in the Arizona Department of Environmental Quality's (ADEQ) process to develop the draft revisions to the State Implementation Plan (SIP) that will implement regional haze regulations in Arizona. Previous to this effort, through our affiliation with WEST Associates, we provided input to the Grand Canyon Visibility Transport Commission (GCVTC) and its successor body, the Western Regional Air Partnership, as they worked on their recommendations and plans to reduce visibility impairment in the national parks and wilderness areas of the Colorado Plateau.

Throughout our involvement we have continued to support and advocate the approach to visibility management that is presented in Arizona's draft SIP. Specifically, AEPCO supports the SIP's recognition that to realize progress in achieving visibility goals we must have a program that encompasses not only industrial facilities, but also a wide range of emission sources that contribute to visibility degradation, including vehicles, agricultural activities and forest fires. We also strongly support the SIP's adoption of the GCVTC's recommendation to implement a voluntary program for sulfur dioxide (SO_2) emissions reductions from industrial sources. This program is structured to ensure that the reduction commitments from these sources are achieved by including a "backstop" cap-and-trade program that would be imposed if voluntary efforts were unsuccessful.

The pursuit of SO_2 reductions per the program included in the regional haze SIP is beneficial to the environment as it offers reductions from major sources of emissions not addressed by Best Available Retrofit Technology (BART) regulations. In addition, relying on voluntary reductions and a "backstop" emissions trading program is a more cost-effective approach to regulation than a typical command-and-control program.

We understand that this SIP is an initial step in implementing regional haze regulations in Arizona and additional work has yet to be accomplished in developing and proceeding with the details of the visibility management programs included in the SIP. We look forward to our continuing role as a stakeholder in these efforts, and appreciate ADEQ's broad inclusion of those affected by these rules in the agency's activities to date.

If you have any questions regarding these comments, please contact Kara Downey at (520) 586-3631 or kdowney@ssw.coop.

Sincerely,

Mark W. Schwirtz
Senior Vice President & Chief Operating Officer

Via Facsimile and Electronic Mail

c/ J. Andrew
K. Downey
P. Cooper
P. Ledger
R. Hewlett
M. Nelson
File: ADEQ Correspondence, Air Quality

Dec 3, 2003

Deborrah Martinkovic,
Air Quality Division
Arizona Department of Environmental Quality
1110 W. Washington St.
Phoenix, AZ 85007

Re: **Regional Haze State Implementation Plan - Draft of October 24, 2003**

Dear Ms. Martinkovic

Arizona Public Service Company (APS) has actively participated in the state stakeholder process and strongly supports the Arizona Section 309 Regional Haze State Implementation Plan (SIP). We believe the draft plan meets all federal and state requirements and provides effective and workable strategies towards making 'reasonable progress' on reducing regional haze in Arizona and the west.

To maximize public participation and plan effectiveness, this plan was developed in coordination with the Western Regional Air Partnership (a coalition of western states and Indian nations) and provided numerous opportunities for all stakeholders to be involved. This outreach and cooperation has resulted in an innovative plan that demonstrates real progress and stakeholder ownership.

APS has engaged in the development of this innovative regional haze program through the Grand Canyon Visibility Transport Commission and the subsequent Western Regional Air Partnership. We have also been active in the State Regional Haze process and, although we are disappointed by the resolution of the state SO2 allocation methodology as incorporated in the backstop-trading program, we remain committed to the overall program success. Please see additional comments in the attachment.

.
Thank you for the opportunity to participate

Sincerely

William D. Wiley
Senior Environmental Policy Advisor

Attachment- Specific comments

APS Comments On
Regional Haze State Implementation Plan for Arizona
Public Review Draft October 24, 2003

APS appreciates the opportunity to participate in the state regional haze process and supports submittal of the Arizona 309 Regional Haze State Implementation Plan (SIP). We believe, however that the SIP would be enhanced with the following changes.

1. Please clarify in the SIP that references and appendices are for reference only and are not enforceable as part of this SIP (e.g. TSD, NOx/PM report, P2 appendix, etc.).

2. Sections 7 and 8. These Sections refer to Stationary Source requirements and the Backstop SO2 Trading program. Please clarify what is required under the expanded 10-year record-keeping requirement. Does it include all documents currently required under our Title V permits (this includes hourly emissions values and monitor maintenance records), or is there a selected subset, i.e. annual emissions inventory or Title IV annual emission sums?

3. Table 8-2 (page 42). Table 8-2 erroneously suggests that APS' Four Corners Power Plant, which is located on the Navajo Nation Indian Reservation, is subject to the jurisdiction of the Navajo Nation. This is not accurate. The plant is subject to EPA Region IX jurisdiction, not Navajo jurisdiction. We strongly encourage the state to address this issue in a clarifying footnote, next to entry 10 on Table 8-2 ("Navajo Nation"), stating, "Although the Four Corners Power Plant is located on the Navajo Nation Indian Reservation, the plant is subject to environmental regulation by EPA Region IX." We understand that this same issue applies to SRP's Navajo Power Plant in Page, Arizona.

4. Section 8.1.3 – Determination of Program Trigger- Changes in flow rate measurements. The new test methods (2F, 2G, and 2H) are not used to continuously monitor flow rates. Instead, they may be used to initially characterize a continuous flow monitor system and then be used for ongoing quality assurance audits. Importantly, reductions in flow rates are not realized unless a continuous flow monitor is first re-characterized using one or all of the new methods (Question 3.13 of EPA's Part 75 Emissions Monitoring Policy Manual – October 28, 2003). Using the new methods should only reduce the reference method flow rate, resulting in the reference method being lower than the flow monitor reads. Also, Acid Rain regulations require that all hourly measurements be biased based on the most recent quality assurance testing. However, this bias is only applied when the flow monitor reads are lower than the reference method. Therefore, a source that chooses to use one or all of the new methods for ongoing quality assurance without first re-characterizing the monitor will not reduce the flow rates measured by the continuous flow monitor.

Further, the new methods were published for use in mid 1999 as EPA's answer to several claims that conventional methods resulted in overestimating flow rates. However, EPA has subsequently determined that, in fact, this may not be the case (Question 3.6 of EPA's Part 75 Emissions Monitoring Policy Manual – October 28, 2003). EPA now believes these claims are counterbalanced by evidence that little or no overestimation has been seen.

Because of this recent information published by EPA, the language in this section requiring adjustments based on the use of the new flow methods should be deleted. If the language is not deleted then it should be clarified that adjustments should only be required when an existing flow monitor is re-characterized using the new methods and where the monitor's coefficients had to be changed because the old and new methods produced different results.

5. Section 8.3.1 (g) renewable energy allocations. Please clarify that renewable energy allocations are only available for renewable energy physically located within the participating five state 309 region.

6. Section 8.3.1 (g) (6). We believe this Section should be revised to specifically provide for public notice and comment prior to finalizing the State (and facility specific) Allocation Report for Arizona.

7. Section 12 Pollution Prevention and Renewable Energy Programs. All participants in the pollution prevention subcommittee supported this section of the SIP . APS supports the current language of the proposed SIP, as it recognizes the importance of existing programs and authorities in supporting renewable energies and energy efficiency in Arizona. The Arizona Corporation Commission is reviewing these programs in ongoing workshops and is the appropriate authority for evaluating their place in the state's energy mix, while considering energy reliability and affordability. ADEQ need not and should not duplicate regulatory efforts in these areas.

8. Miscellaneous. There are several typographical errors and minor corrections needed throughout the document. (e.g. pg.15- Mt Baldy is in 'eastern' AZ., pg. 21- 'Mesa Verde National Park', pg. 37- backstop 'market' instead of 'marking', etc).

I attended the comment meeting last night and thank you for an informative, capsulated presentation of the Arizona SIP. I have a couple follow-up questions:
1. I do not find the City of Phoenix four recommendations on the website. Would you please direct me to the location?
2. Are any power plants or proposed power plants desiganted as stationary sources?

Caroline Butler, CLA
Legal Division
Arizona Corporation Commission
1200 West Washington
Phoenix, Arizona 85007
Phone: 602-542-3402
FAX: 602-542-4870

To the Editor:

With "Officials map war on haze," the Tribune maintains it's practice of uncritically filling print with press releases from self-serving government bureaucracies. Why the unquestioning acceptance that "officials" can indeed "do something" about the haze? It's bad enough the headline declares another "war" --along with the War on Drugs, the War on Hunger, and the War on Obesity, presumably-- but there's no apparent attempt to keep public officials honest. For example, there are no answers to tough questions for ADEQ director Steve Owens, questions such as,

"Mr. Owens, how much will the haze be reduced by your planned measures? How will you measure this reduction? How long will it take to meet the planned reduction? How will you know when to declare 'victory'? How much will this cost taxpayers? Will there be a limit to the amount expended for haze reduction? What additional sacrifices may be required of valley residents? Will there be a cost-benefit analysis? If plans are predicted to be uneconomical or improvement negligible, will we be told to just live with the haze? How did Congress come to 'target' the Tonto National 'Forest' for this blessing?"

The result of this new war declaration is predictable: we're in for another open-ended expenditure of public funds wasted on a declared problem that can be realistically solved only by the mass exodus of residents from the Valley of the Sun. But not to worry, Valleyites, short of that extreme measure the parasite classes will continue to provide the illusion they're "doing something" about it, at your expense, of course. And if there is still haze after ten years, why, they'll just work harder at it! And meanwhile, the Tribune will continue transcribing instead of reporting.

Richard D. Welling
Mesa

The camer's and instrument's are not going to get
rid of anything.
The picture of the inversion on the front page of the
Rrib show's you how to do it.

Duane Harrison
navigatordhr@wmconnect.com

Corky Martinkovic:
There are natural means of ridding
ourselves of pollution using off the
shelf product's.
Concentrate on the answer and not
the problem.

Duane Harrison

Navigatordhr@wmconnect.com

Regarding the plan to reduce haze in scenic areas. I am not sure if you are taking comments about the Superstition Wilderness, but I have heard that Maricopa County is about to grant a permit modification to allow SRP to burn diesel at the San Tan plant when natural gas supplies are low. The haze around the plant in the winter is already thick in the winter. The Superstitions are much less visible in the area of the San Tan plant than from Mesa where the air is clearer. Is there anything the state can do about this being allowed? Sincerely,
Suzanne Pager

FYI - without attachments
LC

>Date: Wed, 12 Nov 2003 14:06:12 -0700
>To: dam@ev.state.az.us
>From: Lee Comrie <LComrie@pagnet.org>
>Subject: Regional Haze SIP
>Cc: mswg@pagnet.org,mm
>
>As Chair of the Mobile Source Working Group, and on behalf of its members,
>I would like to notify you of an apparent error in Appendix A-9. Mobile
>Sources. The appendix includes a letter sent to Ms. Wrona from myself
>dated July 10, 2003 with the attached report entitled "Arizona Regional
>Haze Mobile Source Working Group Mobile Source Significance
>Determination". This version was later updated to reflect the comments
>and suggestions made at the Stakeholder Advisory Committee meeting held on
>July 24, 2003. I am attaching the updated letter and report to replace
>the previous version for inclusion in this Appendix. I would also like to
>add that an overall review of the document for typographical errors is
>needed. Please contact me if you have any questions.
>LC
>
>Leonore "Lee" Comrie
>Air Quality Manager
>
>Pima Association of Governments
>177 N. Church Ave., Suite 405
>Tucson, AZ 85701
>
>Ph: (520) 792-1093 Fax: (520) 620-6981

December 3, 2003

Deborrah Martinkovic
Arizona Department of Environmental Quality
1110 W. Washington Street
Phoenix, Arizona 85007

RE: Comments on the Arizona Regional Haze State Implementation Plan

Dear Ms. Martinkovic:

This letter provides comments on the pollution prevention portion of Arizona Department of Environmental Quality's (ADEQ) Regional Haze State Implementation Plan (Haze SIP). Environmental Defense, Grand Canyon Trust, the Southwest Energy Efficiency Project and Western Resource Advocates (formerly the Land and Water Fund of the Rockies) have participated in and monitored the development of the Arizona Haze SIP through the efforts of Rick Moore (Stakeholder Advisory Committee Member) and Amanda Ormond and Jeff Schlegel (Pollution Prevention Work Group Members).

We commend the state on the stakeholder process used to develop the entire Haze SIP. The process allowed a broad constituency to play an active role in the development of the components related to energy efficiency and renewable energy. We also recognize and applaud the efforts of the Pollution Prevention Work Group (P2WG) Chair and Co-Chair, Ursula Kramer and Ray Williamson, respectively, and the assistance of Theresa Rigney, ADEQ.

The state has done a good job addressing many of the pollution prevention requirements in the (RHR) 40 CFR 51.309(d)(8). However, in reviewing and comparing the requirements of the Regional Haze Rule with the SIP draft presented for public comment, we find serious, material omissions in the pollution prevention section (Chapter 12).

By its own admission, the ADEQ has developed the 2003 SIP as a "baseline" or "foundational" SIP and, as such, the plan lacks any commitment to action. The Pollution Prevention section of the SIP is little more than a catalogue of existing programs or efforts. The Haze SIP, as drafted, proposes no future actions. The plan does not:

- propose any strategy that the state will undertake to ensure that progress will be made towards achieving the goal that renewable energy will comprise 10 percent of the regional power needs by 2005 and 20 percent by 2015, nor

- propose strategies to expand energy efficiency efforts.

The state is required to report on progress made in the area of pollution prevention between submittal of the plan in 2003 and the first reporting period in 2008. Unless the state develops a strategy to promote renewable energy and calculates its contribution to the 10/20 renewable energy goal, the requirement that it "explain why meeting the State's contribution was not feasible" will be a hollow exercise. In addition, if no commitments to action are enumerated in the plan there will be no way for the public and interested parties to monitor the state's progress over the next five years. Therefore, **the state should include, in the 2003 SIP, what concrete actions it is going to take toward meeting the 10/20 renewable energy goals.**

For example, the Arizona Corporation Commission is currently considering changes to, and possible expansion of, the existing environmental portfolio standard and the return of funding to energy efficiency programs. The ADEQ could commit in the 2003 SIP to monitor this regulatory process and provide technical input on benefits from expansion of renewable energy and energy efficiency programs on regional haze. This action was recommended by a majority of members of the pollution prevention work group for consideration by ADEQ.

The RHR requires reporting certain types of data related to renewable energy and energy efficiency. Although Arizona does provide detailed information on existing and planned renewable energy generation data and energy efficiency programs, information is lacking in the following areas:

40 CFR 51.309(d)(8)(i) clearly requires the state's plan to include "the State's anticipated contribution toward the renewable energy goals for 2005 and 2015." While the SIP does quantify that Arizona's current contribution is about 0.08% in 2002, nowhere in the pollution prevention section, Chapter 12, nor elsewhere in the plan, does Arizona quantify its anticipated contribution to the 10/20 goals for 2005 and 2015, as required by the RHR. **The State needs to provide numbers that reflect Arizona's anticipated contribution to the regional renewable energy goals of 10 percent by 2005 and 20 percent by 2015.**

The RHR section 40 CFR 51.309(d)(8)(iii) requires the state to document "programs to preserve and expand energy conservation efforts". Energy efficiency efforts can be one of the most cost-effective approaches for reducing emissions from power plants and addressing regional haze. Table 12-8 in the state's draft plan provides a list of energy efficiency programs. With the exception of the first two of the 34 programs in Table 12-8, the programs listed were existing programs as of 2002, and there is no information provided on programs that will be, or are expected to be, expanded in the future. Simply listing *existing* energy efficiency programs is not sufficient to meet the RHR requirement to "preserve and *expand* energy conservation efforts." The non-consensus recommendations submitted to the ADEQ from the majority of the P2WG members provided a list of energy efficiency efforts that the ADEQ should consider supporting. The

ADEQ should state in the 2003 its commitment to pursue such efforts. **The state needs to add information on actions or programs to expand energy efficiency efforts (including future programs it will support) as required in 40 CFR 51.309(d)(8)(iii)**.

Also related to the efficiency programs listed in Table 12-8 by virtue of being included in this section, it is presumed that all energy efficiency programs listed in the table are the programs that the state anticipates will be preserved and reported on in 2008. This is problematic because the State Energy Office operates the majority of programs listed, yet the Energy Office does not have funding through 2008 to operate all programs listed. Energy Office funding is predominately from Petroleum Violation Escrow (PVE) funds, which are limited and nearly exhausted. If these programs are discontinued, due to lack of funding, the state will not have preserved energy efficiency programs. In fact it will have reduced the state's energy efficiency programs. Indeed, a core Clean Air Act (CAA) requirement of all SIPs is the duty of the state to have adequate funding to carry out the programs in the plan. See CAA §110(a)(2)(E), 42 U.S.C. § 7410(a)(2)(E). **The State should review the list of energy efficiency programs listed in Table 12-8 and only include those programs that the state believes will be fully funded and in existence through the first reporting period in 2008. Alternatively, the state should add qualifying language explaining that, absent additional funding, the listed Energy Office programs are likely to be eliminated prior to reporting in 2008.**

In the same table few programs provide quantification of actual or expected energy reductions. This information is needed for future milestone reports to document progress in energy conservation. **Although baseline information on energy use reduction resulting from energy efficiency programs is not required to be reported in the 2003 SIP, the state should develop and collect this data for use in reporting progress in 2008.**

To satisfy the requirement of 40 CFR 51.309(d)(8)(iv) to provide "documentation of the potential for renewable energy resources" the state has included resource maps from the National Renewable Energy Laboratory. However, information on the total electricity generation potential for various renewable energy sources cannot be derived from these maps. **We suggest that Arizona use the Renewable Energy Atlas of the West (as other states have) for satisfying this provision of the rule, since the atlas provides estimates of the electricity generation potential from each renewable resource for each state in the West.**

The submittal of the 2003 Arizona Haze SIP in December culminates over a decade of work to define methods and enact policy and regulations to reduce haze-causing emissions. The Grand Canyon Visibility Transport Commission clearly recognized the potential contributions of energy efficiency and renewable energy to help reduce regional haze and lower the cost of compliance. The Western Regional Air Partnership and its Air Pollution Prevention Forum spent several years developing products and recommendations for use by states related to energy. Arizona professionals have spent hundreds of hours participating on various work groups and forums to develop the draft Haze SIP. While the state has done a good job addressing many of the requirements in the pollution prevention section of the RHR, it needs to address the above items to submit a complete Haze SIP.

In conclusion, to complete the job, we strongly encourage ADEQ to identify specific energy efficiency and renewable energy measures to be carried out, to determine Arizona's contribution to the region's renewable energy goals, to increase its direct involvement in state-sponsored initiatives and legislation related to renewable energy and energy efficiency, and to quantify the benefits of these programs. These are core requirements of the regional haze program under 40 CFR 51.309 and, importantly, the lasting foundation for cleaner, healthier air.

We look forward to reviewing ADEQ's modifications in the pollution prevention section of this SIP.

Respectfully submitted,

Vickie Patton
Attorney
Environmental Defense

Rick Moore
Associate Director
Grand Canyon Trust

Howard Geller
Executive Director
Southwest Energy Efficiency Project

John Nielsen
Energy Project Director
Western Resource Advocates

MARICOPA ASSOCIATION of GOVERNMENTS

302 North 1st Avenue, Suite 300 ▲ Phoenix, Arizona 85003
Phone (602) 254-6300 ▲ FAX (602) 254-6490
Email: mag@mag.maricopa.gov ▲ Website: www.mag.maricopa.gov

December 3, 2003

Ms. Theresa Pella, Manager
Air Quality Planning Section
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007-2952

Dear Ms. Pella:

The Maricopa Association of Governments appreciates the opportunity to comment on the Draft Regional Haze State Implementation Plan For The State of Arizona. MAG previously commented on the Regional Haze SIP in a letter to the Arizona Department of Environmental Quality on September 22, 2003. In the September 22, 2003 letter, MAG's comments focused on Chapter 9 - Mobile Sources, specifically Table 9-2, "Contribution to Light Extinction from Phoenix Mobile Source Emissions". We commented on our concerns about the data provided in Table 9-2 due to the errors in modeling assumptions for Maricopa County and requested that Table 9-2 be removed. Again, based on the discussion below, we request that Table 9-2 be removed from the Regional Haze SIP.

The Western Air Regional Partnership (WRAP) Air Quality Modeling Forum evaluated the contribution of mobile source emissions to visibility impairment at the 16 Class I Areas on the Colorado Plateau. This evaluation was presented in a technical memorandum dated November 4, 2002 and part of this evaluation is reflected in the Draft Regional Haze SIP as Table 9-2, "Contribution to Light Extinction from Phoenix Mobile Source Emissions". Data from Table 9-2 provides the evaluation of visibility impacts of mobile source emissions in Maricopa County as a percentage of the projected WRAP 2018 Base Case light extinction.

The 1996 mobile source emissions inventory and the subsequent mobile source emissions projections developed by the WRAP over-estimates emissions for Maricopa County. In the "Review of 1996 WRAP Emissions Inventory For Use in Arizona's Regional Haze State Implementation Plan", a review by the Arizona Department of Environmental Quality Emissions Inventory Workgroup found that the WRAP Emissions Inventory overstates the Maricopa County vehicle miles of travel (VMT) by about 8 percent in the winter (affecting carbon monoxide emissions), 13 percent on an average annual day (affecting reentrained PM-10 emissions), and 25 percent in the summer (affecting volatile organic compounds and nitrogen oxides emissions). The VMT estimated by the WRAP for the summer season is 13 percent higher than the winter VMT which does not correlate with MAG data which shows higher VMT in the winter than in the summer.

In the WRAP emissions projections developed through 2018, the rate of growth for the average annual vehicle miles of travel between 1996 and 2018 was consistent with estimates developed by MAG. However, in the WRAP analysis, the 3.54 percent summer rate of growth assumed between 1996 and 2018 results in an over-estimation of Maricopa County vehicle miles of travel by about eleven percent. Since visibility impairment at the 16 Class I areas tends to be highest during the summer, the WRAP's over-estimation of summer VMT overstates Maricopa County's contribution to regional haze on the 20 percent worst days (in Table 9-2). The Emission Inventory Work Group had previously pointed out this error in the calculation of VMT projections in a letter to the WRAP Emissions Forum dated June 6, 2003.

If you have any questions about the above discussion, please contact me at (602) 254-6300.

Sincerely,

Dean Giles

Dean Giles
Air Quality Planning Program Manager

N3615(8213)

Deborrah Martinkovic, Air Quality Planning Section
Air Quality Division
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

Dear Ms. Martinkovic

Thank you for the opportunity to comment on the final draft of Arizona's State Implementation Plan for Visibility Protection and Regional Haze. As you know, visibility protection is a critical air quality concern for Grand Canyon National Park and the other National Park System units in Arizona and on the Colorado Plateau. Like the State of Arizona, we have been partners in this effort since the first formative meeting for the Grand Canyon Visibility Transport Commission in August 1991, and are pleased to see the Commission's work, and that of the Western Regional Air Partnership that built on it, reaching this stage.

Arizona's proposal, which is based on the recommendations of the Grand Canyon Visibility Transport Commission (GCVTC) as codified in Environmental Protection Agency's (EPA) regional haze rule under 40CFR 51.309, will implement measures to improve visibility by reducing regional haze in the 16 mandatory federal Class I areas on the Colorado Plateau (located in the States of Colorado, New Mexico, Utah and Arizona) through the year 2018. On a periodic basis, additional measures may need to be adopted by the State to ensure that reasonable progress is being made to attain the national visibility goal of no human-caused impairment to visibility in mandatory federal Class I areas. Using the templates developed by the Western Regional Air Partnership (WRAP), Arizona's proposed plan appears to contain all the major components required for inclusion in State implementation plans as specified in EPA's regional haze rule.

We appreciate the open, participatory process you have used in developing this plan. We believe hearing and incorporating the views of stakeholders from across the State have benefited this effort. Since the National Park Service was able to participate in developing the Plan, we were able to resolve our issues and concerns, and have few comments at this stage.

We do believe section 7.3 (regarding future regulation of nitrogen oxides and particulate matter) needs some adjustment to better reflect the findings of the Western Regional Air Partnership and the requirements of Section 309(d)(4)(ii-iv) of the Regional Haze Rule.

A Memorandum of Agreement between the State of Arizona and the National Park Service regarding certification of impairment by sulfur dioxide sources has not been signed. However, we are ready to move forward on the basis of the draft Agreement developed through the Western Regional Air Patnership.

A line-by-line review of these and other minor issues is attached to this letter.

We look forward to continued progress in reducing the haze over the National Parks and Wilderness Areas of Arizona and her surrounding states as we move on to address the other eight Class I areas of southern Arizona and those in nearby states under Section 51.309(g) of the Regional Haze Rule.

If you have any questions, please don't hesitate to contact Mr. Carl Bowman, Grand Canyon National Park's Air Quality Specialist, at (928) 638-7817 or carl_bowman@nps.gov.

Sincerely

Joseph F. Alston
Superintendent

attachment

bcc with attachment:
GRCA: Jeff Cross
ARD-DEN: John Bunyak, Brian Mitchell, Bruce Polkowsky
National Park Service - AIR
P. O. Box 25287
Denver, CO 80225-0287
IMRO: John Reber
PEFO: Lee Baiza (Supt.), Karen Beppler-Dorn (Res.Mgmt.)
Petrified Forest National Park
P.O. Box 2217
Petrified Forest National Park, AZ 86028

Attachment

Regional Haze State Implementation Plan for the State of Arizona, Public Review Draft of 10/24/03

Specific line comments by the National Park Service, Grand Canyon National Park

page: line

15:18 Geographic error, "land on the ~~western~~ eastern side of the state and is one of the many extinct volcanoes found throughout the state."

21:31 Typographic error, "Mesa ~~Vera~~ Verde National Park, Colorado – Spanish for "green table," Mesa Verde allows visitors to experience"

21:44 Typographic error, "large amount of visitors every year. There are over 100~~,000~~ miles of trail, and despite peaks that rise"

22:9-12 This section describes Oregon's Black Canyon National Wilderness Area, rather than the Black Canyon of the Gunnison National Wilderness Area in Colorado. A possible substitute is taken from the park's website, "The Black Canyon of the Gunnison's unique and spectacular landscape was formed slowly by the action of water and rock scouring down through hard Proterozoic crystalline rock. No other canyon in North America combines the narrow opening, sheer walls, and startling depths offered by the Black Canyon of the Gunnison." Other statistics that may be of use include the depth of the gorge (up to 2,600' deep), visitation in 2002 (174,349), and the portion of the Canyon within the park (the most spectacular 12 miles of the total 53).

23:27 This may be a bit of an oversimplification, since the eye only responds to visible, not all, light. Suggested change: "frequencies, or wavelengths, of visible light simultaneously."

24: Figure 4.1 This illustration is a good way to explain these concepts.

27:25-26 In addition to the state-sponsored IMPROVE monitoring, the National Park Service has maintained IMPROVE monitors (transmissometer and particle samplers) in Petrified Forest and Grand Canyon national parks since 1987, providing a long baseline of visibility measurements .

39:17 The wording of Section 7.3 does a better job than previous versions to reflect Arizona's commitment to evaluate the need for additional NO_x and PM controls. However, line 25 goes somewhat beyond the WRAP NO_x and PM report's, and thus Arizona's, findings on the adequacy of this work to support a determination. The report states, "The WRAP's current modeling system, while sufficient for analyzing the regional impact of some emission changes, **is not predicting nitrate concentrations well enough to support a decision on whether or not stationary source NOx controls are an effective way at achieving reasonable progress** – the results are simply too uncertain. Several improvements to the modeling system are underway, but until the model produces better nitrate results, other means of assessment will be necessary to determine the appropriate level of NOx control in future SIPs" (*Stationary Source NOx and PM Emissions in the WRAP Region: An Initial Assessment of Emissions, Controls, and Air Quality Impacts*, pp I-4&5, emphasis added).

Given the current indeterminate need for controls, the SIP should also address how this need will be determined. Although this determination could be implied from the wording of lines 25- 28, it would be better to simply state that the determination process and necessary programs will be part of the 2008 SIP revision. Suggested wording of lines 23-28 to clarify these issues is:

23 included in Appendix A-7c. The report represents the State of Arizona's initial assessment of stationary
24 source NOx and PM strategies for regional haze. The State of Arizona ~~has~~ can not determine~~d that~~ the need for NOx and PM
25 strategies ~~are not needed~~ at this time. The State of Arizona commits to ~~adopting long-term strategies and~~
26 ~~Best Available Retrofit Technology (BART) requirements for stationary sources of NOx and PM as~~ a SIP
27 revision in 2008, addressing long-term strategies and Best Available Retrofit Technology (BART) requirements for stationary sources of NOx and PM. ~~if Arizona determines such emission control strategies are needed to demonstrate~~
28 ~~reasonable progress.~~

48:42-48 These lines call for the backstop trading program to be triggered by either a "consensus" (line 42) or a "unanimous" (line 45) decision by participating states and tribes. The language should be consistent to avoid later misunderstanding, should consensus to trigger the program be reached without unanimous assent, or to make clear Arizona's intentions if consensus is reached without unanimity.

68:17 The language in section 8.5(a)(1)(i-iii) generally agrees with the most recent Draft Memorandum of Agreement posted to the WRAP website (http://wrapair.org/forums/mtf/documents/ravi_bart/MOAonRA_BARTrev012003.doc). The Agreement has not yet been completed and signed between the National Park Service and the State of Arizona. The following language corrects discrepancies between the Draft SIP and Draft MOA:

69:1 Clarify the status of the agreement, "Park Service and U.S. Forest Service intend ~~agree~~ to use the following screening process in making"

69:7 Update criterion, "(ii) There are BART-eligible sources of sulfur dioxide within 150 km ~~100 miles~~ of the mandatory Federal"

77:13 Missing verb, "smoke. In addition, a statewide inventory and emissions tracking system must be established for volatile"

78:18 Typographic error, "including the State Department of Agriculture, State Land Department, Federal Land Managers~~'s~~,"

79: Table 10-1 is a good addition to the Plan.

118 Descriptions of the two National Parks describe them as "recreational" areas, while their statutory purpose is as preserves (the courts have determined the "conserve" phrase of 16 USC 1 §1 as the primary, and the "provide" phrase as the secondary purpose of national parks: "…

which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations"). The following corrections reflect this fundamental purpose.

118:21-22 Recreational use of national parks is limited to those activities that do not compromise the long-term preservation of their features. A correction reflecting this mission and better defining the park's high use is, "and adjacent uplands. This ~~high use recreational area~~ natural preserve is under the jurisdiction of the U.S. National Park Service. Intensive use is confined to relatively small areas on the North and South rims, while most of the park is remote and primitive."

118:37 In land management, the term "multiple use" includes activities such as grazing and mining, which are not permitted in the Park. Correction, "this ~~multi-use tourist and recreational area~~ popular preserve includes information on wind generated emissions. A"

124: Table 14.3 Typographic error, "~~Capital~~ Capitol Reef national Park"

125: Table 14.4 Typographic error, "~~Capital~~ Capitol Reef national Park"

Appendix A-13b. Table 1 (Grand Canyon National Park):
Point Sources within 50 km: add a coal fired power plant 20 km east of the Park (Navajo)

Appendix A-13b. Table 3 (Petrified Forest National Park):
Paved and Unpaved Roads: There are approximately 40 miles of two-lane paved road in the Park, and a 4.5 mile portion of Interstate 40 passes through the northern portion.

Wind-generated emissions: add "dry riverbeds" to the sources of windblown dust both within and adjacent to the Park.

Prescribed Burning and Wildfire: Vegetation in the park is shrub and grassland, with few trees. No prescribed fires are currently conducted in or within 50 km. of the park. Wildfires (grass) are rare.

Point Sources: Coal fired power plants are 35 km west (Cholla) and 52 km southeast (Coronado) of the Park.

PACIFICORP
PACIFIC POWER UTAH POWER

Transmitted Via Email to: dam@ev.state.az.us

December 03, 2003

Corky Martinkovic
Arizona Department of Environmental Quality
Air Quality Division
Phoenix Main Office
1110 W. Washington St.
Phoenix, AZ 85007

Re: Arizona's State Implementation Plan submittal to EPA under Section 309 of the Regional Haze Rule (40 CFR 51.309)

Dear Ms. Martinkovic:

PacifiCorp appreciates this opportunity to comment on Arizona's State Implementation Plan submittal under Section 309 of the federal regional haze rule.

PacifiCorp is an electricity company with headquarters in Portland, Oregon. We conduct our retail electric utility business as Pacific Power and Utah Power and engage in power production and sales on a wholesale basis under the name PacifiCorp. We serve approximately 1.5 million retail customers in service territories aggregating about 135,800 square miles in portions of six western states: Utah, Oregon, Wyoming, Washington, Idaho and California. The company owns or has interests in generating plants with an aggregate nameplate rating of 8,280 megawatts (MW) and plant net capability of 7,832 MW.

The company owns and operates thermal plants in Wyoming, Utah, Arizona, Colorado, Montana and Oregon. This includes seven coal-fired power plants owned and/or operated by the company in Utah and Wyoming and Cholla Unit 4 which is located near Holbrook, Arizona. Arizona, Utah and Wyoming all have stated their intention to file SIPs under section 309.

PacifiCorp supports the state of Arizona's decision to adopt the Section 309 approach under the federal regional haze rule. The plan brings to fruition years of significant technical study and public participation initiated by the Grand Canyon Visibility Transport Commission and continued by the Western Regional Air Partnership. PacifiCorp compliments Arizona for its leadership role in developing the Section 309 option for nine Western states.

The Backstop Market Program for Sulfur Dioxide

The centerpiece of Section 309 is the backstop regulatory program for sulfur dioxide (SO_2) emissions from stationary sources. In many ways, this backstop program sets in motion a significant experiment in public policy for air quality in the region. The premise of the program is twofold. First, the costs of SO_2 controls within the region will be reduced by setting firm targets for regional emissions and then allowing sources the flexibility to choose the steps needed to keep their collective emissions below those targets. Second, the most efficient means to assure that the milestone targets are met, in the event that sources do not keep their collective emissions down on a voluntary basis, would be to implement a cap and trade program.

Notwithstanding the backstop nature of this program, sources within the participating Section 309 states are faced with real incentives to manage their emissions. Failing to take voluntary actions that keep the region in compliance with the SO_2 milestones will result in real consequences for sources. For this program to work, states must foster a regulatory environment that gives sources confidence that reasonable actions taken to reduce emissions under the Section 309 backstop program will be recognized as responsible investments designed to meet the human health and environmental welfare goals of the states participating in this regional program.

Finally, PacifiCorp believes this program resulted from a voluntary process driven by the states and tribes within the region. The SO_2 milestones were the result of careful, deliberate negotiation that considered the role of SO_2 emissions in the mandatory class I federal areas within the region as a whole. In a very general sense, sources recognize that they, along with many other sources that emit visibility-impairing pollutants in the region, contribute to regional haze visibility impairment in the mandatory class I areas. At the same time, there was also a careful consideration of the factors that must be addressed in determinations of BART and reasonable progress under Section 169A of the Clean Air Act. The milestones represent a fair and reasoned response, voluntarily negotiated to address the contribution made by these sources.

Additional Issues for the 2003 SIP

As Arizona continues to review its proposal, we urge you to consider the following issues:

Additional Class I Areas and the SO_2 Milestones: Section 309 states must provide closure in the 2003 SIP that, for purposes of SO_2 from affected stationary sources covered by this program, the emission reduction milestones provide "greater reasonable progress" than would be achieved by the application of best available retrofit technology for all class I areas in the region. This objective was expressed by the states and tribes in the Annex and confirmed in subsequent modeling demonstrations performed by the WRAP. The work completed by the WRAP demonstrated this not only for the 16 mandatory class I federal areas on the Colorado Plateau, but for all mandatory class I federal areas in the region, including those in the state of Arizona (see: Technical Support Document, 4.1.2. Stationary Source SO_2 Control Scenario Modeling Results for Western Class I Areas).

A significant benefit under the rule is that no further demonstrations are necessary to show that, for stationary sources of SO_2 covered by this program, the milestones will satisfy the BART provisions of §169A of the CAA. Affected sources covered by this program must have certainty that the SO_2 milestones will not be reopened.

Reconciliation of SIP Requirements: PacifiCorp believes all five states must remain committed to take additional steps in order to reconcile their 2003 SIP submittals where necessary. These SIPs reflect the work and commitments of individual states, but it is essential to recognize that this is a coordinated program among states and tribes. In order for the program to function smoothly, the states must work together to ensure those affected sources face a consistent set of policies across the region. This is especially important for companies like PacifiCorp that have operations in more than one Section 309 state. The WRAP provides a mechanism to accomplish this.

Changes in flow rate measurement methods: Per section 8.1.3(3)(a), while PacifiCorp understands the intent of this provision as it was negotiated in the Annex (i.e., to avoid so called "paper changes" in emissions), we also have continuing concerns about how it will be implemented in the real world. This section assumes that monitoring emissions is an exact science with discreet actions that affect the accuracy of the data. This is simply not true. There are many variables that affect emissions and the data that is reported. In order to standardize the reporting of emissions, EPA has created a very detailed program under Title IV of the Clean Air Act. Utilities have complied with EPA's requirements for measuring, conducting quality assurance and quality control activities, and reporting stack emissions since 1995. All data supplied to EPA under Title IV of the Clean Air Act is certified to meet these EPA standards. PacifiCorp recommends that Arizona be very cautious about adjusting the interim milestones using these methods, and recommends that the state rely on the emissions that utilities report to the EPA under Title IV of the acid rain program, rather than getting caught-up in the creation of additional clumsy and burdensome databases to address relatively minor changes in the milestones.

<u>Year 2013 Assessment</u>: Per section 8.1.4, PacifiCorp recommends the following: following the letter and spirit of the Annex, PacifiCorp believes that this process entails two steps: (1) a determination based on the evidence that the 2018 milestone will not be met; and (2) a consensus decision with the other 309 states that triggering the program is "necessary" to ensure the 2018 milestone is met (i.e., consensus that <u>but for</u> an early triggering of the program, the 2018 milestone will not be met). This properly places the burden on those asserting that the program should be triggered early.

Revise 8.1.4(2)(b) At the end of this subsection, add the following sentence: "<u>The draft report will be posted on the WRAP website for a period of public review and comment for not less than 30 days.</u>"

Revise 8.1.4(3) "Consensus Decision" as follows:
"The State of Arizona commits to meet with the participating states and tribes in March 2014 to discuss any comments received on the 2018 emission projections in the draft report. The participating states and tribes will decide, through a consensus process, <u>whether it can be determined that the 2018 milestone will not be met, and whether it is necessary to trigger the WEB trading program early in order to meet the SO2 emission reduction goals in 2018</u>."

<u>Utility Allocation Issues</u>: PacifiCorp generally agrees with the approach for utilities adopted by Arizona [see 8.3.1] and the other §309 states on this matter. Given the extremely low probability that the program will be triggered in the first five years, it is not essential to develop a precise allocation methodology or numeric allowance totals for individual utility sources at this time. The approach offered by Arizona offers a solid foundation to move quickly on finalizing allocations in the 2008 SIP.

We have the following additional comments on the principles and equity issues enunciated in the text as they apply to utility units **(comments are indicated in bold font):**

<u>Principles</u>:

- "Each unit will have enough allowances to operate as a clean source and at an operating rate (capacity factor) that is a realistic upper bound for the unit." **PacifiCorp agrees. The floor methodology would identify units emitting at very clean levels (e.g., 0.10 – 0.12 lbs/mmBtu of SO2) and ensure that these units could operate at maximum realistic levels (e.g., 100 %). This approach recognizes past investments in emission controls and ensures that these clean units will be able to operate at high levels without the need to buy additional allowances.**

- "There will not be significant winners and losers in this process." **PacifiCorp believes the way to ensure this is through the design of the reducible portion of the allocation formula, and that using an average emission rate/historic heat input approach is the**

most equitable and straightforward for this purpose. However, even this methodology tends to offer greater rewards to cleaner units (i.e., units operating just above the "clean unit" floor level, but at lower levels than others in the region). While this produces a desirable outcome in that it gives greater rewards to cleaner units, some may perceive those rewards as being too great. We recommend a cap on the level of allowances awarded to these units to address this perceived inequity.

- "The focus is on a fair approach that is applied equally to all sources rather than on state and tribal budgets." **Some have argued that instead of using a uniform methodology applied equally to all sources across the region, states should be given allocation budgets based on the "opt-in, opt-out tables" in the Annex. PacifiCorp agrees that state budgets are not appropriate for a regional program. Furthermore, we would strongly oppose use of the "opt-in, opt-out tables under any circumstance.**

- "The allocation process will use data that reflect current conditions, including current monitoring methodologies." **PacifiCorp agrees. This has special significance for designing the reducible portion of the allocation methodology. The proposed SIP offers one approach for using recent baseline data. Arizona and the other §309 states should consider other alternatives including a period of time that is closer to the period when allocations are actually made. The essential point is that recent operating conditions based on heat input should be the basis for allocating the reducible portion. Some proposals have suggested using an operating level based on a uniform capacity factor, such as 85%. We disagree. This kind of approach would divorce allocations from operational realities in the region. (See also comments below under "Equity Issues".)**

Equity Issues:

- "Sources that are currently burning very low sulfur coal may see changes in their supply in the future. Historic actual emissions may not reflect future operations." **There are two essential components of emissions management – fuel input and control levels. Variability in fuel input is a fact of life faced by all operating units in the region. While PacifiCorp understands the need to address gross inequities, it is skeptical of adjustments to the allocation formula that insulate units from all consequences of fuel variability.**

- "Sources that are currently operating at a low utilization may not reach full capacity in the future. Assumptions about growth that are realistic on the regional level may provide a windfall to some sources, and not provide adequate allowances for other sources." **For these reasons PacifiCorp believes the best indicator of utilization is the most recent data available from actual plant operation. A variety of methods, such as an average annual heat input over the most recent 3 years of operation, could be used. The closer these historic years are to the years when allocations will actually be created, the more relevant they will be. PacifiCorp recommends that the actual allocations of allowances be delayed until the market has been triggered. At that point in time the most recent and relevant operating data can be used in the allocation process. PacifiCorp does not support projecting future utilization factors to determine allocations, especially so far into the future that load forecasts are unreliable.**

- "There are some utility units in the region that are not BART-eligible and are operating at a low level of control for SO2. The relative responsibility of BART-eligible vs. non-BART-eligible is a consideration in the process." **PacifiCorp agrees. The proposed framework would address this issue.**

- "Sources that are operating at a high level of control are already bearing the cost of control and this affects their ability to compete in the market." **PacifiCorp agrees and believes that the proposed framework addresses this issue. Under the proposed allocation framework, "clean units" would be held harmless, and the cleaner units affected by the reducible portion of the formula could receive a proportionally greater number of allowances that would recognize their previous efforts to reduce emissions.**

- "Sources that have no SO2 controls are facing a large expense that could affect their ability to continue to operate." **While this may be a true statement, we must remember the purpose of the program which is to reduce emissions across the region. The value of a market program is that even though liability may be assigned to a source to reduce emissions, it does not force controls on a specific source. Source owners have the option to control the source or to buy allowances from sources which have lower marginal costs of control. There are alternatives under a market program that can reduce costs for the operator and the region. Therefore, interfering with this mechanism in order to protect individual sources may be counterproductive.**

- "Emission rate disparities exist throughout the region." **The proposed framework recognizes this fact. See comments above.**

Beyond 2003

While essential technical information and policy decisions are in place to submit a plan under Section 309 by the end of this year, proper implementation of the program through 2018 will require a continued commitment from the participating states and stakeholders. The period between 2003 and 2008 will provide important challenges to finalize policy decisions affecting several issues including, but not limited to, the following:

- the sulfur dioxide allocation methodology including quantification of specific allocations for affected sources in the event the program is triggered;
- the appropriate role of the "reasonably attributable visibility impairment" (RAVI) program given the Section 309 program to reduce emissions for regional haze;
- requirements concerning emissions of NOx and PM; and
- any other requirements for the additional class I areas.

PacifiCorp remains committed to work with participating states to meet these objectives.

Thank you for considering these comments. If you have any questions, please do not hesitate to contact me at (801) 220-4581.

Sincerely,

William K. Lawson

William K. Lawson
Environmental Manager
PacifiCorp

P. O. Box 52025
Phoenix, AZ 85072-2025
(602) 236-5900
www.srpnet.com

Mail Station: PAB352
Direct Phone: (602) 236-2968
Fax: (602) 236-3407
Email: kgwantta@srpnet.com

CERTIFIED MAIL: 7003 1010 0005 0174 2690
RETURN RECEIPT REQUESTED

December 5, 2003

Mr. Stephen A. Owens
Director
Arizona Department of Environmental Quality
1110 West Washington Street
Phoenix, Arizona 85007

Re: Arizona's Regional Haze State Implementation Plan for the Colorado Plateau

Dear Director Owens:

Salt River Project ("SRP") appreciates the opportunity to provide comments on the Arizona Department of Environmental Quality's ("ADEQ") proposed State Implementation Plan ("SIP") for addressing Regional Haze in those Class I areas located on the Colorado Plateau. ADEQ is to be commended for developing the SIP with a substantive stakeholder process, and its significant collaboration and continued participation in the Western Regional Air Partnership ("WRAP"). The draft SIP demonstrates the State's commitment to continue the progress that has been made in improving visibility in the Class I areas on the Colorado Plateau and in the other Class I areas located in the State.

A. Background of SRP

SRP was established in 1903 as the nation's first multipurpose reclamation project authorized under the National Reclamation Act. Today, SRP is the nation's third-largest public power utility and the largest provider of surface water in Arizona. It serves electricity to nearly 800,000 customers and delivers water for more than one million Phoenix metropolitan area residents. SRP owns and operates an electrical system which generates, transmits, and distributes electric power to residential, commercial, industrial and agricultural power users in a 2,900 square mile service territory, and an additional 2,400 square mile service area for wholesale and mine loads. SRP employs over 4,000 people in the State of Arizona.

SRP's generating assets include coal, natural gas, oil, nuclear, hydro, landfill gas, and solar, with a total generating capacity of approximately 6,000 megawatts. SRP's coal generating assets include approximately 1,300 megawatts in northern and west-central Arizona, 400 megawatts in northwest Colorado, 300 megawatts in southern Nevada, and 150 megawatts in northwest New Mexico. SRP's share of capital investments in new and improved air pollution control equipment at these facilities have exceeded $150 million over the past ten years, and could exceed $250 million by the end of the decade.

SRP is a significant supporter of renewable energy and energy efficiency programs. SRP has significant investments in hydro, landfill gas, and solar electric generating facilities. Most recently, SRP entered into a power purchase agreement with Public Service of New Mexico for 50 megawatts of wind power, which will be located in east-central New Mexico. SRP is a significant supporter of Arizona State University's renewables and fuel cells research programs, the renewable programs of the Electric Power Research Institute, and is a partner in EPA's Energy Star program. SRP's renewable energy and energy efficiency efforts, which are completely voluntary, yet comparable to those of many regulated utilities, are a direct reflection of SRP's commitment to its customers, the State of Arizona, and the environment, to pursue cost effective clean sources of alternative and renewable energy, and to promote energy efficiency.

B. Pollution Prevention

As part of the State's stakeholder process to assist with the development of the draft Regional Haze SIP, ADEQ established the Pollution Prevention Workgroup ("P2WG") to collect information necessary for the State to fulfill the Regional Haze Rule's pollution prevention requirements. In developing information necessary for the SIP, this group, one of several workgroups of which SRP was a member, spent a significant amount of time debating matters beyond its initial charge. The topics that were the subject of greatest discussion included the following:

1. ADEQ's roles and responsibilities with respect to energy policy.
2. ADEQ's roles with respect to the Arizona Corporation Commission's Environmental Portfolio Standard and its relationship to the Regional Haze Rule.
3. ADEQ's roles in quantification of energy efficiency programs.
4. ADEQ's obligations relating to 40 CFR 51.309(d)(8)(iii), providing for programs to preserve and expand energy conservation efforts.

As a result of these discussions, the P2WG's efforts culminated with not only the development of recommended SIP language to satisfy the Regional Haze Rule's requirements, but also with non-consensus recommendations concerning the four topics above. These recommendations were ultimately presented to the SIP Stakeholder Advisory Committee and ADEQ. Since it is SRP's understanding that ADEQ is still giving consideration to these recommendations, SRP's comments on the pollution prevention aspects of the SIP, which are presented below, are focused on these issues.

B.1 Regulatory Roles in Energy Policy

ADEQ is required to submit a Regional Haze SIP that addresses the requirements set forth in the Regional Haze Rule. In satisfying its requirements under the rule, ADEQ, however, is not required to be an advocate for, or otherwise participate in matters specifically involving energy policy. In Arizona, energy policy is the responsibility of the Governor, legislature, and the Arizona Corporation Commission, while at the Federal level, several agencies and both the executive and legislative branches of government play significant roles in dictating energy policy.

These agencies certainly find environmental information valuable in the development of their policies and programs, and may choose to draw on ADEQ's expertise in this area. However, SRP believes several members of the P2WG have lost sight of the fact that ADEQ serves many important functions for the State of Arizona, and like all State agencies, operates within certain budget constraints. As such, investing resources toward meaningful participation in energy policy, which is not ADEQ's core function, would likely have an undesirable affect on programs more directly related to its fundamental mission; the protection of public health and the environment. Further, as discussed below, based on the studies conducted by WRAP to date, diverting resources or investing new resources towards energy policy would not appear at this time to be a prudent policy decision for ADEQ.

B.2 Quantification of Benefits

Significant resources have been invested in WRAP, and by WRAP, to determine what if any impact that full implementation of the Grand Canyon Visibility Transport Commission's ("GCVTC's") 10/20 renewables goals and incorporation of certain energy efficiency measures, on a regional basis, could have on regional haze. The intent of this assessment is to inform the public on the potential benefits, in terms of regional haze reduction, that could be realized by achieving the goals. These rather rigorous technical analyses have shown that such programs will have little to no impact on regional SO2 emissions, which is a primary contributor to haze in the West, and less than a two-percent reduction in NOx emissions, which is an insignificant contributor to regional haze. Further, in meeting its assessment and reporting obligations under the Regional Haze Rule, ADEQ will be required to assess progress toward improving visibility in Class I areas, and take appropriate action if necessary on a periodic basis.

This notwithstanding, certain members of the P2WG felt it necessary to recommend further quantification of benefits associated with certain pollution prevention programs, seemingly ignoring the work that has been conducted to date, and that will be required by the Regional Haze Rule in the future. As such, SRP does not feel it is necessary to remind ADEQ of its fundamental regulatory obligations pursuant to the Regional Haze Rule, or to suggest that ADEQ's and WRAP's efforts to date have been inadequate. Rather, SRP would like to take this opportunity to applaud ADEQ for the significant work it has conducted to date, for its taking a leadership role in WRAP, and offer its continued support for ADEQ's efforts at addressing regional haze.

B.3 Energy Conservation Elements of the Regional Haze Rule

The pollution prevention information submitted to ADEQ by the P2WG meets all of the associated requirements of the Regional Haze Rule. The enforceable provisions of the rule relating to pollution prevention are essentially limited to inventorying existing pollution prevention programs, making projections of potential short-term and long-term benefits, and regularly assessing the State's progress toward contributing to the 10/20 renewable energy goals established by the GCVTC. The Regional Haze Rule does not require the State to adopt any new specific energy conservation policies, or establish any stated goals relating to energy conservation.

ADEQ reiterated this information to the entire P2WG on several occasions. Nevertheless, certain P2WG members recommended that ADEQ take on the role as an advocate for certain energy efficiency programs, including several directed at utilities in the form of additional charges to electric consumers (e.g., energy efficiency system benefit charges, electricity rate "reforms", etc.). Yet, as noted previously, the significant work conducted by WRAP to date suggests that energy efficiency programs, even when combined with renewables programs, would have essentially no effect on regional haze in the Colorado Plateau. As such, it seems premature at best for ADEQ to volunteer its advocacy in the name of Regional Haze for programs that are currently projected to have little or any of such benefits.

C. Stationary Sources

Section 8.3.1 of the draft SIP identifies several "equity issues" that Arizona and the other states implementing Section 309 SIPs will take into consideration when assigning initial allocations (both the floor and reducible allocations) to utilities, in the event the backstop cap and trade program is triggered. SRP's comments on a few of these issues are presented below.

C.1 BART-Eligibility

One of the equity issues suggests that BART-eligible sources have a "responsibility" to perhaps achieve greater controls than non-BART-eligible sources. This statement seems to ignore one important point. In order to be subjected to BART controls under the regional haze program, a source would actually need to be found to be contributing to visibility impairment in a Class I area. Further, in the event a BART-eligible source is found to be contributing to impairment, the level of controls required for that facility would be dependent on several factors (degree of improvement, cost, environmental impacts, existing controls, useful life).

So just because a source is BART-eligible does not mean it would have automatically been subjected to substantive additional controls had the state in which the source was located elected to proceed under Section 308. Therefore, BART-eligibility alone should not be significant factor or issue considered in developing an equitable system for allocating allowances, and SRP suggests that this issue be deleted or revised accordingly.

C.2 Well Controlled Units

Although equity issues related to well-controlled units are noted in the proposed rule, SRP suggests that the rule be revised to further recognize that many units in the region have limits that are equivalent to, or even better than, what would likely be considered a "clean unit" under the regional haze program. Similarly, several of these units are operating at emission rates that are perhaps better than what would be considered a "clean unit." Since these units are already operating at a competitive disadvantage with respect to operating costs associated with pollution controls, they should not be penalized for having emissions limits and/or actual emissions at levels less than what would be the basis for a floor allocation under this new rule. In addition, some facilities may be currently operating at lower emission rates than would be expected in future years either because their controls are relatively new, or because they have reduced emissions, perhaps temporarily, due to market conditions associated with Acid Rain allowances, and such sources should not be penalized for these factors.

For example, Navajo Generating Station ("NGS") was required to install scrubbers in the 1990's pursuant to a Reasonably Attributable Visibility Impairment determination. As a result of this process, the facility agreed to an annual plantwide sulfur dioxide limit of 0.10 lb/MMBtu, which was determined to be "better than BART." And even though the facility has operated well in compliance with this standard (it is actually one of the best performing coal plants in the country, due in part to the low sulfur fuel currently being used, and the nearly new condition of its scrubbers), if the Navajo Nation was to opt into the Section 309 program, and if NGS was to agree to regulation by the Navajo Nation for regional haze purposes, under no circumstance should the facility be subjected to SO2 requirements that are more stringent than the limit already established in the name of visibility improvement. Similarly, several sources in the West have recently made significant investments in pollution controls in accordance with settlement actions, and the emission levels and investments required by these actions should be considered in establishing initial allocations.

D. Conclusions

As a substantial supporter of renewable energy and energy efficiency programs in the State of Arizona, SRP understands the objectives of several members of the P2WG to go far above and beyond the requirements of the Regional Haze Rule. However, while their goals and recommendations may be laudable, the Regional Haze Rule is not the appropriate mechanism for championing or advocating ideas that are far outside the scope of its intended purpose.

Again, SRP strongly appreciates the efforts of ADEQ to develop its Regional Haze SIP by a collaborative stakeholder process. Thank you for you consideration of these comments.

Sincerely,

Kevin Wanttaja

Kevin Wanttaja
Manager, Environmental Services

cc: Debborah Martinkovic, ADEQ
Dick Hayslip
Dan Casiraro
Chris Janick
Herjinder Hawkins
ORG 2-1-2

Embedded e-mail from Chris Janick attached to SRP's formal comments

Corky:

SRP's comments on the draft SIP are presented in the attached letter (you will receive a copy in the mail as well). In addition to those comments, there is one other item that should be changed. Page 97, under the heading "Green Pricing", makes reference to SRP's Solar Choice program and solar equipment at Santan. This program has been replaced with what we now call EarthWise Energy (as referenced in a few other parts of the Pollution Prevenion section), and now includes not only solar, but other renewable energy sources as well. In addition, in order to make room for the expansion of our Santan plant, the solar equipment referenced in this paragraph was relocated to the Rogers Substation (as reflected in Appendix A-12b). As such, SRP requests that this paragraph be revised to read as follows:

Salt River Project: SRP provides a renewable energy purchase option to its customers. Dubbed EarthWise Energy, SRP customers can purchase 100-watt blocks of renewable capacity for $3.00 per month. For more details see http://www.eren.doe.gov/greenpower/gp_munipu.html#srp

CEED

THE CENTER FOR ENERGY
AND ECONOMIC DEVELOPMENT

December 3, 2003

Via Facsimile, Electronic Mail, and U.S. Mail

Stephen A. Owens, Director
Deborah Martinkovic
Arizona Department of Environmental Quality
Air Quality Division
1110 West Washington
Phoenix, AZ 85007

Re: Proposed Regional Haze Rule Implementation Plan

Dear Director Owens and Ms. Martinkovic:

The Center for Energy and Economic Development (CEED) submits these comments in response to the Arizona Department of Environmental Quality's October 24, 2003, draft Arizona Proposed Regional Haze Rule State Implementation Plan (SIP). We appreciate the opportunity to provide you with these detailed comments, recommendations and supporting rationale with respect to the direction Arizona should take concerning implementation of the federal Regional Haze Rules (RHR).

CEED is a non-profit organization formed by the nation's coal-producing companies, railroads, a number of electric utilities, equipment manufacturers, and related organizations for the purpose of educating the public, including public-sector decision-makers, about the benefits of affordable, reliable, and environmentally compatible coal-fueled electricity. CEED has several members from each of these several industry groups present and doing business in Arizona. CEED has been a participant in the Department's past stake-holder process and continues to have an active stake in the future development and implementation of visibility protection plans in Arizona for Class I areas (national parks and wilderness areas) that achieve state and federal goals in a rational and cost-effective manner.

I. INTRODUCTION

EPA's RHR were promulgated on April 22, 1999 and contain provisions of general national applicability for all states (§ 308) and alternative provisions (§ 309) by which certain western states can opt to be governed on an accelerated timeframe. CEED notes that the Department's proposed SIP (if adopted and subsequently approved by the U.S. Environmental Protection Agency (EPA)) would implement the optional provisions contained in 40 C.F.R. §51.309.

As an introductory matter, CEED believes that it is critical for the Department to be aware that the RHR was challenged in the U.S. Court of Appeals for the District of Columbia Circuit by several states, industry organizations, and the Sierra Club. On May 24, 2002 the U.S. Court of Appeals issued an opinion on EPA's Regional Haze Rules (RHR). See, American Corn Growers Association, et. al. v. EPA, 291 F.3d 1 (D.C. Cir. May 24, 2002). See, Attachment A. CEED took a leading role in that litigation – particularly with respect to the Best Available Retrofit Technology (BART) provisions of the RHR that the Court invalidated.

Specifically, the Court of Appeals invalidated several provisions of the RHR and held that EPA lacks the statutory authority to impose group BART "stationary source" attribution and retrofit requirements on the states. The Court agreed that EPA's group-attribution and retrofit approach violated the federal Clean Air Act (CAA) because that statute requires attribution and a cost-benefit comparison to be applied to each source on a source-by-source basis and not in a group fashion, as EPA had done. Additionally, the Court found that EPA's group retrofit requirements meant a source could be forced to spend millions of dollars in retrofit equipment without any beneficial impact on regional haze. The Court also recognized that Congress expressly intended for states to decide which sources impair visibility and what level of controls are appropriate. The Court "remanded" these invalidated provisions of the RHR to EPA, along with several separate RHR provisions challenged by the Sierra Club. EPA must now take administrative action to address the several facets of the Court's ruling.

CEED believes that, as a result of the uncertainty created by the U.S. Court of Appeals decision to invalidate several key provisions of the RHR (and to also uphold others) along with the Court's anticipation that EPA will need to undertake a substantial re-write of the RHR, it would be premature for Arizona to take any administrative action on the RHR by choosing § 308 or § 309 as an option at this time. At present, there is no federal requirement to submit an RHR SIP and Arizona should not act in advance of EPA's actions to address the judicial remand.

II. ARIZONA SHOULD NOT COMMIT TO A SPECIFIC REGIONAL HAZE IMPLEMENTATION APPROACH UNTIL AFTER EPA HAS RESPONDED TO THE COURT'S REMAND OF THE RHR

The Court's decision applies to **all** of the RHR's BART provisions, not just the BART provisions of § 308. According to the Court, "[i]n sum, **we conclude that the Haze Rule's BART provisions** are contrary to the text, structure and history of § 169A of the [Clean Air Act]." Slip Op. at 13. (Emphasis added). Nothing in this language excludes the BART provisions of § 309.

CEED believes that RHR § 309(f), under which the Annex was developed, is clearly one of the "BART provisions" referenced by the Court's decision. Section 309(f) expressly provides an alternative means for states to comply with their obligations under the BART provisions of RHR § 308 and under CAA § 169A. In this regard, the BART requirements of RHR § 308(e) apply to every state. RHR § 309(f)(1) provides that "[a] Transport Region State may choose to comply with the provisions of this section **and by doing so shall satisfy the requirements of section 51.308(b)-**

(e) . . ." through the Annex process (emphasis added). RHR § 309(f)(1)(i) provides that "[t]he emission reductions milestones [included in the Annex] must be shown to provide for greater reasonable progress than would be achieved by application of best available retrofit technology [BART] pursuant to section 51.308 **and would be approvable in lieu of BART**." (Emphasis added.) As a BART provision intended to implement the BART requirements of CAA § 169A, RHR § 309(f) comes within the Court's decision and remand of the rule to EPA.

While the Court of Appeals ruled to "vacate the rule in part and sustain it in part," the effect of the Court's remand is that EPA has been asked by the Court to review the entire rule. This intent is signaled by the fact that the Court said it would not address the merits of the challenges to the RHR brought by Sierra Club, because of the uncertainties created by the Court's decision to vacate and remand all of the BART provisions contained in the RHR.

A clear reading of the Annex submitted to EPA on or about September 29, 2000 demonstrates that it was developed based upon the group retrofit requirement provisions of the RHR. Specifically, the WRAP stated that, as required by the RHR, it had followed the same RHR Group BART approach that the Court of Appeals has now found to be unlawful. For example, the Annex states that "[t]his process was developed through the best efforts of the WRAP through a stakeholder based process **and is based on the WRAP's reading of the regional haze rule language and preamble**." See, ATTACHMENT C to WRAP Annex entitled "*Demonstration that the SO_2 Milestones Provide Greater Reasonable Progress than BART*." P C-2 (Emphasis added). Additionally, the Annex clearly indicates that the WRAP applied four of the CAA's BART factors to sources in the entire western United States on a **group** basis, as a result of the regulatory framework required by EPA's RHR. Further, in applying the critical fifth CAA BART factor – "the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology," the WRAP also used the group approach.

CEED has been an active participant in several western states regional haze administrative processes. CEED has observed that the State of Colorado has specifically opted not to pursue the §309 option and, instead, will only act after EPA addresses the Court's remand. Arizona should take the same considered approach to adopting visibility protection measures. As other states continue to evaluate the visibility protection options, CEED has observed that state environmental agency personnel present and discuss the Annex in a way that confirms the "Group-BART" origins of the Annex, an approach that is clearly contrary to the law. For example, Wyoming has released a written summary of BART issues for its stakeholder process that reports how the regional SO_2 emissions milestones contained in the Annex were developed using Group-BART assumptions made by the WRAP. (See, "What is BART?" prepared by Wyoming Department of Environmental Quality, pp.5-6.)[1]

[1] Further, the WRAP report entitled, "Stationary Source NO_X and PM Emissions in the WRAP Region: An Initial Assessment of Emissions, Controls, and Air Quality Impacts," which the Department has included in its proposed SIP, is legally and technically flawed because it was developed and utilizes the same group-BART process to define a future NO_X and PM trading program under §309 for stationary sources.

In light of the Court's view that the remand on Group BART could have ripple effects throughout the rule, Arizona should not act on "implementation of the RHR" at least until EPA is ready to act on the remand. If the provisions of the RHR attacked by the Sierra Club are related to the provisions struck down by the Court, the Annex provisions are even more related. Given the direct links between §§ 308 and 309 described above, it is not tenable to say that EPA's reconsideration of § 308 will not affect § 309. As the primary example of this relation, § 309(f)(i) of the Annex requires that emission reduction milestones provide "better" reasonable progress than would be obtained through application of BART to BART-eligible sources. As a simple matter of logic, and the relationship between these provisions, it is impossible to determine whether § 309 emission reduction milestones are better than BART (as applied to BART-eligible sources) when there is currently no applicable rule or implementation to determine what BART is and how it can be bested by a § 309 program. In short, a § 309 emission reduction milestone determination is directly affected by the way in which EPA redrafts § 308(e) on remand.

III. THE DEPARTMENT'S PROPOSED SIP DOES NOT MEET THE MINIMUM REQUIREMENTS OF EITHER ARIZONA STATUTE OR 40 CFR §51.309 AND ARIZONA MUST THEREFORE PURSUE A RHR SIP UNDER 40 C.F.R. §51.308

The Department's proposed SIP is deficient because it does not contain all of the required elements of a § 309 SIP analysis and proper determinations. The Department has failed to consider or include in the required analysis the impact of mobile sources from "all areas within the state", to consider these impacts on a statewide basis, and to assess the current impact of mobile source emissions in Arizona on visibility in the 16 Class I areas. The effect of these deficiencies is that Arizona stakeholders, such as CEED and its members, have never been afforded the opportunity to present testimony outlining 1) the several technical, legal and policy concerns associated with deficient mobile source contribution analysis, and 2) the disproportionate impact that deficient analysis and accounting will have on stationary sources in Arizona. For this reason, Arizona cannot cure this legal and technical deficiency in the time available. CEED believes Arizona is better served by implementing the provisions of §308 after EPA addressed the Court's removal of major components of the rule.

A. Mobile Source Emissions Have Not Been Considered From "All Areas Within the State" and the Impact of Those Sources on a Statewide Basis

In May 2002, the Arizona Legislature enacted a statute authorizing the State of Arizona Department of Environmental Quality to develop regional haze plans. However, Arizona's ability to opt-in to § 309 was expressly conditioned by the requirement that Arizona mobile source emissions do not contribute significantly to visibility impairment at any of the 16 Class I areas on the Colorado Plateau.

> The department may submit a plan revision under 40 Code of Federal Regulations section 51.309 **only if the revision contains a determination pursuant to 40 Code of Federal Regulations section 51.309(d)(5)(ii) that mobile source emissions**

> **from areas within the state do not contribute significantly to visibility** impairment in any of the Grand Canyon Visibility Transport Commission Class I areas.

Arizona Revised Statutes, § 49-414.01(E) (emphasis added).

While §9.2 of the Department's proposed §309 SIP is entitled, "Inventory of Current and Projected Emissions from Mobile Sources," this section of the proposed SIP does not demonstrate that the Department has met the minimum requirements of either Arizona Revised Statutes, §49-414.01(E) or RHR §309(d)(5). Specifically, §9.2(b) of the Department's proposed §309 SIP, entitled "Determination of Significance of Arizona Urban Area Mobile Source Emissions" fails to meet the requirements of ARS §49-414.01(E)'s requirements to assess whether mobile source emissions significantly contribute to visibility impairment in any of the 16 Class I areas in the Transport Region from all "areas within the state" because the Department only assessed "urban area mobile source emissions." The SIP, on its face, therefore fails to conduct or include a required mobile source visibility impairment "significance" assessment from all non-urban areas located within the State of Arizona.

The effect of the Department's exclusion of all non-urban areas in Arizona is highlighted by the Grand Canyon Visibility Transport Commission's definition of "mobile source", which states:

> **(Mobile Source:)** A pollution source that moves. Mobile sources are often divided into road sources, including cars, trucks, buses, and motorcycles, and non-road sources like trains, planes, boats, lawnmowers, etc.

See "Recommendations for Improving Western Vistas," Report of the Grand Canyon Visibility Transport Commission, dated June 10, 1996, page ix. This definition is not exclusive of sources outside of Arizona urban areas. All mobile sources within the state must be accounted for and included in the assessment of visibility impacts from the combined mobile sources in the State of Arizona.

In addition, RHR §309(c) requires that each "Transport Region State" opting to submit a §309 SIP "that complies with the requirements of this section." must do so by December 31, 2003. The several required elements of a §309 SIP are set forth in §309(d), entitled "Requirements of the first implementation plan for states electing to adopt all of the recommendations of the Commission Report." That section states that, "each Transport Region State must submit an implementation plan that meets the following requirements." One of the "requirements" that must be in a §309 SIP submittal by December 31 is adherence to and completion of the provisions of RHR §309(d)(5), entitled "Mobile sources" which state:

> The plan submission must provide for:
>
> (i) Statewide inventories of current annual emissions and projected future annual emissions of VOC, NO_X, SO_2, elemental carbon, organic carbon, and fine particles from mobile sources for the years 2003 to 2018. The future year inventories must include projections for the year 2005, or an alternative year that is determined by the State to represent the year during which mobile source emissions will be at their lowest levels within the State.
>
> (ii) A determination whether mobile source emissions in any areas of the State contribute significantly to visibility impairment in any of the 16 Class I Areas, based on the statewide inventory of current and projected mobile source emissions.

For states with areas in which mobile source emissions are found to contribute significantly to visibility impairment in any of the 16 Class I areas, §309(d)(5)(iii) goes on to require the establishment and documentation of a mobile source emissions budget for any such area. Such budgets must also include provisions requiring the State to restrict the annual VOC, NO_X, SO_2, elemental and organic carbon, and/or fine particle mobile source emissions to their projected lowest levels, to implement measures to achieve the budget or cap, and to demonstrate compliance with the budget through an emissions tracking program.

The Department's proposed §309 SIP contains further legal defects because §9.2 of the proposed SIP also does not comport with the minimum requirements of RHR §309(c). As indicated above, §9.2(b) of the Department's proposed §309 SIP is entitled "Determination of Significance of Arizona Urban Area Mobile Source Emissions." (Emphasis added.) Thus, in addition to violating ARS 49-414.01(E) by failing to look at mobile source emissions "significance" to Class I area visibility impairment from all "areas in the state", the Department's proposed SIP also fails to meet the minimum requirements contained in 40 CFR 51.309(d)(5)(ii) which require: "A determination whether mobile source emissions in any areas of the state contribute significantly to visibility impairment in any of the 16 Class I areas… ." (emphasis added).

By excluding non-urban mobile sources from the mobile source significance assessment, the Department's proposed SIP does not adequately assess or provide an accurate "significance determination" required by ARS 49-414.01(E) for a large population of mobile sources (and their visibility impairing emissions) that clearly exist in "non-urban" areas in Arizona. The Department's unexplained failure to follow the requirements of ARS 49-414.01(E) and §309(d)(5) is therefore arbitrary, capricious and otherwise not in accordance with law.

B. The Department Has Not Properly Considered the Current Impacts of Mobile Sources on Visibility Impairment

The Department's proposed §309 SIP demonstrates that the Department has failed to conduct the mobile source significance determinations required by both ARS 49-414.01(E) and 40 CFR 51.309(d)(5)(ii) for both current and projected mobile source emissions. This fact is evidenced by the plain meaning of the text of §9.2(b), which states as follows:

> *(b) Determination of Significance of Arizona Urban Area Mobile Source Emissions.* Pursuant to 40 CFR 51.309(d)(5)(ii) and (iii) as promulgated on July 1, 1999, the State of Arizona determined that mobile source emissions from any area of the State do not "significantly contribute to" visibility impairment in any of the 16 GCVTC Class I areas. This determination was based on two findings.
>
> Finding #1. The degree of emission reductions demonstration in Table 9-1 far exceed the emission reductions that will be achieved from any other source sector affected by the Regional Haze Rule. The GCVTC defined reasonable progress for mobile sources from urban areas as standards being implemented by EPA. The recently adopted EPA standards, and pending standard will result in emission reductions from over 50% from their 2003 levels by 2018. In summary, the emission reductions projected for mobile sources constitute reasonable progress.
>
> Finding #2. The WRAP performed a modeling analysis to estimate the impact of mobile source emissions from Phoenix Metropolitan area of the GCVTC Class I in 2018. The forecast year 2018 was chosen since it represents the year with the lowest emissions, and is at the end of the planning period. Table 9-2 summarizes the relative impact of emissions from the Phoenix Metropolitan area at the 16 GCVTC Class I areas, expressed as a percentage of the projected WRAP 2018 Base Case light extinction. Based on WRAP modeling, by 2018 the impact of mobile sources from Arizona urban areas on the GCVTC class I areas will be between 0% and 4% of the projected light extinction.

(Emphasis added.)

As clearly indicated by the Department's above-noted "Findings," the Department has only made a "determination" whether urban mobile source emissions contribute significantly to visibility impairment in any of the Class I areas based solely on future, projected mobile source emissions.

The Department's failure to conduct an assessment (or separately make a "determination" based thereon) of whether the current state-wide inventory of mobile source emissions demonstrates that there is a significant contribution to visibility impairment in any of the 16 Class I areas is arbitrary, capricious, and not in accordance with the requirements of ARS 49-414.01(E) or 40 CFR 51.309(d)(5)(ii).

As a result of these several legal and technical deficiencies in the Department's proposed §309 SIP, Arizona cannot submit a §309 SIP. This result is compelled by ARS 49-414.01(E) and 40 CFR 51.309(c).

> A Transport Region State that elects not to submit an implementation plan that complies with the requirements of this section [§309] (or whose plan does not comply with all of the requirements of this section [§309]) is subject to the requirements of §51.308 in the same manner and to the same extent as any state not included within the Transport Region.

40 CFR §51.309(c) (Emphasis added.)

IV. THE RHR § 309 ANNEX IS NOT A RATIONAL OR COST-EFFECTIVE APPROACH FOR IMPROVING VISUAL AIR QUALITY IN ARIZONA OR OTHER WESTERN STATES

In addition to illustrating the impact of the American Corn Growers decision on the § 309 Annex, CEED believes the Annex is flawed for the following reasons:

- It has not been shown that the Annex will achieve a humanly perceptible improvement in visual air quality in western states' Class I areas. Further, the Annex only focuses on SO_2 emissions.

- Adequate economic analysis, depicting the Annex program's costs to the several western states' economy, is not available. Further, the broad nature of the economic analysis makes it very difficult to assess the Annex's impact. However, on its face, the costs of the Annex program seem to have a strongly disproportionate effect on states such as Wyoming, Colorado and New Mexico -- the states farthest from the 16 Class I areas subject to the Annex. This problem is compounded by the fact that Wyoming, Colorado and New Mexico are also "receptor states" of significant visibility impairing emissions which are generated upwind;

- The Annex contains and is based upon several comparison assessments of natural gas use costs vs. coal usage, which do not accurately reflect the volatility of the natural gas market. As such, the Annex contains an unrealistic cost assessment and similarly creates an unjustified bias against coal and in favor of natural gas; and

- Given that the Annex would apply to all current and future SO_2 emissions sources, the regional SO_2 cap would impose economic disincentives for the development of new coal-fired generating facilities. This information was provided to the Arizona Department of Environmental Quality and all stakeholders through an analysis prepared by Energy Ventures Analysis, a nationally-recognized research firm that tracks new power plant construction for the North American Electric Reliability Council. See, Attachment B.

V. CONCLUSION

While additional EPA action on the RHR will take time, CEED believes that all air quality plans must have a basis in sound science and all states should be afforded the time to develop expertise on regional haze and to produce the intelligent, well-thought-out plans and control strategies that the Clean Air Act envisioned. EPA must allow the time that states and others will need to rationally address regional haze in a cost-effective manner. Further, implementation of the regional haze rule should be coordinated with legislation being debated in the Congress for a multi-pollutant approach. Smart air quality planning depends on adequate and accurate information to assess both the effectiveness and the cost of possible emissions control strategies. This is the heart of Clear Air Act § 169A's intent for a state to make "reasonable progress" in visibility improvement.

On behalf of CEED and its members, thank you for the opportunity to present these views. Your consideration is most appreciated. Please contact me if you have any questions or if we can provide additional information.

Sincerely,

Terry Ross

Terry Ross
Vice-President, West Region
Center for Energy and Economic Development
P.O. Box 288
Franktown, CO 80116
(303) 814-8714
tross@ceednet.org

Attachment A

United States Court of Appeals

FOR THE DISTRICT OF COLUMBIA CIRCUIT

Argued February 25, 2002 Decided May 24, 2002

No. 99-1348

American Corn Growers Association,
Petitioner

v.

Environmental Protection Agency,
Respondent

State of Michigan, Department of
Environmental Quality, et al.,
Intervenors

Consolidated with Nos. 99-1349, 99-1350,
99-1351, 99-1352, 99-1357, 99-1358, 99-1359,
01-1111, 01-1112, 01-1113

On Petitions for Review of an Order of the
Environmental Protection Agency

Peter Glaser argued the cause for Industry petitioners and intervenors on the BART Issues in Case Nos. 99-1348,

99-1349, 99-1350, 99-1351, 99-1352, 99-1356, 99-1357, 99-1358 and 99-1359. With him on the joint briefs were Paul M. Seby, Henry V. Nickel, F. William Brownell, Michael L. Teague, Kevin L. Fast, David M. Flannery, Kathy G. Beckett, Scott D. Goldman, Harold P. Quinn, Jr., William H. Lewis, Jr., and Michael A. McCord.

Kevin L. Fast argued the cause for Industry petitioners in Case Nos. 01-1111, 01-1112 and 01-1113. With him on the joint briefs were Peter Glaser, Paul M. Seby, Henry V. Nickel, F. William Brownell, and Michael L. Teague.

David S. Baron argued the cause and filed the briefs for petitioner Sierra Club.

Jennifer M. Granholm, Attorney General, State of Michigan, Thomas L. Casey, Solicitor General, and John Fordell Leone, Assistant Attorney General, were on the briefs for intervenor State of Michigan.

Pamela S. Tonglao, Kenneth C. Amaditz, and H. Michael Semler, Attorneys, U.S. Department of Justice, argued the causes for respondents. With them on the brief was M. Lea Anderson, Attorney, U.S. Environmental Protection Agency.

Erick Titrud argued the cause for intervenors State of Maine, State of New Hampshire, State of Vermont, and Tribal and Environmental intervenors. With him on the joint brief were Ann Brewster Weeks, Vickie L. Patton, William G. Grantham, G. Steven Rowe, Attorney General, State of

Maine, Philip T. McLaughlin, Attorney General, State of New Hampshire, Maureen D. Smith, Senior Assistant Attorney General, and William H. Sorrell, Attorney General, State of Vermont.

Peter Glaser, Henry V. Nickel, F. William Brownell, Michael L. Teague, Kevin L. Fast, Paul M. Seby, Harold P. Quinn, Jennifer M. Granholm, Attorney General, State of Michigan, John Fordell Leone, Assistant Attorney General, David M. Flannery, Kathy G. Beckett, William H. Lewis, Jr.,

and Michael A. McCord were on the joint brief for Industry and State intervenors, in support of respondents.

Mark L. Shurtleff, Attorney General, State of Utah, Fred Nelson, Assistant Attorney General, and Susan M. McMichael were on the brief for amici curiae State of Utah and State of New Mexico Environment Department, in support of respondent EPA.

Before: Edwards, Randolph, and Garland, Circuit Judges.

Opinion for the Court filed Per Curiam.

Opinion concurring in part and dissenting in part filed by Circuit Judge Garland.

Per Curiam: In 1999, the Environmental Protection Agency promulgated a final rule to address regional haze. See Regional Haze Regulations, 64 Fed. Reg. 35,714 (July 1, 1999). The Haze Rule calls for states to play the lead role in designing and implementing regional haze programs to clear the air in national parks and wilderness areas that have been classified as "mandatory class I Federal areas,"1 such as Yellowstone National Park, Grand Canyon National Park, and Shenandoah National Park. See 40 C.F.R. ss 81.401-.437 (listing areas that have been designated as Class I areas where visibility is an important value). Numerous petitioners now challenge the Haze Rule. We vacate the rule in part and sustain it in part.

I. Introduction

"Regional haze," as EPA defines it, is visibility impairment caused by geographically dispersed sources emitting fine

1 "Class I" areas include all international parks, national wilderness areas which exceed 5,000 acres in size, national memorial parks which exceed 5,000 acres in size, and national parks which exceed 6,000 acres in size and which were in existence on August 7, 1977. See 42 U.S.C. s 7472(a). The term "mandatory class I Federal areas" is defined as "Federal areas which may not be designated as other than class I." Id. s 7491(g)(5). At the time the Haze Rule was promulgated, there were 156 Class I areas across the country. See 64 Fed. Reg. at 35,714.

particles and their precursors into the air. See 64 Fed. Reg. at 35,715. The emission and movement of sulfur dioxide, oxides of nitrogen, and fine particulate matter from sources, such as power plants, contribute to haze. See id. Fine particulate matter scatters and absorbs light. See id.

Haze has degraded visibility in most of the country's national parks and wilderness areas. See id. The average visual range in many Class I areas in the western United States is 100 to 150 kilometers - which is just one-half to two-thirds the estimated visual range that would exist without manmade air pollution. See id. In most of the eastern United States, the average visual range is less than 30 kilometers - or about one-fifth the visual range that would exist under estimated natural conditions. See id.

Before 1977, the Clean Air Act (the "CAA" or the "Act") "did not elaborate on the protection of visibility as an air-quality related value." Chevron U.S.A., Inc. v. EPA, 658 F.2d 271, 272 (5th Cir. 1981). But in 1977, "[i]n response to a growing awareness that visibility was rapidly deteriorating in many places, such as wilderness areas and national parks," id. at 272, Congress added s 169A to the Act. See Clean Air Act Amendments of 1977, Pub. L. No. 95-95, s 128, 91 Stat. 685, 742 (current version at 42 U.S.C. s 7491). Section 169A established as a national goal the "prevention of any future, and the remedying of any existing, impairment in visibility in mandatory class I areas which impairment results from man-made air pollution." See 91 Stat. at 742 (current version at 42 U.S.C. s 7491(a)(1)). Congress directed EPA to issue regulations requiring states to submit State Implementation Plans ("SIPs") containing emission limits, schedules of compliance, and other measures necessary to make reasonable progress toward meeting the national visibility goal. See 91 Stat. at 743 (current version at 42 U.S.C. s 7491(b)(2)). In addition, Congress required states to address possible visibility impairment caused by currently-operating large stationary sources which had been in operation between 1962 and 1977. See 91 Stat. at 743 (current version at 42 U.S.C. s 7491(b)(2)(A)).

Congress also gave EPA the responsibility of promulgating regulations under s 169A to "assure ... reasonable progress toward meeting the national goal." See 91 Stat. at 742-43 (current version at 42 U.S.C. s 7491(a)(4)). EPA issued its first regulations in 1980. See 45 Fed. Reg. 80,084 (Dec. 2, 1980). The 1980 visibility regulations, which apply to states containing at least one Class I area, addressed visibility impairment reasonably attributable to one source, or to a small number of sources. See id. at 80,085. EPA limited the reach of the 1980 regulations to impairment attributable to specific sources and deferred any action on regional haze attributable to multiple sources located across broad geographic regions because there was insufficient data regarding the relationship between emitted pollutants, pollutant transport and visibility impairment. See id. at 80,086.

In 1990, Congress amended the Clean Air Act again, adding s 169B in an attempt to prompt EPA to further address visibility impairment in national parks and wilderness areas. See Clean Air Act Amendments, Pub. L. No. 101-549, s 816, 104 Stat. 2695 (1990) (current version at 42 U.S.C. s 7492). Section 169B requires, among other things, that EPA undertake research to identify "sources" and "source regions" of visibility impairment in Class I areas, consider designating transport commissions to study the interstate movement of pollutants, and establish a transport commission for the Grand Canyon National Park. See 42 U.S.C. s 7492.

EPA established the Grand Canyon Visibility Transport Commission ("GCVTC") in 1991 to assess information about the adverse impacts on visibility in and around sixteen Class I areas on the Colorado Plateau region and to provide policy recommendations to EPA to address such impacts. See 56 Fed. Reg. 57,522 (Nov. 12, 1991). The GCVTC issued its report to EPA in 1996. Then in 1997 EPA issued a notice of proposed rulemaking with regard to regional haze, see 62 Fed. Reg. 41,138 (July 31, 1997), noting that advances in scientific and technical knowledge, including analyses provided by the GCVTC, had made it possible for EPA to target region-wide visibility impairment. After receiving more than 1,300 comments to the proposed rule, EPA published the final

Haze Rule on July 1, 1999. See 64 Fed. Reg. at 35,714. The final Haze Rule reaches all states because, EPA concluded, all states contain sources whose emissions are "reasonably anticipated to contribute to regional haze in a Class I area." Id. at 35,721. Under the Haze Rule, a state must develop and submit a SIP that provides for reasonable progress toward achieving "natural visibility conditions" in the national parks and wilderness areas in that state. See 40 C.F.R. s 51.308(d)(1). SIPs addressing regional haze in an "attainment" area must be submitted within one year of the date the area is designated as "attainment," and revised SIPs for "non-attainment" areas must be submitted within three years after the designation. See id. s 51.308(b)(1)-(2).

The Haze Rule, for the most part, does not specify what control measures a state must implement in its initial SIP. See 64 Fed. Reg. at 35,721 (noting that the determination of what specific control measures must be implemented "can only be made by a State once it has conducted the necessary technical analyses of emissions, air quality, and the other factors that go into determining reasonable progress"). But the rule does require states to: (1) provide for an improvement in visibility in the 20 percent most impaired days; (2) ensure that there is no degradation in visibility during the 20 percent clearest days; and (3) determine the annual rate of visibility improvement that would lead to "natural visibility" conditions in 60 years. See 40 C.F.R. s 51.308(d)(1); see also id. s 51.301; 64 Fed. Reg. at 35,734. A state may not adopt a rate of improvement that would achieve natural visibility conditions in more than 60 years unless it demonstrates that the 60-year rate is unreasonable. See 40 C.F.R. s 51.308(d)(1)(ii).

The Haze Rule also provides that each state must develop a long-term strategy for achieving its visibility improvement goals. This strategy must include the identification of all major stationary sources subject to Best Available Retrofit Technology ("BART") requirements. See id. s 51.308(e). In identifying sources subject to BART, the Haze Rule calls for states to use a group rather than a source-by-source approach. See 64 Fed. Reg. at 35,740 (providing that a state should find a source subject to BART "if it can be shown that

the source emits pollutants within a geographic area from which pollutants can be emitted and transported downwind to a Class I area") (italics added). In addition, when establishing emission limits for BART sources, states must consider the improvement in visibility that would result if the technology were used at all comparable BART sources (rather than the improvement that a particular device at a particular source would accomplish). See 40 C.F.R. s 51.308(e)(1)(ii)(B).

The various petitioners and intervenors in this consolidated case raise numerous challenges to the Haze Rule. In Part II we address the claim that EPA acted contrary to law in establishing a group rather than a source-by-source approach to BART determinations. In Part III we address the claims of industry petitioners in Case Nos. 01-1111, 01-1112, and 01-1113 that EPA acted without legal authority and in anarbitrary and capricious manner in promulgating the "natural visibility" goal and the "no degradation" requirement in the regional haze regulations. Finally, in Part IV, we address the challenges raised by the Sierra Club - namely that EPA failed to set reasonable criteria for measuring or assuring reasonable progress, and that EPA acted contrary to law in extending the statutory deadline for submission of state haze control plans.

II. BART Issues

Under s 169A of the Act, each state must review all BART-eligible sources - meaning all major stationary sources built between August 1962 and August 1977 - to determine whether the sources emit "any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility" in a Class I area.2 42 U.S.C. s 7491(b)(2)(A). After deciding that a BART-eligible source emits a pollutant which may reasonably be anticipated to

2 A "major stationary source" is a source that has the potential to emit 250 tons or more of any pollutant. See 42 U.S.C. s 7491(g)(7).

cause or contribute to Class I visibility impairment, the state then must determine what is the best available retrofit technology for controlling emissions from that source. See id. Under the Act, states must take the following five factors into consideration when deciding what BART controls to place on a source:

> the costs of compliance, the energy and nonair quality environmental impacts of compliance, any existing pollution control technology in use at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

Id. s 7491(g)(2).

The Haze Rule interprets and implements these statutory

BART provisions in two main ways. First, the Haze Rule requires states to "find that a BART-eligible source is 'reasonably anticipated to cause or contribute' to regional haze if it can be shown that the source emits pollutants within a geographic area from which pollutants can be emitted and transported downwind to a Class I area." 64 Fed. Reg. at 35,740 (italics added). In other words, states must subject BART-eligible sources to BART requirements even absent empirical evidence of that source's individual contribution to visibility impairment in a Class I area so long as the source is located within a region that may contribute to visibility impairment. See id. at 35,740; see also Br. for EPA at 26-27. EPA explained in the preamble to the Haze Rule that this sort of "collective contribution" approach was "consistent with that taken in the programs for acid rain and ozone, programs which also address regional air quality problems caused by transported pollutants." 64 Fed. Reg. at 35,740; see also 63 Fed. Reg. at 57,376.

Second, the Haze Rule provides that once a state has decided that a particular source is subject to BART and is considering what BART controls to place on that source, the state must analyze "the degree of visibility improvement that would be achieved in each mandatory Class I Federal area as a result of the emission reductions achievable from all sources

subject to BART located within the region that contributes to visibility impairment in the Class I area." 40 C.F.R. s 51.308(e)(1)(ii)(B) (italics added). This means that of the five statutory factors to be considered by states when determining BART controls, see 42 U.S.C. s 7491(g)(2), only four factors (the costs of compliance, the environmental impacts of compliance, any existing pollution control technology in use at the source, and the remaining useful life of the source) are considered on a source-specific basis. The Haze Rule requires states to consider the fifth statutory factor (the degree in improvement) on a group or "area wide" basis.

Industry petitioners attack EPA's decision to use a group rather than a source-by-source BART approach, arguing that the language, statutory structure, and legislative history of s 169A make it clear that the Haze Rule runs afoul of the Act. See Br. for Industry Pet'rs and Intervenor in Case Nos. 99-1348, et al. at 13. For the reasons that follow, we grant the petition for review, vacate the BART rules, and remand to EPA.

In the Haze Rule, EPA extracts one of the five statutory factors listed in s 169A(g)(2) and treats it differently than the other four. See 64 Fed. Reg. at 35,741 (providing that only "the degree in improvement in visibility that would be expected at each Class I area as a result of imposing BART" is to be considered on a group rather than a source-specific basis). In effect, EPA bifurcates the states' determination of the appropriate BART emission limitations for specific sources. States must first estimate possible emission reductions on a source-by-source basis based on the application of the technology, the cost, time for compliance, energy and nonair environmental impacts, and the remaining useful life of the source. See id.; see also 40 C.F.R. s 51.308(e)(1)(ii)(A).

"Taking these factors into account allows the State to arrive at an estimate of the 'best system' of retrofit control technology for a particular source." 64 Fed. Reg. at 35,741. States must then calculate the degree in improvement in visibility that would be expected at each Class I area as a result of

imposing BART on all sources subject to BART. See id.; see also 40 C.F.R. s 51.308(e)(1)(ii)(B).

EPA argues that its bifurcated approach to determining appropriate BART controls is permissible because s 169A(g)(2) is unclear about how a state must analyze anticipated visibility improvement. See Chevron U.S.A., Inc. v. Natural Res. Def. Council, 467 U.S. 837, 842-43 (1984). We cannot agree. The Haze Rule's splitting of the statutory factors is consistent with neither the text nor the structure of the statute. See 42 U.S.C. s 7491(g)(2). All five s 169A(g)(2) factors inform the states' inquiries into what BART controls are appropriate for particular sources. Although no weights were assigned, the factors were meant to be considered together by the states. The language of s 169A(g)(2) can be read in no other way. To treat one of the five statutory factors in such a dramatically different fashion distorts the judgment Congress directed the states to make for each BART-eligible source. This is most apparent with respect to the states' duty to take into account "the costs of compliance" in deciding not only whether to order an individual source to install any new pollution control equipment, but also what type of equipment - or as the statute puts it, what type of "retrofit technology." How is a state to determine what is too costly (and what is not) for a particular source? The statute answers that the state must consider the degree of improvement in visibility in national parks and wilderness areas that would result from the source's installing and operating the retrofit technology. EPA has a far different answer: in assessing the cost of compliance imposed on a source, the state may not consider the degree to which new equipment at a particular source would help cure the haze in some distant national park. Under EPA's take on the statute, it is therefore entirely possible that a source may be forced to spend millions of dollars for new technology that will have no appreciable effect on the haze in any Class I area.3 A similar problem arises when a state considers, as it

3 EPA's rule requires states to consider the cost of compliance in terms of the likely emission reductions which would be achieved

must, the "existing pollution control technology in use at the source." How is a state to decide whether the source already has installed sufficient devices without determining how much, if at all, the source is contributing to visual impairment in downwind Class I areas? As the industry petitioners correctly note, there is no point during the Haze Rule's BART determination "in which it could be demonstrated that the degree of improvement in visibility obtained from installing a particular set of emissions controls at a source with 'exceedingly low' or even merely theoretical visibility impacts is not justified by the cost of BART in light of those low or theoretical impacts." Br. for Industry Pet'rs and Intervenor in Case Nos. 99-1348, et al. at 17-18.

The Haze Rule's treatment of s 169A(g)(2)'s degree-of-improvement calculation is, the industry petitioners argue, not the only respect in which the rule is inconsistent with the Act. As they see it, the Haze Rule also unlawfully constrains

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by the imposition of BART, no matter whether this reduction would enhance visibility in downwind national parks. See 64 Fed. Reg. at 35,741 (explaining that the four factors, including cost, "should be taken into account for each source subject to BART in order to compare tradeoffs between the control efficiencies and costs associated with various control alternatives"). The preamble to the rule provides very little guidance about how states are to calculate the degree of improvement in visibility under the regime EPA contemplates. The preamble tells the states only this:

> To calculate the degree of improvement in visibility that would be expected at each Class I area as a result of imposing BART on all sources subject to BART, the State should estimate the possible emissions reductions resulting from the application of BART at all subject sources located within the region that contributes to visibility impairment in the Class I area. The State should work on its own or in conjunction with other States, such as a regional planning body, to determine the geographic scope of the region that contributes to each Class I area. The States should consult with one another to determine the emission reductions achievable from sources subject to BART in other states.

Id.

the states' statutory authority because under the Act it is the states - not EPA - who must determine which BART-eligible sources should be subject to BART. See 42 U.S.C. s 7491(b)(2)(A) (providing that each BART-eligible source that, "as determined by the State ... emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility," shall install and operate the best available retrofit technology (italics added)); see also id. s 7491(g)(2) (listing the factors that "the State ... shall take into consideration" in determining BART controls (italics added)).

We agree with these petitioners that the Haze Rule's BART provisions are inconsistent with the Act's provisions giving the states broad authority over BART determinations. See id. s 7491(b)(2)(A); see also id. s 7491(g)(2). The Haze Rule ties the states' hands and forces them to require BART controls at sources without any empirical evidence of the particular source's contribution to visibility impairment in a Class I area. See 64 Fed. Reg. at 35,740; see also Br. for EPA at 26-27. If the Haze Rule contained some kind of a mechanism by which a state could exempt a BART-eligible source on the basis of an individualized contribution determination, then perhaps the plain meaning of the Act would not be violated. But the Haze Rule contains no such mechanism. Section 169A(c)(1) - on which EPA relies - is a procedure by which the Administrator, with the approval of federal land managers, can exempt a source from BART requirements. See 42 U.S.C. s 7491(c)(1) ("The Administrator may, by rule, after notice and opportunity for public hearing, exempt any major stationary source from [the BART requirements], upon his determination that such source does not or will not, by itself or in combination with other sources, emit any air pollutant which may reasonably be anticipated to cause or contribute to a significant impairment of visibility in any mandatory class I Federal area."); see also id. s 7491(c)(3). It does not provide the states with a means by which they can exempt sources based on individual contribution determinations.

Our conclusion that the Haze Rule's BART provisions impermissibly constrain state authority is reinforced by the Conference Report on the 1977 amendments to the Act. See Demby v. Schweiker, 671 F.2d 507, 510 (D.C. Cir. 1981). The Report explains:

> The agreement clarifies that the State, rather than the Administrator, identifies the source that impairs visibility in the Federal class I areas identified....
>
> In establishing emission limitations for any source which impairs visibility, the State shall determine what constitutes "best available retrofit technology" ... in establishing emission limitations on a source-by-source basis to be included in the State implementation plan so as to carry out the requirements of this section.

H.R. Conf. Rep. No. 95-564 (1977), reprinted in 3 Senate Comm. on Env't and Pub. Works, A legislative History of the Clean Air Act Amendments of 1977, at 535 (1978) [hereinafter "1977 Legislative History"]. The "agreement" to which the Conference Report refers was an agreement to reject the House bill's provisions giving EPA the power to determine whether a source contributes to visibility impairment and, if so, what BART controls should be applied to that source. See id. at 533-35. Pursuant to the agreement, language was inserted to make it clear that the states - not EPA - would make these BART determinations. See id. at 533-35; see also H.R. Res. 4151, 95th Cong. (1977), reprinted in 1977 Legislative History at 1985, 2325-30. The Conference Report thus confirms that Congress intended the states to decide which sources impair visibility and what BART controls should apply to those sources. The Haze Rule attempts to deprive the states of some of this statutory authority, in contravention of the Act.

In sum, we conclude that the Haze Rule's BART provisions are contrary to the text, structure and history of s 169A of the Act because the rule isolates s 169A(g)(2)'s benefit calculation and constrains authority Congress conferred on the states. Although petitioners also contended that no concept of a group or area-wide BART determination could ever be consistent with the Act,4 we need not decide that broad issue today. We hold only that the Haze Rule's treatment of s 169A(g)(2)'s benefit calculation and its infringement on states' authority under the Act render the BART provisions of the rule impermissible.

III. The "Natural Visibility" Goal and the "No Degradation" Requirement

The industry petitioners in Case Nos. 01-1111, 01-1112, and 01-1113 ("Reconsideration Petitioners") cite four grounds in support of their claim that the "natural visibility" goal and the "no degradation" requirement in the Haze Rule should be vacated as "arbitrary and capricious" and otherwise not in accordance with law: (1) EPA exceeded its authority under s 169A(a)(1) and adopted regulations that conflict with the PSD program in establishing "natural visibility" as the goal of the regional haze program; (2) the regulations impermissibly constrain state discretion in requiring that the states develop their visibility programs using the "no degradation" requirement as a bench mark; (3) EPA has no authority to impose upon the states the goal of achieving "natural visibility" conditions, and thereby restrict the opportunity of some states to participate in the planning process aimed at addressing regional haze; and (4) EPA promulgated the Haze Rule without providing adequate notice and an opportunity for comment. We find no merit in these claims and, accordingly, deny industry petitioners' challenge to the "natural visibility" goal and the "no degradation" requirement.

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4 The industry petitioners argued that source-by-source BART determinations are required by the statute and that no concept of area-wide BART determinations is permissible. See Brief for Industry Pet'rs and Intervenor in Case Nos. 99-1348, et al. at 14 (arguing that s 169A makes it clear that BART determinations "must be made on a source-by-source basis"). Cf. Train v. Natural Res. Def. Council, 421 U.S. 60, 64 (1975) (discussing the history of the Clean Air Act and how the premise of the Act was to give states and local governments responsibility over preventing air pollution "at its source").

Before we turn to the merits of petitioners' claims, we must first address EPA's contentions that petitioners' challenge to the natural visibility goal and their claims of inadequate notice are barred because they were not properly raised before the agency. We find no merit in EPA's contentions. Petitioners argued that the Haze Rule conflicted with the PSD program in both their comments to the agency before the regulations were issued and in their petition for reconsideration. See Supplemental Comments of the Utility Air Regulatory Group at 22, reprinted in Joint Appendix ("J.A.") 156; Petition for Reconsideration of the Regional Haze Regulations Submitted by Utility Air Regulatory Group & National Mining Ass'n at 10-11, reprinted in J.A. 97-98. Petitioners also sought notice and comment in connection with these portions of the Haze Rule in their petition for reconsideration. See Petition for Reconsideration of the Regional Haze Rule Submitted by the Center for Energy and Economic Development at 11-14, reprinted in J.A. 116-19.

On the merits, we reject petitioners' claim that EPA had no authority under s 169A to adopt the natural visibility goal. EPA acted under express congressional authorization in promulgating the challenged regulations. See 42 U.S.C. s 7491(a)(4). In a case such as this, where

> "there is an express delegation of authority to the agency to elucidate a specific provision of the statute by regulation," Chevron, 467 U.S. at 843-844, ... any ensuing regulation is binding in the courts unless procedurally defective, arbitrary or capricious in substance, or manifestly contrary to the statute.

United States v. Mead Corp., 533 U.S. 218, 227 (2001) (footnote omitted). The natural visibility goal is neither "manifestly contrary to the statute" nor "arbitrary or capricious in substance." Indeed, the goal is an eminently reasonable elucidation of the statute.

The statutory goal enunciated in s 169A(a)(1) is quite clear: "the prevention of any future, and the remedying of any existing, impairment of visibility." 42 U.S.C. s 7491(a)(1). Petitioners argue that a "natural visibility" goal cannot be

gleaned from this statutory standard. This claim is specious. Agency regulations that aim to remedy any existing impairment of visibility and prevent any future impairment - as the statute commands - will of necessity aim to achieve a state of natural visibility. There is no material inconsistency between the statutory and regulatory goals, for the latter merely elucidates the former.

The petitioners also claim that Congress did not intend for the statutory goal of s 169A(a) to displace the objectives of the PSD program. Therefore, according to petitioners, the natural visibility goal and the no degradation requirement cannot be squared with the PSD program, because that program recognizes that some impairment of visibility would be acceptable in Mandatory Federal Class I areas. We reject this argument, because EPA has reasonably construed the PSD program and the disputed regional haze rules as complementary regulatory regimes.

There are two things worth noting at the outset. First, the natural visibility goal is not a mandate, it is a goal. As EPA has explained, this goal serves as the foundation for analytical tools to be used by the states to set reasonable progress goals. 64 Fed. Reg. at 35,732-33 Petitioners' claim that the agency is without authority to mandate attainment of the national goal is therefore meritless.

Second, the statute specifically calls for regulations to assure "reasonable progress toward meeting the national goal" of remedying any current and preventing any future impairment of visibility. 42 U.S.C. s 7491(a)(4). The no degradation provision requires implementation plans to "provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least impaired days over the same period." 40 C.F.R. s 51.308(d)(1). This regulation plainly and permissibly serves to assure the reasonable progress sought by Congress.

The PSD program was adopted pursuant to the 1977 amendments to the Act. See generally Ala. Power Co. v. Costle, 636 F.2d 323, 349-51 (D.C. Cir. 1979). The program

generally controls any additional deterioration of air quality by establishing maximum allowable increases of certain pollutants in specified areas. See 42 U.S.C. s 7473(b). It is therefore true, as industry petitioners point out, that the PSD program may sometimes allow for limited air quality deterioration. EPA, however, has taken pains to explain that the PSD program and the Haze Rule are not at odds:

> Section 169A of the CAA requires the EPA to promulgate regulations to ensure that the States revise their implementation plans to contain those measures necessary to make reasonable progress toward the national visibility goal. In addition to the remedying of any existing visibility impairment, that goal requires the prevention of any future visibility impairment in mandatory Class I Federal areas. As part of the overall strategy to effectuate that goal, the final rule requires States to identify all anthropogenic sources of visibility impairment. The States accordingly should take into account the cumulative effect of all existing, man-made sources of air pollution in developing their regional haze implementation plan as well as potential new sources.
>
> With respect to the comment that EPA lacks authority to impose a welfare-based standard which renders other requirements of the CAA such a[s] PSD and NSPS largely superfluous, EPA notes that when Congress amended the CAA in 1977 to provide for the protection of visibility, it was aware of both the PSD and NSPS provisions. Nevertheless, Congress required EPA to issue regulations to address visibility. In contrast, the final regional haze rule requires States to take into account the visibility impact of emissions from both existing and new sources, and stationary and nonstationary sources. This is only one of many instances under the CAA in which Congress has provided for overlapping regulation. Indeed, the PSD and NSPS programs both focus on the control of emissions from new stationary sources. EPA believes that the regional haze rule and these other provisions are complementary means of improving air quality.
>
> Commenters raised a number of specific questions regarding the interaction of the PSD program and the regional haze rule. One commenter asked the EPA to address the relationship of allowable Class I impacts to the proposed visibility impact limits. All PSD areas are categorized as Class I, II, or III. The classification of an area determines the corresponding maximum allowable increases, or increment, of air quality deterioration. Only a relatively small increment of air quality deterioration is permissible in Class I areas. These increments are measured over annual, 24-hour, and/or 3-hour averaging times. Nowhere, however, does the CAA provide that air quality must be allowed to deteriorate to the full extent allowed by the Class I increments standing alone.

> To read the statute in that manner would contravene both the general goals of the CAA to "protect and enhance" air quality (see section 101(b)(1)) but the specific long-term goal of section 169A is to eventually remedy existing visibility impairment in Class I areas. Accordingly, we believe that allowing localized air quality increases in the short-term due to the emissions from major new sources subject to PSD is not inconsistent with the regional haze program. The regional haze program is focused on long-term emission decreases from the entire regional emission inventory, comprised of major and minor stationary sources, area sources and mobile sources. We expect that long-term emission strategies for regional haze will derive substantial emission decreases from the inventory as a whole, and that these overall strategies will be able to accommodate some localized increases within the framework of a regional decrease. We also note that the overall inventory would decrease in cases where new sources are built that replace older, more polluting sources. Accordingly, we do not see any inherent conflict between the two programs.
>
> While the PSD program generally allows for a small increment of air quality deterioration in Class I areas, section 165 of the CAA also provides for the additional protection of air quality-related values, "including visibility," in Class I Federal areas beyond that provided by the increments. That is, where the FLM [Federal Land Manager] demonstrates that emissions from a new or modified source will have an adverse impact on air quality-related values (AQRVs), notwithstanding the fact that the emissions from the source do not cause or contribute to concentrations in excess of the increment for a Class I area, "a permit shall not be issued." Section 165(d). Thus, under PSD there can be no increase in emissions from the construction or modification of a major stationary source where that increase would result in adverse impacts on AQRVs in a Class I Federal area.

Responses to Significant Comments on the Notice of Proposed Rulemaking s I.F (Apr. 1999), reprinted in J.A. 1062-63.

The Government also reminds us that the PSD program "does not require that [visibility] deterioration occur. Nor does it create an entitlement to degrade air quality in general or visibility in particular, because nothing in the CAA provides for issuance of a PSD permit as a matter of right." Br. for EPA at 59. We agree.

Petitioners cite Alabama Power in an attempt to support their claim that the existence of the PSD program effectively bars "natural visibility" as a viable regulatory goal. Alabama Power supports no such claim. Indeed, the court noted that "[s]ection 169A is available to protect visibility in Class I areas where visibility is an important characteristic, and the [agency] may choose to invoke [its] rulemaking authority ...

to address this problem." 636 F.2d at 368. In acknowledging the availability of s 169A, the court implicitly embraced EPA's view that the visibility program is a supplement to the PSD program.

Industry petitioners additionally claim that the no degradation requirement conflicts with s 169A(g)(1)'s list of factors that states must consider when determining reasonable progress. Section 169A(g)(1) states:

> in determining reasonable progress there shall be taken into consideration the costs of compliance, the time necessary for compliance, and the energy and nonair quality environmental impacts of compliance, and the remaining useful life of any existing source subject to such requirements.

42 U.S.C. s 7491(g)(1). Petitioners argue that, because "reasonable progress" could at times involve degradation, the "no degradation" requirement restricts the States' authority to apply the statutory criteria. We disagree.

As noted above, the statute commands EPA to promulgate regulations assuring "reasonable progress toward meeting the national goal." Id. s 7491(a)(4). The national goal includes "the prevention of any future ... impairment of visibility." Id. s 7491(a)(1). The no degradation requirement simply elucidates "reasonable progress." The requirement does not, however, in any way alter the list of s 169A(g)(1) criteria. In fact, the cited statutory factors do not include "degradation." Therefore, the States will be able to comply with the no degradation requirement while applying the s 169A(g)(1) criteria.

Next, although the petitioners assert that the Haze Rule somehow restricts the opportunity of some states to participate in the planning process aimed at addressing regional haze, we can find no real evidence in support of this claim. This contention certainly offers no ground upon which to vacate the disputed regulations.

Finally, petitioners claim that they did not have fair notice and an adequate opportunity to comment on the regulatory goal of natural visibility, because "EPA provided no notice in its 1997 proposal that it intended to require States to achieve natural visibility conditions." Br. for Reconsideration Pet'rs at 25. Rather, according to petitioners, EPA merely proposed regulations patterned on the statutory goal enunciated in s 169A(a)(1), i.e., "'preventing any future, and remedying any existing, impairment of visibility."' Br. for Reconsideration Pet'rs at 25 (quoting old 40 C.F.R. s 51.300(a)(1)). This argument is meritless. As noted above, there is no material inconsistency between the statutory goal enunciated in s 169A(a)(1) and the regulatory goal of "natural visibility." The latter is a "logical outgrowth" of the former. Fertilizer Inst. v. EPA, 935 F.2d 1303, 1311 (D.C. Cir. 1991). Therefore, EPA did not violate any notice and comment requirements in adopting the natural visibility goal as a part of the Haze Rule.

If there is any tension between the Haze Rule and the PSD program, it is EPA's responsibility to harmonize the regulatory requirements. It has done so in a perfectly reasonable fashion. EPA's regulatory harmonization is both consistent with the statute and reasonable. Accordingly, we deny the petitions for review of the natural visibility goal and the no degradation requirement.

IV. The "Reasonable Progress" Criteria and the Extension of the Statutory Deadline

While the Industry Petitioners attack the Regional Haze Rule as overstepping EPA's statutory authority, Sierra Club argues that EPA has not gone far enough to meet its statutory responsibilities.

In its first cluster of attacks on the Haze Rule, Sierra Club contends that the Rule does not satisfy EPA's responsibility under CAA s 169A(a)(4) to "promulgate regulations to assure ... reasonable progress toward meeting the national [visibility] goal," 42 U.S.C. s 7491(a)(4), its responsibility under CAA s 169B(e)(1) to establish "criteria for measuring 'reasonable progress' toward the national goal," 42 U.S.C. s 7492(e)(1), and its obligation under the Administrative Procedure Act not to act in an "arbitrary or capricious" fashion, 5 U.S.C. s 706 (2)(A). Sierra Club argues that the Haze Rule's requirements for improvement in visibility during the 20 percent most impaired days and for no degradation during the 20 percent least impaired days, 40 C.F.R. s 51.308(d)(1); see also 64 Fed. Reg. at 35,734, do not qualify as "reasonable progress" criteria and are arbitrary and capricious. Similarly, it argues that the Rule's requirement that a state not adopt a rate of improvement that would take more than 60 years to achieve natural visibility unless the state demonstrates that the 60-year rate is unreasonable, 40 C.F.R. s 51.308(d)(1)(i)(b), (ii), does not meet the statutory mandates and lacks "requisite specificity" because a state would be "free to reject the 60 year time frame merely by claiming that such a schedule is not 'reasonable."' Reply Br. for Sierra Club at 5, 8.

We might well consider the latter attack unripe even without reference to our decision in Part II that the group-BART provisions of the Haze Rule are invalid. If in the future a state does conclude that it needs more than 60 years to achieve natural visibility, and if EPA decides to accept that conclusion, it will at that time be open to Sierra Club to challenge EPA's decision as arbitrary and capricious. In the meantime, this court will certainly "'benefit from postponing review until the policy in question has sufficiently crystallized."' Grand Canyon Air Tour Coalition v. FAA, 154 F.3d 455, 472 (D.C. Cir. 1998) (quoting Florida Power & Light Co. v. EPA, 145 F.3d 1414, 1421 (D.C. Cir. 1998)).

But in any event, our decision to invalidate the group-BART provisions renders this entire cluster of challenges unripe for disposition. Because those provisions were intimately related to EPA's assessment of what was necessary to achieve the goal of natural visibility, we cannot be sure whether on remand EPA will retain its current criteria for evaluating reasonable progress or adopt others. If the invalidation of the group-BART provisions causes EPA to doubt the efficacy of the remaining elements of the Haze Rule, perhaps EPA will see wisdom in some of Sierra Club's complaints and, for example, increase the percentage of days during which there must be improvement in visibility, or increase the specificity of its criteria for reasonable progress. In light of the uncertainty that our decision creates with respect to the form of the rule that may emerge upon remand, the only prudent course is for us to decline to address Sierra Club's challenges at this juncture.

Sierra Club's second major attack on the Haze Rule challenges EPA's determination to give states 3 years to file haze SIPs for areas designated "attainment" or "unclassifiable." We are troubled by EPA's action, which appears to contra-

□vene express statutory language, but in light of our decision regarding group-BART we leave this to EPA to reconsider on remand as well.

The Transportation Equity Act for the 21st Century, Pub. L. No. 105-178, 112 Stat. 107, 463 (1998) ("TEA-21"), provides that, for areas designated as "nonattainment" for the new national ambient air quality standard (NAAQS) for fine particulate matter, EPA shall require states to submit haze SIPs 3 years after the area has been so designated. See TEA-21 s 6102(c)(2) (incorporating the 3-year deadline of 42 U.S.C. s 7492(e)(2)). However, TEA-21 also expressly mandates that for any area designated as "attainment" or "unclassifiable" for that standard, EPA "shall require the [SIP] to be submitted 1 year after the area has been so designated." Id. Nonetheless, the Haze Rule permits a state to "choose to defer addressing the [Rule's] core requirements for regional haze ... and the requirements for BART" by submitting a so-called "commitment SIP," containing a "demonstration of ongoing participation in a regional planning process to address regional haze, and an agreement ... to continue participating," a "description of the regional planning process," and a "list of all BART-eligible sources within the state." 40 C.F.R. s 51.308(c), (c)(1). If a state submits such a commitment SIP, the deadline for submitting a haze SIP is extended from 1 year to 3. Id. s 51.308(c)(2); see Br. for EPA at 87; Br. for Sierra Club at 25.

On its face, this provision of the Haze Rule appears to extend the express statutory deadline for "attainment" and "unclassifiable" areas, an action which is beyond the agency's authority. See Sierra Club v. EPA, 129 F.3d 137, 140 (D.C. Cir. 1997) (holding that EPA cannot establish a "grace period" for compliance when not authorized to do so by the CAA); Sierra Club v. EPA, 719 F.2d 436, 469 (D.C. Cir. 1983) (reversing an EPA implementation plan that would have effectively extended the statutory deadline for state submissions under CAA amendments). The statute requires states to submit, by the 1-year deadline, SIPs "contain[ing] such emission limits, schedules of compliance, and other measures as may be necessary to carry out" the haze regulations. 42

U.S.C. s 7492(e)(2) (incorporated by reference into TEA-21 s 6102(c)(2)). A commitment SIP, which by definition addresses neither the Haze Rule's "core requirements for regional haze," nor its "requirements for BART," 40 C.F.R. s 51.308(c), does not appear to satisfy the statutory requirement. Cf. Natural Res. Def. Council, Inc. v. EPA, 22 F.3d 1125, 1134 (D.C. Cir. 1994) (holding, under CAA s 110(k)(4), that EPA cannot satisfy its responsibility to determine whether a state plan submission complies with the CAA unless the submission "contains something more than a mere promise to take appropriate but unidentified measures in the future," and that a submission containing nothing more than such a commitment cannot extend the statutory deadline).

Notwithstanding our doubts about the validity of this provision, we decline to vacate it in light of the uncertainty that our decision invalidating the group-BART provisions of the Haze Rule will cast upon the contents of the SIPs required of the states. With the Rule and hence the contents of the SIPs now altered and subject to revision on remand, the more prudent course for this court is simply to remand the deadline-extension issue as well. This will permit the agency to reconsider its decision to extend the deadline at the same time that it decides what form the substantive requirements of a revised Haze Rule should take.

Garland, Circuit Judge, concurring in part and dissenting in part: In the Clean Air Act, Congress declared a national goal of restoring natural visibility in the country's largest national parks and wilderness areas. In Part II of today's opinion, the court adopts an interpretation of the Act that, in the view of the Environmental Protection Agency (EPA) and the National Academy of Sciences, will prevent the achievement of Congress' goal. If that interpretation were required by the statutory language, we would of course be compelled to adopt it. But such an interpretation is not required. To the contrary, EPA's construction of the Clean Air Act as permitting the group-BART provisions of the Haze Rule is a reasonable interpretation of the legislative language. It is therefore entitled to our deference under the standard announced in Chevron U.S.A. Inc. v. Natural Res. Def. Council, Inc., 467 U.S. 837, 842-43 (1984). Accordingly, while concurring in most of the court's opinion, I dissent from the conclusions it reaches in Part II.

A

Chevron instructs courts to apply a two-step framework when reviewing an agency's construction of a statute. First, we must ask "whether Congress has directly spoken to the precise question at issue," in which case we "must give effect to the unambiguously expressed intent of Congress." Id. at 842-43. However, if the "statute is silent or ambiguous with respect to the specific issue," we move to the second step and must defer to the agency's interpretation as long as it is "based on a permissible construction of the statute." Id. at 843; accord Barnhart v. Walton, 122 S.Ct. 1265, 1271-72 (2002).

My colleagues stop at Chevron's first step, concluding that the language of the Clean Air Act (CAA) can be read in only one way. They adopt the view of the industry petitioners that under the Act, BART ("best available retrofit technology") controls cannot be imposed on a source unless a state determines how much that particular source contributes to visual impairment in a downwind national park or wilderness area, as well as how much improvement in visibility would result from installing BART controls at that specific source. Op. at 10-11. EPA, by contrast, interprets the Clean Air Act

as permitting a collective assessment of the impact that emissions from (and controls on) sources located in upwind regions have on visibility impairment in downwind areas.

Before considering the grounds for the court's decision, it is important to understand why EPA decided to require a collective contribution approach, rather than a tracing of the effects of each individual source's emissions. Congress added s 169A to the Clean Air Act "[i]n response to a growing awareness that visibility was rapidly deteriorating" in major national parks and wilderness areas ("Class I areas"). Chevron U.S.A., Inc. v. EPA, 658 F.2d 271, 272 (5th Cir. 1981). The section establishes a national goal of restoring natural visibility in such areas,1 and expressly instructs EPA to issue regulations to "assure ... reasonable progress" toward meeting the national goal. 42 U.S.C. s 7491(a)(4). After examining the results of scientific studies, EPA concluded that such reasonable progress was not possible without a collective approach. The record compiled by EPA showed that visibility impairment in Class I areas is caused in large part by long-range transport of combined emissions from multiple sources.2 Although it is practicable to trace emissions from an individual source into its surrounding region, and to model the transport of combined pollution from that region to a downwind Class I area,3 it is not possible to trace emissions

1 Section 169A declares the national goal to be "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory class I Federal areas." 42 U.S.C. s 7491(a)(1). As the court holds today, agency regulations that aim to accomplish these objectives "will of necessity aim to achieve a state of natural visibility." Op. at 16.

2 See, e.g., Congressional Research Service, Regional Haze: EPA's Proposal to Improve Visibility in National Parks and Wilderness Areas 2 (1997) (J.A. at 242); National Academy of Sciences, National Research Council, Protecting Visibility in National Parks and Wilderness Areas 7-8, 196-99 (1993) (J.A. at 362, 456-57) [hereinafter "NAS Report"].

3 See Regional Haze Regulations, 64 Fed. Reg. 35,714, 35,718 (July 1, 1999). The court does not dispute the reasonableness of, or

from an individual source directly to such a downwind area without great time and expense4--and even then the results would be of uncertain reliability.5 Citing the National Academy of Sciences' conclusion that a program focused "on determining the contribution of individual emission sources to visibility impairment is doomed to failure,"6 EPA adopted the group-BART approach that is at issue here.

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support for, the latter proposition. Cf. Appalachian Power Co. v. EPA, 135 F.3d 791, 802 (D.C. Cir. 1998) (noting that "computer models are a useful and often essential tool for performing the Herculean labors Congress imposed on EPA in the Clean Air Act," and that "their scientific nature does not easily lend itself to judicial review" (internal quotation marks omitted)); id. at 814 ("[O]ur consideration of EPA's use of computer models proceeds with considerable deference to the agency's expertise.").

4 See NAS Report at 240-41 (J.A. at 478) ("It would be extremely time-consuming and expensive to try to determine the percent contribution of individual sources to haze one source at a time."); Regional Haze Regulations, 64 Fed. Reg. at 35,740 ("[E]stablishing the contribution from one particular source to the problem of regional haze would require lengthy and expensive studies and pose substantial technical difficulties.").

5 See NAS Report at 2 (J.A. at 359) ("During transport, the emissions from many sources mix together to form a uniform, widespread haze known as regional haze."); id. at 20 (J.A. at 368) ("[T]he extent to which [source-specific] techniques can be used in attributing visibility impairment is uncertain, as is their usefulness in estimating the effect that different control strategies might have on visibility."); id. at 25-26 (J.A. at 370-71) ("Efforts to decide whether a particular source is contributing to regional haze have thus far encountered grave obstacles. Studies designed to estimate the effect of a particular source on surrounding visibility are expensive, and the results can be uncertain and controversial."). To take just one example, "the efforts to trace the contribution of the Navajo Generating Station to haze in the Grand Canyon National Park took several years and cost millions of dollars without leading to quantitatively definitive answers." Id. at 7 (J.A. at 361).

6 EPA, Resp. to Pets. for Recons. of Regional Haze Rule 16 (Jan. 10, 2001) (J.A. at 17) (quoting NAS Report at 7 (J.A. at 361));

My colleagues do not dispute that we must defer to EPA's expert opinion regarding the impracticability of tracing individual source emissions.7 Rather, they conclude that notwithstanding EPA's view of the facts, the industry petitioners are correct that the Haze Rule's group-BART provisions violate the plain meaning of the Clean Air Act by: (i) employing a group rather than source-by-source standard in determining the appropriate BART controls for a particular source, and (ii) constraining the authority of the states to make their own BART-related decisions. These two contentions are considered in Parts B and C below. Because I conclude that there is nothing in the Clean Air Act that bars the approach taken by EPA, and that to the contrary the Haze Rule rests on a reasonable interpretation of the statutory language, I would follow the Supreme Court's direction in Chevron and uphold the Rule.

B

As the court notes, the Haze Rule employs a group analysis in making two determinations required by the Clean Air Act: (i) whether a pollution-emitting source is subject to BART requirements at all, and (ii) what kind of BART controls should be placed on a subject source. The industry petitioners contend that the Clean Air Act prohibits the use of a group standard in making either of these determinations.

Under the Act, a source is subject to BART requirements, and hence a state implementation plan must require such a source to install BART controls, if it "emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility in any [Class I] area." CAA

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see also NAS Report at 240 (J.A. at 478) ("The committee doubts ... that such attributions could be the basis for a workable visibility protection program.").

7 See Appalachian Power, 135 F.3d at 801-02 ("Our analysis is guided by the deference traditionally given to agency expertise, particularly when dealing with a statutory scheme as unwieldy and science-driven as the Clean Air Act."); see also Husqvarna AB v. EPA, 254 F.3d 195, 199 (D.C. Cir. 2001).

s 169A(b)(2)(A), 42 U.S.C. s 7491(b)(2)(A). Under the Haze Rule, a state must "find that a BART-eligible source is 'reasonably anticipated to cause or contribute' to regional haze if it can be shown that the source emits pollutants within a geographic area from which pollutants can be emitted and transported downwind to a Class I area." Regional Haze Regulations, 64 Fed. Reg. at 35,740. That is, a source is subject to BART requirements, without proof of that source's individual contribution to visibility impairment in a Class I area, as long as the source emits pollutants into an upwind area from which pollutants may be transported to a downwind Class I area. Id.

The industry petitioners contend that CAA s 169A(b)(2) unambiguously provides that a source is subject to BART requirements only if a state can show the extent to which that particular source contributes to impairment in a Class I area. That section, however, requires states to impose BART controls on any source that "emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility in any [Class I] area." 42 U.S.C. s 7491(b)(2)(A) (emphasis added). Far from plainly compelling the petitioners' reading, the italicized words pile ambiguity upon ambiguity and virtually invite the reader to adopt the construction favored by EPA. See Merriam-Webster's Collegiate Dictionary 252 (10th ed. 1996) (defining "contribute" as "to give or supply in common with others," or "to give a part to a common ... store") (emphasis added); Central Ariz. Water Conservation Dist., 990 F.2d 1531, 1541 (9th Cir. 1993) ("The phrase 'may reasonably be anticipated' suggests that Congress did not intend to require EPA to show a precise relationship between a source's emissions and all or a specific fraction of the visibility impairment within a Class I area." (quoting with approval National Research Council, Haze in the Grand Canyon: An Evaluation of the Winter

Haze Intensive Tracer Experiment 5 (1990))). If a source is one of several that emit pollutants into an upwind area, and if pollution from that area is transported downwind to a nation-

al park,8 then it can hardly be unreasonable to conclude that the pollutants issued by the source "may reasonably be anticipated" to "contribute" to "any" impairment in the park.

My colleagues wisely do not accept the industry petitioners' contention that s 169A(b)(2) bars a collective determination of whether a source is subject to BART. (As discussed in Part C infra, they do conclude that EPA may not require the states to employ such a mode of analysis.) They do, however, accept the petitioners' contention that to determine the kind of BART controls that should be imposed on a subject source, a state must determine how much that particular source contributes to visual impairment in the downwind Class I area, Op. at 11, as well as the degree of improvement in visibility that would occur in the downwind area if that particular source installed such controls, id. at 10. The Haze Rule, by contrast, provides that once a state has concluded that a particular source is subject to BART requirements, in determining the kind of BART controls to place on the source the state must consider the degree of improvement that would be achieved in the downwind area by imposing BART controls on all subject sources in the contributing upwind area. See 40 C.F.R. s 51.308(e)(1)(ii)(B); Regional Haze Regulations, 64 Fed. Reg. at 35,741.

The industry petitioners rest their contention that the statute unambiguously bars this collective assessment approach on s 169A(g)(2), which states:

> [I]n determining best available retrofit technology the State ... shall take into consideration [1] the costs of compliance, [2] the energy and nonair quality environmental impacts of compliance, [3] any existing pollution control technology in use at the source, [4] the remaining useful life of the source, and [5] the degree of improve-

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8 Under the Haze Rule, the state must establish the first condition directly and the second through the application of computer modeling techniques. See Regional Haze Regulations, 64 Fed. Reg. at 35,740, 35,741; supra note 3.

> ment in visibility which may reasonably be anticipated to result from the use of such technology.

42 U.S.C. s 7491(g)(2). According to both the industry petitioners and the court, this section requires the state to take into consideration each of the five listed factors on a source-by-source basis. Since the Haze Rule does require source-by-source consideration of the first four factors, see Regional Haze Regulations, 64 Fed. Reg. at 35,740-41; Op. at 9, the only question is whether such consideration is also required of the fifth factor: "the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology."

There is nothing in the statutory language that requires a source-by-source application of the fifth factor. Section 169A(g)(2) requires an assessment of the degree of improvement that may reasonably be anticipated "from the use of such technology," but it does not say whether that improvement must be from the use of such technology by a single source or by all sources in the upwind area.9 Although the court says that the statute does not permit any of the five factors to be treated differently from any of the others, the statute itself does not say so. Moreover, the first four factors are different in kind from the fifth: the first four all go to the cost of imposing controls on a particular source and permit a determination of the most cost-effective control technology for each such source. Regional Haze Regulations, 64 Fed. Reg. at 35,740-41. The fifth factor, by contrast, goes to the benefit to be derived from using the most cost-effective controls. In EPA's expert view, that benefit can best be determined by considering the total benefit that would accrue if each source in the upwind area used the kind of controls most cost-effective for that source.

The industry petitioners concede that s 169A(g)(2) does not require a state to undertake a cost-benefit analysis in deciding the type of controls to impose, or specify the weight to be

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9 See Regional Haze Regulations, 64 Fed. Reg. at 35,741 ("EPA interprets the language 'from the use of such technology' to refer to the application of BART level controls to all sources subject to BART.").

accorded to any of the five factors.10 All that is required is that the state "take into consideration" the five listed factors. 42 U.S.C. s 7491(g)(2). Because the statute does not specify how the state should take those factors into consideration, it does not bar EPA from employing a group rather than source-by-source mode of analysis in considering benefits. See Weyerhaeuser Co. v. Costle, 590 F.2d 1011, 1045 (D.C. Cir. 1978) (holding that where "Congress did not mandate any particular structure or weight" for the factors EPA is to consider, "it left EPA with discretion to decide how to account for the consideration factors, and how much weight to give each factor"); see also New York v. Reilly, 969 F.2d 1147, 1150 (D.C. Cir. 1992) (same).

Other related provisions of the Clean Air Act support EPA's reading of s 169A(g)(2) as permitting a region-wide assessment. Section 169A(a)(3) directs EPA to undertake a study to "identify the classes or categories of sources ... which, alone or in conjunction with other sources ..., may reasonably be anticipated to cause or contribute significantly to impairment of visibility," 42 U.S.C. s 7491(a)(3) (emphasis added), and s 169A(b)(1) directs that the regulations promulgated under s 169A take into account the recommendations of that study, 42 U.S.C. s 7491(b)(1). Similarly, s 169B(a)(1) instructs EPA to conduct research "to identify and evaluate sources and source regions of ... visibility impairment." 42 U.S.C. s 7492(a)(1) (emphasis added); see id. s 7492(a)(2). These provisions not only permit, but again appear to invite a group-BART approach.

The court states that "under EPA's take on the statute, it is ... entirely possible that a source may be forced to spend

10 Reply Br. for Industry Pet'rs at 8 ("Industry Petitioners agree ... that states are free to determine the weight and significance to be assigned to each of the CAA s 169A(g)(2) factors."); see Op. at 10; cf. American Textile Mfrs. Inst., Inc. v. Donovan, 452 U.S. 490, 510 (1981) ("When Congress has intended that an agency engage in cost-benefit analysis, it has clearly indicated such intent on the face of the statute."); Central Ariz., 990 F.2d at 1542 n.10 (holding that "Congress has not required 'cost-benefit' analysis in the [Clean Air] Act").

millions of dollars for new technology that will have no appreciable effect on the haze in any Class I area." Op. at 10. In accordance with the statute, however, EPA has structured the Haze Rule to avoid this result. The Rule creates an evidentiary presumption that, if a source emits pollution into an upwind region from which it can be shown that pollution is transported downwind to a Class I area, then it "may reasonably be anticipated" that the source "cause[s] or contribute[s] to" impairment in the Class I area--and hence that limiting the source's emissions will reduce that impairment.11 But the presumption is not irrebuttable. To the contrary, the Haze Rule incorporates the exemption provision of s 169A(c)(1), which permits EPA to

> exempt any major stationary source from the [BART] requirement of subsection (b)(2)(A) of this section, upon his determination that such source does not or will not, by itself or in combination with other sources, emit any air pollutant which may reasonably be anticipated to cause or contribute to a significant impairment of visibility in any mandatory class I Federal area.

11 The court does not dispute the reasonableness of this presumption. See American Iron & Steel Inst. v. EPA, 115 F.3d 979, 1000 (D.C. Cir. 1997) (holding that it is reasonable for EPA to presume that if a pollutant is present in fish tissue at a level exceeding that set by regulation, then any facility "that contributes a pollutant to a body of water [in which the fish swims] ... has the reasonable potential to contribute to that exceedence"); see also Baltimore Gas & Elec. Co. v. Natural Res. Def. Council, Inc., 462 U.S. 87, 103 (1983) (holding that a reviewing court must be "at its most deferential" when the agency is "making predictions, within its area of special expertise, at the frontiers of science"); American Trucking Ass'ns, Inc. v. EPA, 175 F.3d 1027, 1055 (D.C. Cir. 1999) ("[W]e have expressly held that EPA's decision to adopt and set air quality standards need only be based on reasonable extrapolations from some reliable evidence." (internal quotation marks omitted)), rev'd on other grounds sub nom. Whitman v. American Trucking Ass'ns, Inc., 531 U.S. 457 (2001).

42 U.S.C. s 7491(c)(1); see also 40 C.F.R. ss 51.303, .308(e)(4). Hence, a source that emits pollution into a source region, but that can show that BART controls are unnecessary because its pollution does not contribute to a significant

impairment of visibility in a Class I area, will not have to spend money installing BART controls.12 All that the Haze Rule does is put the burden of proof on the polluter, rather than on the state. Moreover, the statute's limitation of the exemption to a source that does not by itself "or in combination with other sources" contribute to a significant impairment, 42 U.S.C. s 7491(c)(1), once again invites the collective-assessment approach taken by EPA.

Finally, one more provision of s 169A deserves repeat mention here. As discussed in Part A above, s 169A(a)(4) instructs EPA "to promulgate regulations to assure reasonable progress toward meeting the national goal" of restoring natural visibility conditions. 42 U.S.C. s 7491(a)(4). Yet EPA's findings indicate that it will not be possible "to assure reasonable progress" if the statutory interpretation announced today prevails: it is simply not practicable to determine, as the court's interpretation requires, how much a particular "source is contributing to visual impairment in downwind Class I areas," or the degree of improvement in visibility in such areas "that would result from [a particular] source's installing and operating" BART controls. Op. at 11, 10; see supra notes 4, 5. Indeed, EPA explained that it "avoided inclusion of any approach in the regional haze rule that required the assessment of the visibility improvement attributed to an individual source because" the National Academy of Sciences had determined that such an approach was "doomed to failure." Resp. to Pets. for Recons. of

12 The court correctly notes that under this exemption, it is EPA rather than the state that determines whether a source has made the required showing. EPA, however, does not rely on the exemption to answer the state-authority issue discussed in Part C below, but rather to counter the petitioners' claim that the Haze Rule fails to provide a source with the opportunity to demonstrate that it makes no appreciable contribution to visibility impairment in a Class I area. Br. for EPA at 29-30, 32.

Regional Haze Rule 16 (Jan. 10, 2001) (J.A. at 17) (quoting National Academy of Sciences, National Research Council, Protecting Visibility in National Parks and Wilderness Areas 7-8, 196-99 (1993) (J.A. at 362, 456-57)). We should not lightly assume that Congress enacted a statute that makes it impracticable to achieve the same statute's stated goal. There certainly is nothing in the language of the Clean Air Act that requires us to adopt such a self-defeating construction.

C

The industry petitioners' second attack on the Haze Rule marches under the banner of states' rights, but in this case that banner is a false flag. The Rule gives states great leeway to make the BART determinations required by the Clean Air Act, reserving to EPA no more authority than Congress conferred upon the agency. Moreover, as discussed above, the industry petitioners' insistence that both EPA and the states are barred from using group-BART principles will impose an enormous unfunded mandate on the states--requiring them to engage in lengthy, expensive, and likely fruitless studies to trace pollutants from specific sources into specific Class I areas.13 It is not surprising, therefore, that only a single state has enlisted under the petitioner's banner. Five others have filed briefs in support of EPA, while the balance remain silent.

The industry petitioners attack, as unlawfully constraining state authority, both the provision of the Haze Rule that concerns which sources are subject to BART requirements, and the provision that concerns the kind of BART controls that must be installed on subject sources. With respect to the former, the petitioners emphasize s 169A's declaration that "each major stationary source ... which, as determined by the State ... emits any air pollution which may reasonably

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13 See supra notes 4, 5; Br. for Maine, et al. at 10 (protesting that to adopt the industry petitioners' interpretation of s 169A(g)(2) "would impose staggering and costly administrative burdens" on the states).

be anticipated to cause or contribute to any impairment of visibility" in a Class I area, is subject to BART requirements. 42 U.S.C. s 7491(b)(2)(A) (emphasis added). With respect to the latter, they stress that s 169A requires that each subject source install "the best retrofit technology, as determined by the State," 42 U.S.C. s 7491(b)(2)(A), and that "in determining best available retrofit technology the State ... shall take into consideration" the five factors discussed in Part B above, id. s 7491(g)(2) (emphasis added). By directing the states to employ a group-BART analysis in making these determinations, the industry petitioners contend, and the court agrees, that EPA has unlawfully constrained the states' decisionmaking authority. Op. at 11-13.

The Haze Rule, however, does not contravene the statutory commands italicized above. Under the Rule, it is the state and not EPA that determines which specific sources emit pollution that "may reasonably be anticipated to cause or contribute to" impairment, and hence are subject to BART requirements. All that EPA has done, as explained in Part B, is reasonably interpret that phrase to include sources that emit pollution into upwind regions from which pollution is transported to national parks. It is still the state that must determine both that the source emits covered pollutants, and that the region into which the source emits such pollutants is one from which emissions may reasonably be anticipated to be transported to downwind parks. See 40 C.F.R. s 51.308(e)(1)(ii); Regional Haze Regulations, 64 Fed. Reg. at 35,739-41; Br. for EPA at 43. Similarly, it is still the state that must take into consideration the five statutory factors and the state that must then determine the best available retrofit technology for a particular source. All that EPA has done, again as explained in Part B, is reasonably interpret the fifth of those factors to require the state to analyze the degree of anticipated improvement on a group basis. See Regional Haze Regulations, 64 Fed. Reg. at 35,741.

Moreover, the Clean Air Act expressly delegates to EPA the authority to make these kinds of judgments. As already noted, s 169A directs EPA to promulgate regulations to

assure reasonable progress toward meeting the national goal of restoring natural visibility. 42 U.S.C. s 7491(a)(4). It further instructs that those regulations shall "provide guide-lines to the States ... on appropriate techniques and meth-ods for implementing" the section's provisions, including the provisions governing which sources are subject to BART requirements and the kind of BART controls that should be imposed. Id. s 7491(b)(1). The section likewise directs EPA to "require each applicable implementation plan for a State ... to contain such emission limits, schedules of compliance and other measures as may be necessary to make reasonable progress toward meeting the national goal" of restoring natu-ral visibility. Id. s 7491(b)(2). Similarly, the next section of the Act, s 169B, orders EPA to "carry out [its] regulatory responsibilities" under s 169A by promulgating "criteria for measuring 'reasonable progress' toward the national goal." 42 U.S.C. s 7492(e)(1). These provisions give EPA ample authority to promulgate guidelines requiring states to use group-BART principles to determine both the sources that are subject to BART requirements and the kinds of controls those sources must install.

My colleagues contend that the Conference Report on the 1977 Clean Air Amendments reinforces their view that the Haze Rule impermissibly constrains state authority. Op. at 13. But that report is a weak reed upon which to rest a Chevron step one claim regarding the Act's plain meaning. As the court recounts, the report merely states that the conference "agreement clarifies that the State, rather than the Administrator, identifies the source that impairs visibili-ty," and that in determining the appropriate BART controls for such a source, "the state shall determine what constitutes 'best available retrofit technology' ... in establishing emis-sion limitations on a source-by-source basis." H.R. Conf. Rep. No. 95-564, at 535 (1977). The report tells us nothing more about the referenced "agreement" than can be gleaned from these quotations, and the quotations themselves do little more than restate the statutory language. Moreover, as noted above, the Haze Rule is consistent with these quota-tions: under the Rule, it is the state rather than EPA that

identifies the sources that impair visibility, and it is the state that determines the best available retrofit technology for each such individual source. All that the group-BART provisions of the Rule do is effectuate EPA's authority to "provide guidelines to the states" for making these determinations regarding particular sources. 42 U.S.C. s 7491(b)(1).14

As the Clean Air Act repeatedly declares, restoring natural visibility to national parks and wilderness areas is a "nation-al" goal. See id. s 7491(a)(1), (a)(4), (b)(2), (b)(2)(B); id. s 7492(e)(1). It is not surprising, therefore, that while the Act leaves many determinations regarding particular sources to the states, it grants EPA authority to establish national guidelines for the kind of analysis the states must employ in making those determinations.15 Under the statute, those guidelines must "assure ... reasonable progress toward meeting the national goal" of restoring natural visibility. Id. s 7491(a)(4). Because EPA has reasonably determined that group-BART principles are necessary to provide such assurance, the provisions of the Haze Rule that incorporate those

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14 The court states that the "agreement" referred to in the report was an agreement to reject the provisions of an earlier House bill. As there may have been many reasons for rejecting that bill, the "[r]ejection of [the] proposed legislation during the course of enactment provides a hazardous basis from which to determine legislative intent," GAO v. GAO Pers. Appeals Bd., 698 F.2d 517, 525 n.52 (D.C. Cir. 1983), and a particularly hazardous foundation for a Chevron step one claim. In any event, the most the court can divine regarding the content of the agreement is that it was to insert language clarifying that the states were to "determine whether a source contributes to visibility impairment and, if so, what BART controls should be applied to that source." Op. at 13. As noted in the text, the Haze Rule leaves both determinations in the hands of the states.

15 Cf. Appalachian Power Co. v. EPA, 249 F.3d 1032, 1047 (D.C. Cir. 2001) (holding that a state's development of its implementation plan under CAA s 110 is not "free of extrinsic legal constraints," including EPA's reasonable construction of CAA s 126).

principles are a permissible exercise of the agency's delegated power.

D

In sum, there is nothing in the language, structure or history of the Clean Air Act that bars EPA from promulgating the group-BART provisions of its Haze Rule. To the contrary, those provisions represent "a reasonable interpretation of an ambiguous statute," and therefore must be given effect by this court. Christensen v. Harris County, 529 U.S. 576, 586 (2000) (citing Chevron, 467 U.S. at 842-844). Accordingly, I respectfully dissent from the court's decision to strike down those provisions.

Estimate of WRAP Emissions Cap on construction of Greenfield Coal Capacity

WRAP recommended its new source set-aside be limited to 27,000 TPY across the entire nine-state affected region. Of this amount, 9,000 TPY are allocated for each 5-year period beginning 2003-2007. These set-asides are for all qualifying new sources—electric powerplants, industrial boilers, and major process emission sources (e.g. smelters).

Utilities account for roughly 66% of the total 1998 emission inventory of affected sources. If new source allocations were allocated similar to the inventory, roughly 6,000 TPY of the 9,000 TPY in 5-year new allocations would be provided to new electric generating capacity.

The amount of coal-fired capacity that can be built under the 6,000 TPY cap is a function of the achievable emission rate. Assuming an average 10 MMBtu/MWh heatrate, the amount of new coal capacity growth allowed under the WRAP emissions cap every 5 years is as follows:

Emission limit 6,000 TPY New Coal Generator Cap

#SO2/MMBtu	#/MWh	GWh	Potential new MW@85%CF
0.15	1.5	8,000	1,074 MW
0.10	1.0	12,000	1,612 MW
0.05	0.5	24,000	3,223 MW
0.04	0.4	30,000	4,029 MW

(These limits are far below what is being achieved in the east and below the tightest limits being debated by states for further emission reductions).

A review of the two lowest emitting coal-fired units in each WRAP state (except Idaho (no coal unit) and Oregon (no FGD controlled unit) indicates that limits of 0.05-0.10 #SO2/MMBtu are achievable for bituminous coal units and limits of 0.08-.15 $SO2/MMBtu are achievable for PRB coal units.

Utility	Station	Unit	2000 ER	SO2 Removal Performance Design	Actual	Type	Plant Location	Origin
Salt River	Navajo	1	0.038	92%	96%	Limestone	AZ	AZ
Intermountain	Intermountain	1	0.046	90%	94%	Limestone	UT	UT
Salt River	Navajo	2	0.054	92%	94%	Limestone	AZ	AZ
Salt River	Navajo	3	0.056	92%	94%	Limestone	AZ	AZ
Deseret G&T	Bonanza	1	0.063	95%	92%	Limestone	UT	UT
Sierra Pacific	Reid Gardner	4	0.065	85%	93%	Sodium Carbonate	NV	UT
Platte Rv G&T	Rawhide	1	0.072	80%	84%	Lime-Alkaline Fly Ash	CO	SPRB
Tri-State G&T	Craig	3	0.106	85%	87%	Lime	CO	CO
APS	Cholla	2	0.111	90%	89%	Lime	AZ	NM
Plains G&T	Escalante	1	0.130	95%	93%	Limestone	NM	NM
Sierra Pacific	North Valmy	2	0.146	70%	80%	Lime	NV	UT
Black Hills	Neil Simpson II	1	0.148	92%	89%	Lime	WY	PRB
Basin Electric	Laramie River	1	0.155	90%	82%	Limestone	WY	PRB
PSNM	San Juan	4	0.393	75%	77%	Limestone	NM	NM

As current experience shows, the Flue Gas Desulfurization (FGD) performance does depend upon the input coal characteristics. If one examines just the 11 announced new coal-fired powerplants (totaling 5,100 MW) in the WRAP states and assumes that these units are held to the demonstrated emission limits that have currently been achieved by these exemplary plants, the estimated emissions from these plants would total 19,605 TPY. These announced plants are expected to come online prior to 2008 and would far exceed the estimated 6,000 TPY new source set-aside.

This analysis suggests that the WRAP emissions cap will likely have adverse effects on Western power prices by not allowing for the most cost-efficient power generation to be built. If coal-fired generation were capped, higher cost alternatives would have to be developed to meet the regions growing power needs. This shift could also create other energy policy challenges (natural gas transport, reliability risks from reduced fuel diversity, etc.) and other environmental issues.

Tucson Electric Power Company

One South Church Avenue, Post Office Box 711
Tucson, Arizona 85702

Area Code 520
Telephone 571-4000

December 3, 2003

Ms. Deborrah Martinkovic
Air Quality Division
Arizona Dept. of Environmental Quality
1110 W. Washington Street
Phoenix, AZ 85007

Sent via e-mail
and facsimile

RE: Comments to the ADEQ proposed Regional Haze SIP published October 24, 2003

Dear Ms. Martinkovic:

Tucson Electric Power (TEP), a wholly-owned subsidiary of UniSource Energy Corporation (NYSE: UNS), is pleased to submit these comments regarding the Regional Haze State Implementation Plan (SIP). TEP owns and operates electric generation, transmission, and distribution assets and serves more than 350,000 customers in Southern Arizona. TEP generates electricity both from firing fossil fuels as well as renewable resources.

On October 24, 2003, the Arizona Department of Environmental Quality issued, for public comment, a proposed Regional Haze State Implementation Plan (SIP). This SIP has been prepared to satisfy Arizona's obligations, under delegated authority by the Environmental Protection Agency, for addressing Regional Haze. The Regional Haze Rule became effective on August 30, 1999, and delegated States are required to incorporate the requirements of the rule into their SIPs. As Arizona has selected to prepare a SIP in accordance with 40 CFR Part 51, Section 309, the SIP document is due no later than December 31, 2003.

TEP has been actively involved in the deliberations leading up to and including the preparation of this SIP. In 2001, ADEQ initiated a stakeholder process to evaluate which of the available regulatory schemes the State would use to satisfy the requirements of the Regional Haze Rule. TEP participate in that process and we supported the outcome, to prepare a "309 SIP." More recently TEP participated in the Stationary Sources and Pollution Prevention workgroups, which were charged with providing recommendation to ADEQ relating to the preparation of this SIP.

TEP supports the process under which the SIP was developed and commends ADEQ for their efforts in soliciting stakeholder input.

TEP was unable to provide comments to the entire SIP and has limited its comments to the two areas in which has actively participated as interested stakeholder during the SIP draft development: the Stationary Sources and the Pollution Prevention workgroups. Our specific comments follow.

<u>Comments related to Chapter 8</u> – *SO_2 Milestones and Backstop Trading Program*

Page 51, Section 8.3.1

TEP agrees that for Category 1 utility sources the floor allocation should be based on a "clean unit" emission rate for each unit. TEP also and very strongly believes that the heavier burden should be borne by the BART eligible sources since the purpose of the Regional Haze program is to specifically address those sources. As such, the "clean unit" definition for purposes of allocating the floor portion of the allowances need not be the same for all units.

TEP worked very hard and cooperated with several utility stakeholders as well as members of the WRAP and ADEQ during the SIP development to set forth an allocation methodology that would be fair to all participants. Several meetings were held including one in Tucson, Arizona, where an agreement was seemingly reached, only to be later discarded. At that meeting, the following assumptions/agreements were made for purposes of defining "clean unit."

1. Coal-fired units that in 1999 were operating with a baghouse for particulate control, but otherwise uncontrolled for SO_2, would be assumed to be at 20% control efficiency.

2. BART eligible sources that in 1999 were operating with a control efficiency below 70% would be assumed to have a control efficiency of 85%. Units that were controlled at between 70% and 80% were assumed to increase control efficiency by 5%. Units controlled above 80% would remain at that level.

3. Sources with known mandated future controls, other than BARTable sources, would be assumed controlled at that level.

4. Units not subject to BART:

    a. For sources with existing control at or below 50% assume a control efficiency of 50%.

    b. For sources with existing controls between 50% and 70% assume a control efficiency of 70%.

    c. Sources with existing controls above 70% assume the existing level of controls.

5. For purposes of floor allocations to all sources assume operation at 85% capacity factor.

TEP strongly suggests that the above "clean unit" definition be adopted. The above "clean unit" definition addresses all the principles and equity issues described in the SO_2 Milestone/Backstop Trading Program at page 52. It would also provide the stakeholders with the certainty and direction regarding potential future capital expenditures to address compliance with Regional Haze and/or other SO_2 compliance programs.

Certainty was fundamental in TEP's, and the other utilities, support of the Regional Haze Section 309 option.

The Arizona Utility Stakeholders also provided, as a group, an allocation methodology that utilizes the method used by the Market Trading Forum (MTF) in establishing the milestone levels and is based on the opt-in/opt-out table. This methodology also would allow each state to establish state-specific allocation methodologies by assigning a specific number of SO_2 allowances to each state and then specify an allocation methodology in each individual SIP.

TEP strongly suggests that either the "clean unit" definition as above for "floor" allocations or the total allocation methodology that has previously been submitted by the Arizona Utilities be adopted into the SIP.

Page 58, Section 8.3.3

In Section 8.3.1, WEB sources are divided into two categories. Category 1 are those WEB sources that commence operation prior to January 1, 2003, while Category 2 are those that commence operation after January 1, 2003. Category 1 would be eligible to receive reducible portions of the allocation, while Category 2 would not. Both would receive floor allocations. The Category 2 allocations are to be taken from the new source set aside.

The draft rule at R18-2-1610.B defines an existing source as one that commences operation prior to the program trigger and new web source as one commencing operation after the program trigger. Therefore, a unit that commences operation after January 1, 2003, but before the program trigger date, would be considered an existing unit.

Section 8.3.3, Distribution of the New Source Allocations, sets the availability of these allowances for a new WEB source and an existing WEB source. However, a Category 2 WEB source that commences operation after January 1, 2003, but before the program trigger date would, for purposes of receiving allocations under Section 8.3.3, be an existing source. It is not clear how such a source would receive its share of allocations. TEP suggests that the new source set-aside be available for three categories instead of two. The third category to be added under Section 8.3.3 is as follows:

> 8.3.3(1)(c) – Category 2 floor allocations as established in Section 8.3.1(1)(b)(iii).

<u>Comments related to Chapter 12</u> – *Pollution Prevention and Renewable Energy Programs*

TEP fully supports the pollution prevention provisions of the SIP as presented in Chapter 12. This chapter represents the consensus recommendations of the Pollution Prevention Workgroup, in which TEP participated, and which deliberated for nearly a year in order to formulate a consensus position. In accepting the consensus recommendation and rejecting certain non-consensus recommendations, ADEQ recognized two important concepts relating to the pollution prevention provisions of the Regional Haze Rule.

First, the Regional Haze Rule does not mandate the implementation of any specific energy policies. EPA clarified the relationship between the "10/20 goals" and States' requirements relating to the pollution prevention by stating in the preamble to the rule that "The [10/20] goals themselves are not enforceable and States are not required to meet the renewable energy goals." "Rather, EPA is setting enforceable requirements for the States to assess progress toward [the] goals…"

Secondly, Arizona's contribution to the "10/20 goal" should be commensurate with the renewable resources available. Section 12.1 of the SIP references a letter sent by the Pollution Prevention Workgroup to the co-chairs of the WRAP Pollution Prevention Forum, which provides comments to the WRAP document titled "Renewable Energy and Energy Efficiency as Pollution Prevention Strategies for Regional Haze." This letter, which represents the consensus position of the P2WG, presents the workgroup's concerns relating to the proposed method for assigning each State's contribution to the "10/20 goals." Arizona's most abundant renewable resource is solar energy; therefore, Arizona should work to develop this resource. However, as the incremental costs of producing electricity from solar energy is considerably higher than other resources, Arizona's contribution will have to be less than that of other States in the region.

In addition to these two points, it is important to note that, based on the work of the WRAP, even if the 10/20 goals were met and certain energy efficiency measures were adopted, there is expected to be a mere 2% decrease in NOx emissions for the region and essentially no decrease in SO2 emissions.

Thank you for the opportunity to provide these comments and for the excellent work you and other ADEQ staff have done in preparing the proposed SIP and for allowing for substantial stakeholders input.

If you have any questions, please call me at (520) 884-3642.

Sincerely,

TUCSON ELECTRIC POWER COMPANY

Cosimo De Masi
Manager, Corporate Environmental Services

<u>Appendix A-18d. Responsiveness Summary</u>

RESPONSIVENESS SUMMARY
to
Testimony Taken at Oral Proceedings and Written Comments Received on
Arizona Regional Haze State Implementation Plan

The oral proceedings on the Arizona Regional Haze State Implementation Plan (SIP) were held at 4:30 p.m., Monday, November 24, 2003, at Coconino Library, Flagstaff, Arizona; and at 5:00 p.m., Monday, November 24, 2003, at Arizona Department of Environmental Quality, Phoenix, Arizona. The public comment period closed at 5:00 p.m., Wednesday, December 3, 2003. Oral and written comments received and Arizona Department of Environmental Quality's (ADEQ) responses are described below. During its final review of the proposed SIP, ADEQ determined some further clarifications were appropriate. These clarifications are also included below.

1) **Issue:** There is no information in the SIP regarding impacts to the Tonto National Forest or the Superstitions. **Response:** This SIP addresses the federal mandatory Class I areas in Arizona that are part of the Colorado Plateau. The Superstition Wilderness Area is a Class I area, but is not part of the Colorado Plateau and will be addressed in a later SIP under Section 309(g) of the Regional Haze Rule. The Tonto National Forest is not a federally protected Class I area and will not be addressed under the requirements of the Regional Haze Rule.

2) **Issue:** The Pollution Prevention Chapter of this SIP does not include language that discusses how ADEQ would act to preserve and promote renewable energy and energy efficiency programs. **Response:** Detailed reports prepared by the Regional Haze Pollution Prevention Work Group (P2WG) that present differing views of ADEQ's role in energy-related programs have been reviewed by the Director and are considered invaluable as ADEQ continues to take an active role in energy policy in Arizona. ADEQ believes this SIP meets the initial requirements of the Regional Haze Rule as it pertains to energy programs under Section 309.

3) **Issue:** Some of the programs listed in the Pollution Prevention Chapter could be eliminated due to a loss of funding. Removal of these programs could then be considered a retreat from the requirements of the SIP, or continued funding of a program could be required under the federal enforceability of a SIP. **Response:** This SIP is a "snap-shot in time" of renewable energy and energy efficiency programs already in place or planned in response the requirements of the Regional Haze Rule. A listing of these programs in the SIP does not make them federally enforceable. Also, programs associated with pollution prevention are reviewed in relation to the regional Energy Renewable Goal and are not considered control measures.

4) **Issue:** The SIP should include a pointer (with greater detail in future SIP revisions) to the concept of Renewable Energy Credits (RECs) currently being investigated by the Western Governors' Association. **Response:** ADEQ is

aware of the REC concept and understands the Western Regional Air Partnership (WRAP) Air Pollution Prevention Forum (AP2 Forum) may be looking into this in greater detail in the near future. Inclusion of RECs in this SIP, however, is premature.

5) **Issue:** The Pollution Prevention Chapter of this SIP does not include a quantification of energy programs related to the regional Renewable Energy Goal nor an approach for tracking program impact. In addition, Arizona did not use the *Renewable Energy Atlas of the West* for documenting the potential of renewable energy resources. **Response:** The Regional Haze Pollution Prevention Work Group (P2WG) attempted to quantify contributions and potentials related to energy programs and their impact on regional haze. The task was difficult due to formula assumptions modeled on regional characteristics that did not serve Arizona-specific conditions enough to make the results reliable. Work on this issue is included within Sections 12.9 through 12.11 of the Pollution Prevention Chapter of this SIP. Additional information can be found in related sections of the Technical Support Document submitted with this SIP. ADEQ will consider the use of the *Renewable Energy Atlas of the West* in any future work related to the regional Renewable Energy Goal.

6) **Issue:** It is unclear where the four recommendations on pollution prevention developed by the City of Phoenix were included in this SIP, and if any Arizona utilities were classified as stationary sources. **Response:** The four recommendations were developed not by the City of Phoenix but by the Regional Haze Pollution Prevention Work Group. The recommendations, presented as nonconsensus reports, are posted to the ADEQ Web page under Air Quality Planning, Regional Haze, Pollution Prevention Work Group (P2WG) at http://www.adeq.state.az.us/environ/air/plan/haze.html. A list of sources classified as stationary sources, including utilities, can be located in both Chapter 5 and Chapter 8 of this SIP.

7) **Issue:** ADEQ should not have developed this SIP as current products available could prevent air pollution. **Response:** ADEQ appreciates the comment but is required by law to develop a SIP to address the existing conditions that contribute to regional haze as well as activities that could prevent future impairment.

8) **Issue:** Numerous issues related to the stationary source program, *SO_2 Milestones and Backstop Trading Program* (see SO_2 Milestones/Backstop Chapter of this SIP), are yet unresolved. **Response:** Arizona will be an active participant in the Western Regional Air Partnership (WRAP) forums such as the Stationary Sources Forum, formerly Market Trading Forum, and the newly created Coordination Committee (described in the Stationary Sources Chapter of this SIP). It is ADEQ's understanding that work will commence in 2004 to discuss and revise as necessary the *SO_2 Milestones and Backstop Trading Program.*

9) **Issue:** It is not clear if the 10-year record keeping requirement for sources participating in the WEB Trading Program includes all the existing required documents under the current 5-year requirement or a "selected subset" of documents. **Response:** It is ADEQ's understanding that any documents retained under the current 5-year retention requirement in the WEB Trading Program Rule would be expanded to cover 10 years. In addition, any records pertinent to satisfying the pre-trigger requirements of the Web Trading Program Rule would also be retained for 10-years. Any clarification to the specifics of the trading program, however, will be reviewed and revised as necessary as outlined in No. 8 of this Responsiveness Summary. Any necessary revisions or clarifications to the WEB Trading Program Rule will be made prior to the rule's final approval by the Governors' Regulatory Review Council.

10) **Issue:** Table 8-2 (Chapter 8 of this SIP) leads to a possible misconception that the Four Corners Power Plant is not under the jurisdiction of the Region IX of the EPA. **Response:** This table is a duplicate of the Table included in the federal Regional Haze Rule for the stationary source emission reduction program, and is included in the program description of all states submitting a SIP under Section 309 of the Regional Haze Rule. Clarification should be provided at the federal rule level, and then incorporated into the SIPs.

11) **Issue:** It should be clarified that renewable energy allocations (under the WEB trading Program) are only available for renewable energy physically located within the participating five states participating in SIPs under Section 309 of the Regional Haze Rule. **Response:** The WEB Trading Program is a regional program and one state cannot dictate the specifics of the program. As stated earlier, however, any clarification to the specifics of the trading program, however, will be reviewed and revised as necessary as outlined in No. 8 of this Responsiveness Summary.

12) **Issue:** Section 8.3.1(g)(6) of the Web Trading Program (Chapter 8 of this SIP) should be revised to specifically provide for public notice and comment prior to the finalizing of the State's (and facility specific) Allocation Report for Arizona. **Response:** A necessity to develop a proposed Allocation Report for Arizona would also necessitate a SIP revision. This SIP revision would be subject to public notice and comment, including the Allocation Report for Arizona. Again, as stated previously, any clarification to the specifics of the trading program, will be reviewed and revised as necessary as outlined in No. 8 of this Responsiveness Summary.

13) **Issue:** There should be clarification in the SIP that references and appendices are for reference only and are not enforceable as part of this SIP. **Response:** It is ADEQ's understanding that only those programs or activities that constitute committed measures or incorporated state-specific rules are considered federally enforceable. Programs or activities related to goals versus control measures have been noted throughout the SIP.

14) **Issue:** (1) Arizona should not commit to a specific regional haze implementation approach until after EPA has responded to the court's remand of the RHR (Regional Haze Rule); (2) the Department's proposed SIP does not meet the minimum requirements of either Arizona statute or 40 CFR §51.309 and Arizona must therefore pursue a RHR SIP under 50 CFR §51.308; and (3) The RHR Section 309 Annex is not a rational or cost-effective approach for improving visual air quality in Arizona or other western states. **Response:** ADEQ appreciates the analysis of these issues, but does not share in the conclusions. EPA has stated that the court's remand of the RHR does not affect states wishing to pursue an implementation approach under Section 309 of the RHR, and believes the Arizona SIP complies with the requirements of the Regional Haze Rule.

15) **Issue:** Work completed by the Western Regional Air Partnership (WRAP) regarding the emission reduction milestones under the Annex (stationary source SO_2 reduction program) provide greater reasonable progress than would be achieved by the application of best available retrofit controls for all federal mandatory Class I areas in the region, not just the 16 Class I areas on the Colorado Plateau. This would include the remaining eight Class I areas in Arizona not addressed by this SIP. **Response:** ADEQ concurs with WRAP's findings, but this SIP addresses the 16 Class I areas on the Colorado Plateau, four of which are contained in the northern portion of Arizona. This issue will be revisited as Arizona continues to address regional haze in a SIP under Section 309(g) of the Regional Haze Rule as well as the SIP revisions required for periodic review. This issue is discussed further in the Technical Support Document that accompanies this SIP.

16) **Issue:** Language in the Stationary Sources Chapter of this SIP needs to better reflect the findings of the Western Regional Air Partnership (WRAP) regarding the future regulation of nitrogen oxides and particulate matter. **Response:** ADEQ believes the language is appropriate for this SIP, and the inclusion of the NOx – PM Report as an Appendix to this Chapter discusses the need for further analysis of these pollutants related to regional haze. ADEQ will be an active participant with the Western Regional Air Partnership in this endeavor.

17) **Issue:** The 1996 mobile sources emissions inventory and the subsequent mobile source emissions projections developed by the Western Regional Air Partnership (WRAP) over-estimated emissions for Maricopa County. **Response:** ADEQ is aware of this issue and the Regional Haze Emissions Inventory Work Group (EIWG) addressed the concern in their report to the WRAP. The EIWG report is included in Appendix A-14 to Projection of Visibility Chapter of this SIP.

18) **Issue:** Page 97 of the proposed SIP under the heading, "Green Pricing," in the Pollution Prevention Chapter that references SRP's Solar Choice program and solar equipment at Santan needs to be corrected. This program is now called,

"EarthWise Energy" and includes not only solar but other renewable energy sources as well. **Response:** ADEQ has made the clarification.

19) **Issue:** There were several expressions of support for the SIP, and the WEB Trading Program specifically. **Response:** ADEQ appreciates the positive comments and commitment to the national visibility goal.

20) **Issue:** There were several expressions of appreciation for the opportunity to participate in the development of this SIP. **Response:** ADEQ appreciates their involvement and contribution to this SIP and encourages their on-going support and participation.

21) **ADEQ initiated changes to the SIP include the following:** Updates related to final regulations, appendix documents, and Technical Support Document (TSD); and spelling, grammatical, and formatting corrections throughout the document.