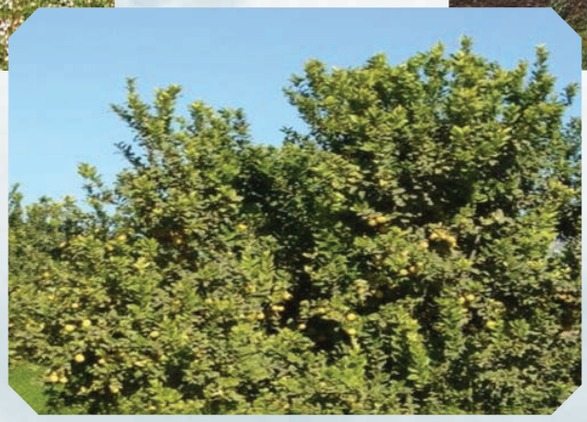
# Guide to Agricultural PM10 Best Management Practices

*"Agriculture Improving Air Quality"*



**Governor's Agricultural Best Management Practices Committee**

*Second Edition, 2008*

# *Governor's Agricultural BMP Acknowledments*

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*Funding support for printing of this guide was provided by a US Environmental Protection Agency 105 Air Quality Grant to the Arizona Department of Agriculture, Agricultural Consultation and Training Program through the Arizona Department of Environmental Quality, Air Quality Division.*

***First Edition 2001***
***Second Edition 2008***

# *Guide to Agricultural PM10 Best Management Practices*
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## *Where can I learn more?*

If you do not know whether your agricultural operation resides within the PM10 Nonattainment Area, or if you have questions regarding compliance or specific components of the agricultural PM10 general permit, contact:

**Arizona Department of Agriculture**
Agricultural Consultation & Training
1688 W. Adams St.
Phoenix, AZ 85007
602-542-3484
800-294-0308
www.azda.gov/ACT/AirQuality.htm

**Agua-Fria New River NRCD**
16251 W. Glendale Ave.
Litchfield Park, AZ 85340
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www.nrcd.org/aguafria/

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4139 E. Broadway Rd.
Phoenix, AZ 85040
602-437-1344
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1430 W. Broadway Rd.
Suite#110
Tempe, AZ 85282
480-966-1610
www.azna.org

**Buckeye Valley NRCD**
220 N. 4th St.
Buckeye, AZ 85326
602-386-7350
www.nrcd.org/buckeyevalley/

**Arizona Department of Environmental Quality**
Air Quality Division
1110 W. Washington St.
Phoenix, AZ 85007
602-771-2300
800-234-5677
www.azdeq.gov/environ/air/index.html

**East Maricopa NRCD**
18256 E. Williams Field Rd.
Suite #1
Higley, AZ 86236
480-988-1078
www.nrcd.org/eastmaricopa/

**FSA Service Center Office**
Maricopa County
Farm Service Agency
12409 W. Indian School Rd.
Building B Ste. 201
Avondale, AZ 85323
623-535-5055 ext 2
www.fsa.usda.gov/az/

**Maricopa County Cooperative Extension**
4341 E. Broadway Rd.
Phoenix, AZ 85040
602-470-8086
www.cals.arizona.edu/maricopa/

**Maricopa County Farm Bureau**
4001 E. Broadway Rd.
Suite #B9
Phoenix, AZ 85040
602-437-1330
MCFB@qwestoffice.net

# Introduction

### *Why is the Guide to Agricultural PM10 Best Management Practices needed?*

The Federal Clean Air Act requires that emissions from all significant sources in areas not meeting the national ambient air quality standards be controlled through effective programs. Through a study conducted by the Arizona Department of Environmental Quality (ADEQ) in 1995, agricultural activities were identified as a source that contributes to the production of particulate matter (PM).

PM10 is particulate matter that is 10 micrometers or less in diameter (as compared to a human hair that is about 70 micrometers). These particles are very small and can invade the natural defense mechanism of the human respiratory tract, penetrating deep into the lungs. Consequently, PM10 can cause a wide variety of harmful health effects, especially for children, the elderly, and people with pre-existing respiratory or cardiovascular disease.

With this threat to human health, coupled with repeated violations of the federal health standard for PM10, public agencies and industry groups in the Phoenix metropolitan area have developed and are implementing programs to help the area meet the federal clean air standards for PM10.

### *The intent of this guide is to:*

- Provide agricultural operators with information and guidance on how to effectively implement individual best management practices (BMPs).
- Inform the general public about the efforts Maricopa County farmers are implementing to improve air quality.
- Provide Natural Resource Conservation Districts (NRCD) and other farm organizations with background information regarding the agricultural PM10 general permit.
- Provide regulators with information and guidance on how to determine compliance with the agricultural PM10 general permit.

### *Why was the agricultural PM10 general permit created?*

The Phoenix metropolitan area has not met the Federal Clean Air Act Standards for PM10 since the Clean Air Act was revised in 1990. On June 10, 1996, the U.S. Environmental Protection Agency (EPA) redesignated the Moderate PM10 Nonattainment Area to Serious, resulting in the need for emission reduction programs for previously unregulated sources, such as unpaved roads, unpaved parking lots, vacant lots and agriculture. On August 3, 1998, EPA issued a federal implementation plan (FIP) addressing these unregulated sources. The FIP included requirements to develop and enforce control measures for these source categories.

To address agriculture's contribution to PM10, the Governor's Agricultural Best Management Practices Committee was created by law in 1998 (Arizona Revised Statutes (A.R.S.) §49-457). The Committee's charge was to develop an agricultural PM10 general permit that would include controls on agricultural operations. The Committee was to identify BMPs that focused on feasible, effective and common sense practices that minimized negative impacts on local agriculture. In the original program, the agricultural PM10 general permit required that at least one BMP be implemented to control PM10 for each of the following three categories: tillage and harvest, non-cropland and cropland. In 2007, the Arizona State Legislature passed Senate Bill 1552, changing the number of BMPs required from one to **two** BMPs per category. The Committee is composed of five local farmers, the Director of ADEQ, the Director of Arizona's Department of Agriculture, the State Conservationist for the Natural Resources Conservation Service (NRCS), the Dean of the University of Arizona College of Agriculture and Life Sciences, and a soil taxonomist from the University of Arizona. After A.R.S. §49-457 was developed and adopted, EPA removed the portion of the Federal Implementation Plan for agriculture on June 29, 1999 [64 Federal Register p. 34726].

### *Who must comply with the agricultural PM10 general permit?*

Any farmer who farms more than 10 contiguous acres of land located within the Maricopa PM10 Nonattainment Area and Maricopa County Portion of Area A (reference map insert) must comply with the agricultural PM10 general permit.

### *What does the farmer have to do?*

- Implement and maintain at least **two** approved BMPs (described later in this document) for each of the three categories: tillage and harvest, non-cropland and cropland.
- Keep records detailing the BMPs selected for each category. The commercial farmer may document the practice on the sample BMP agricultural PM10 permit record or develop a record that includes the information required by the agricultural PM10 general permit. The commercial farmer must make available the record to the ADEQ director within two business days of notice to the farmer.
- The Committee recommends additional record keeping if implementation of the BMPs is not easily visible. Examples of additional record keeping include, but are not limited to, photographs, purchase records, receipts, job sheets, contractor invoices, employee timesheets, logs, narrative statements, individual farm policies, statements of understanding signed by employees or contractors, and training records.
- No fee is associated with the agricultural PM10 general permit.

### *When must the agricultural PM10 general permit be implemented?*

A farmer engaged in agricultural activities before June 10, 2000 must comply with the agricultural PM10 general permit by December 31, 2001. A commercial farmer who engages in agricultural activities after December 31, 2000, has 18 months to comply with the agricultural PM10 general permit.

Legislation enacted in 2007 requires that all farmers engaged in agricultural activities must comply with the agricultural PM10 program by December 31, 2007, as revised by the Governor's Agricultural BMP Committee.

### *What would happen if I do not comply with the agricultural PM10 general permit?*

If the ADEQ director determined that a commercial farmer is not in compliance with the agricultural PM10 general permit, the following three-stage process would occur:

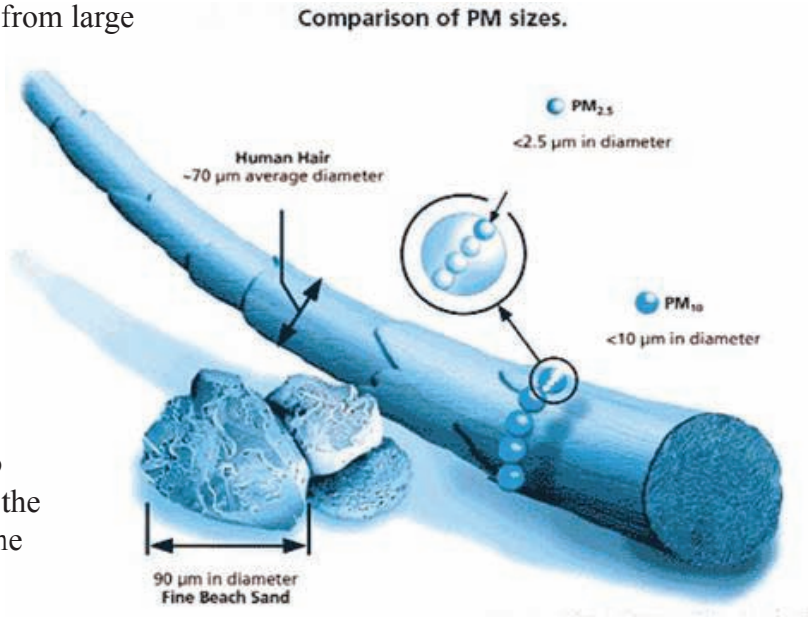
1. If the farmer has not previously been subject to an agricultural general permit related compliance order, the farmer would be required to submit a plan to the local NRCD. The plan must specify the BMPs that the farmer would use to comply with the general permit.
2. If the farmer has previously been subject to an agricultural PM10 general permit related compliance order, the farmer would be required to submit a plan to ADEQ that specifies the BMPs that the farmer would use to comply with the general permit.
3. If the farmer failed to comply with the plan submitted to NRCD and ADEQ, the director of ADEQ may revoke the agricultural PM10 general permit and require the farmer to obtain an individual fee based permit.

**At each stage, the farmer would have the opportunity for a hearing.**

### *Where does the agricultural PM10 general permit apply?*

Any agricultural operation greater than 10 contiguous acres within the Maricopa PM10 Nonattainment Area and Maricopa County Portion of Area A (reference map insert), except on tribal lands, must comply with the agricultural PM10 general permit.

Soils consist of various particles including mineral matter, organic matter, air, and water. These particles vary in shape and size, ranging from large drops of liquid to microscopic dust particles. The mineral particles in soil are classified as sand, silt, or clay. Soils containing high amounts of clay coupled with large silt particles have a greater likelihood of generating PM10.




When the natural soil structure is manipulated or disturbed by tillage, animals, weather, or vehicular traffic, the structure can be broken apart from larger pieces, or clods, into smaller pieces. This process significantly increases the potential for soil particles to become suspended in the air. Further manipulation of the soil increases the chance for smaller particles to become PM10.

Air quality problems occur when the amount of particles released into the air increase in concentration. Large concentrations of PM10 could potentially violate one of the federal air quality standards, or National Ambient Air Quality Standards (NAAQS), set for various air pollutants. The current NAAQS standard for PM10 is 150 micrograms/cubic meter averaged over 24 hours. This standard is a concentration by weight measure. PM10 emissions can also cause visibility impairment (e.g., Brown Cloud) as well as health impacts. The small particles can pass through nostril hairs and enter the lungs, penetrating deep into the lung tissue where it is lodged and not easily, if ever, expelled.

Two meteorological events have the potential to increase the impacts from high concentrations of PM10: high winds and stagnation. Conditions for both of these events can occur in the Phoenix area, one occurring predominantly in the warmer season, the other in the cooler season. Warm season high wind events are generally short (less than one hour) and are the result of the downdrafts from monsoon thunderstorms. The cool season events are longer (six to 12 hours) and are the result of strong pressure gradients associated with a trough or a cold front. An inversion is a region in the atmosphere where the temperature increases with height. The presence of an inversion creates a very stable atmosphere and leads to very little mixing of the air, trapping pollutants close to the ground. An inversion is also produced whenever radiation from the surface exceeds the amount of radiation from the sun – commonly at night or in the winter when the angle of the sun is very low in the sky. Some of the best management practices outlined in this booklet address how to lower PM10 so these events do not increase PM10 concentrations.

Disturbed soil that is broken down into smaller particles can also become a soil conservation problem. Many of the best management practices outlined in this booklet are already used to prevent soil erosion. Other best management practices address ways of limiting PM10 from associated farming activities such as adjoining dirt roads

or road shoulders on farmland. The manipulation or disturbance of soil is inherent to the practice of farming. Best management practices are not designed to eliminate particle emissions 100 percent, but they are designed to reduce the activities that can lead to the increased concentration of PM10.

As a result of discussions between the EPA, Arizona Department of Environmental Quality, and the Arizona Department of Agriculture, the Arizona State Legislature in 1999 enacted legislation with the full support of the Arizona agriculture community to create and implement a Best Management Practice Program. The Agricultural Best Management Practice Program allows growers a wide range of choices to reduce PM10 emissions within the established Maricopa PM10 Nonattainment Area and Maricopa County Portion of Area A (reference map insert).

The Arizona Legislature has defined a BMP for the Maricopa PM10 Nonattainment Area and Maricopa County Portion of Area A (reference map insert) as a technique verified by scientific research that is practical, economically feasible and effective in reducing PM10 on a case by case basis from a regulated agricultural activity. The following section summarizes the BMPs approved by the Governor's Agricultural Best Management Practices Committee to reduce PM10 for each of the three agricultural categories: tillage and harvest, non-cropland and cropland. A wide range of variation in soils and cropping systems exists within the Maricopa PM10 Nonattainment Area and Maricopa County Portion of Area A (reference map insert), which can only be addressed by a wide range of flexible and adaptable management practices. Most methods for controlling PM10 emissions parallel the controls for wind erosion. These methods are based on principles that contain or slow soil movement from fields. Not all of the BMPs will work equally well on every farm because of variations in wind, soils, cropping systems, moisture conditions and, in some cases, the management approaches of individual growers. Such factors should be considered by the individual farmer to ensure he or she implements effective BMPs. This guide represents steps in helping farmers reduce PM10 emissions from farmlands located within the Maricopa PM10 Nonattainment Area and Maricopa County Portion of Area A (reference map insert).

## *Category 1: Tillage and Harvest*

***Any mechanical practice that physically disturbs cropland or crops on a commercial farm.***

**Best management practices for use during tillage and harvest**

Cessation of Night Tillage
Chemical Irrigation
Combining Tractor Operations
Equipment Modification
Green Chop
Integrated Pest Management
Limited Activity during a High-Wind Event
Multi-Year Crop
Planting Based on Soil Moisture
Precision Farming
Reduced Harvest Activity
Reduced Tillage System
Tillage Based on Soil Moisture
Timing of a Tillage Operation
Transgenic Crops

### Cessation of Night Tillage

**Rule Definition**

"Cessation of Night Tilling" means the discontinuance of night tilling on high pollution advisory (HPA) days during stagnant air conditions. See night tilling rule definition.

**Purpose**


Cessation of night tillage between 2:00 a.m. and 8:00 a.m. to decrease the concentrations of PM emissions at night when stagnant air conditions with little if any vertical mixing of the air occurs and a high pollution advisory has been given.

**Suggestions for Implementation**

An individual farm policy should be developed to ensure that no tillage activities occur during stagnant air conditions on HPA days. Notification of HPAs are broadcast by noon of the day prior to the HPA in the media, by e-mail, and by text message. Employees should receive training in implementing the farm policy.

### Chemical Irrigation

**Rule Definition**

"Chemical Irrigation" means applying fertilizer, pesticide, or other agricultural chemicals to cropland through an irrigation system.

**Purpose**

Chemical irrigation reduces the number of passes across a field with tractors, sprayers, fertilizer applicators and machinery. Reducing the number of field operations reduces the emissions associated with those activities.

**Suggestions for Implementation**

- All product application recommendations should be followed to ensure proper implementation.
- The field operations eliminated should be documented to demonstrate the implementation of the practice.

## Combining Tractor Operations

**Rule Definition**

"Combining Tractor Operations" means performing two or more tillage, cultivation, planting, or harvesting operations with a single tractor or harvester pass.

**Purpose**

Combining tractor operations reduces the number of passes or trips that a tractor, implement, harvester or other farming support vehicle makes across a field or unpaved surface, thereby reducing the amount of soil disturbed.

**Suggestions for Implementation**

- Combining tractor operations is most effective if implemented during the time of year when PM10 is most likely to be produced.
- Applying fertilizer and herbicide in a single pass.
- Cultivating and fertilizing in a single pass. Using specialized machinery to bury stalks make new furrows in a single pass.
- Combining multiple heavy tillage operations in a single pass, for example, pulling a ring roller behind a disc.

## Equipment Modification

**Rule Definition**

"Equipment Modification" means modifying agricultural equipment to prevent or reduce particulate matter generation from cropland.

**Purpose**

Modifying and maintaining an existing piece of agricultural equipment or purchasing new equipment to prevent PM10 from becoming airborne during tillage and harvest operations, which helps reduce PM10 and soil erosion.

**Examples of Equipment Modification**

- Shields or deflectors that redirect fan or vehicle exhaust sideways or upward. This can prevent PM10 from becoming airborne because exhaust is not blowing downward on the soil surface.
- Dust shrouds around tillage implements and harvesters.
- Spray bars that emit a mist to knock down PM10.

## Green Chop

**Rule Definition**

"Green Chop" means the harvesting of a forage crop without allowing it to dry in the field.

**Purpose**

Green chop reduces multiple equipment passes in-field as well as reduces soil disturbance and soil compaction.

**Examples of Green Chop**

- Alfalfa
- Winter forage
- Silage corn

## Integrated Pest Management

**Rule Definition**

"Integrated Pest Management" means the use of a combination of techniques including organic, conventional and biological farming practices.

**Purpose**

Integrated pest management creates beneficial insect habitat that reduces the use of herbicides/ pesticides, thereby reducing the number of passes for spraying. It also reduces soil compaction and the need for additional tillage.

**Examples of Integrated Pest Management**

- Monitoring crop for pests to accurately and effectively apply control measures.
- Incorporate biological practices into farming operation to reduce need for spraying.

## Limited Activity during a High-Wind Event

**Rule Definition**

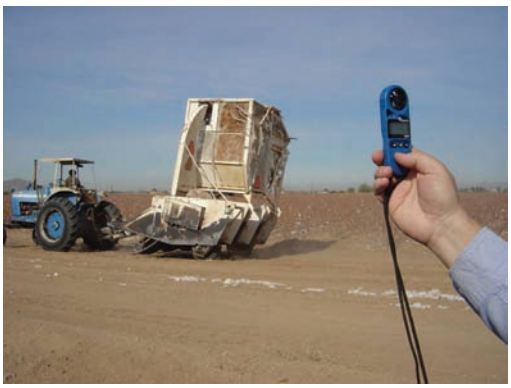
"Limited activity during a High-Wind Event" means performing no tillage or soil preparation activity when the measured wind speed at 6 feet in height is more than 25 mph at the commercial farm site.

**Purpose**

Because this BMP falls within the tillage and harvest category, it also applies during harvest time. Wind speed, temperature and relative humidity affect the distance that PM10 travels and the ability for PM10 to be suspended in the air. Limiting activity during a high-wind event will reduce the transport of PM10. Reducing farm operations during a high wind event, as well as when the wind speed is less than 25 mph, can significantly help reduce PM10 emissions.

**Suggestions for Implementation**

- A device to measure wind speed should be available at the commercial farm site.
- An individual farm policy should be developed to ensure that no tillage or soil preparation activities occur when the wind speed reaches 25 mph.
- Employees and family members should receive training in implementing the farm policy.
- Subscribe to the Dust Action Forecast issued by ADEQ. Notification of Dust Action Forecasts are broadcast by mid-morning of the day prior to the high-wind event.



## Multi-Year Crop

### Rule Definition

"Multi-Year Crop" means a crop, pasture, or orchard that is grown, or will be grown, on a continuous basis for more than one year.

### Purpose

Surface covers, such as crops, pasture and orchards that are grown and maintained for a long duration, protect the soil surface from erosive winds. The longer a crop or cover is protecting the soil surface, the less time the surface is susceptible to wind erosion.

### Examples of Multi-Year Crops include

- Alfalfa
- Citrus
- Roses
- Livestock pastures
- Nuts (Pecans)
- Sod

## Planting Based on Soil Moisture

### Rule Definition

"Planting Based on Soil Moisture" means applying water to soil before performing planting operations.

### Purpose

- Planting based on soil moisture reduces PM10 during the planting operation and is effective from the time of planting until crop establishment. Planting based on soil moisture is one of the most efficient practices to reduce PM10 between planting and crop emergence. Moisture causes soil to crust and therefore PM10 is not easily transported into the air.

### Suggestions for Implementation

- Care should be taken to avoid over compaction of the soil, which could result in additional tillage operations.
- Irrigation should be applied as soon after soil preparation for planting as possible. After watering, a thin crust develops on the soil surface, which stabilizes it until planting.
- The time between bed lifting, irrigation and planting should be minimized as much as possible.
- Use the soil moisture "feel method" to determine adequate soil moisture. See the Natural Resource Conservation Service Publication #1619 "Estimating Soil Moisture by Feel and Appearance." This publication is available at all NRCD offices.

## Precision Farming

**Rule Definition**

"Precision Farming" means using GPS to precisely guide farm equipment in the field.

**Purpose**

Precision farming reduces overlap and allows operations to occur during inclement weather conditions and at night thereby generating less PM.

**Examples of Precision Farming**

- Install overlap reduction technology
- Pass markers
- Variable rate application technology

## Reduced Harvest Activity

**Rule Definition**

"Reduced Harvest Activity" means reducing the number of harvest passes using a mechanized method to cut and remove crops from a field.

**Purpose**

Any time an operation takes place in a field, the soil structure can be modified and some PM10 could be released into the air. Reducing the number of harvest activities can keep the soil structure intact and reduce PM10.

**Suggestions for Implementation**

An example of reduced harvest activity is the elimination of a harvest or rood pass from a cotton harvest. More PM10 is emitted during a normal cotton harvest season because the process requires several harvest passes to remove most of the crop from the plant. The rood process produces a significant amount of PM10 because of the nature of the operation.

## Reduced Tillage System

**Rule Definition**

"Reduced Tillage System" means reducing the number of tillage operations used to produce a crop.

**Purpose**

Any tillage operation in a field can modify the soil structure and possibly release PM10 into the air. Reducing the number of tillage activities can maintain the soil structure and help reduce PM10.

**Suggestions for Implementation**

- Minimum tillage system*
- Mulch tillage system*
- Reduced tillage system*

*Consult NRCS Standard and Specifications, 329 and 344, Residue Management. This document is available at all NRCD offices.

## Tillage Based on Soil Moisture

**Rule Definition**

"Tillage Based on Soil Moisture" means applying water to soil before or during tillage, or delaying tillage to coincide with precipitation.

**Purpose**

Moisture binds soil particles and helps reduce the amount of PM10 released into the air. Fine dry soil can easily erode with increased wind speeds. Sufficient moisture levels can be achieved by irrigating before tillage or tilling after rain. Moisture can also allow large soil clods to form, after tillage, which reduces wind erosion.

**Suggestions for Implementation**

- Fields should be irrigated to the depth of proposed cut prior to soil disruption, or tillage should be conducted to coincide with precipitation.
- The application of moisture or the date of tillage that coincided with precipitation should be documented.
- The soil moisture "feel method" should be used as a way to determine adequate soil moisture. See the Natural Resource Conservation Service publication #1619 "Estimating Soil Moisture by Feel and Appearance". This publication is available at all NRCD offices.

## Timing of a Tillage Operation

**Rule Definition**

"Timing of a Tillage Operation" means performing tillage operations at a time that will minimize the soil's susceptibility to generate PM10.

**Purpose**

Adjusting the time of tillage operations can minimize the amount of time the soil surface is susceptible to wind erosion and generation of PM10. When a field's surface is smooth, dry, and consists of finer grained soil particles, the field is most susceptible to wind erosion, resulting in PM10.

**Some examples of timing of tillage operations to reduce PM10 generation include:**

- Reducing time between leveling (land planing) and bedding, which is when the beds act as miniature windbreaks. For example, a cotton production system where fields are tilled in the fall, land planed, and then bedded, would be less susceptible to wind erosion and PM10.
- Leaving the field surface with large soil clods for as long as possible prior to preparation of seed beds.

## Transgenic Crops

**Rule Definition**

"Transgenic Crops" means the use of plants that are genetically modified.

**Purpose**

Transgenic crops reduce need for tillage or cultivation operations, as well as reduces soil disturbance. Can also reduce the number of chemical applications.

**Examples of Transgenic Crops**

- Genetically altered seed
- Nematode resistant rootstock

## *CATEGORY II: Non-Cropland*

***Any commercial farm land that:***

- ***Is no longer used for agricultural production,***
- ***Is no longer suitable for production of crops,***
- ***Is subject to a restrictive easement or contract that prohibits use for the production of crops, or includes a private farm road, ditch, ditch bank, equipment yard, storage yard or well head.***

**Best management practices for use on non-cropland**

Access Restriction
Aggregate Cover
Artificial Wind Barrier
Critical Area Planting
Manure Application
Reduce Vehicle Speed
Synthetic Particulate Suppressant
Track-out Control System
Tree, Shrub or Windbreak Planting
Watering

### Access Restriction

**Rule Definition**

"Access Restriction" means restricting or eliminating public access to non-cropland with signs or physical obstruction.

**Purpose**

Reducing the number of trips driven on agricultural aprons and access roads can reduce that area's susceptibility to PM10.

**Examples of methods to restrict access include, but are not limited to:**

- Installing physical barriers such as gates, fencing, posts, signs, shrubs, trees or other physical obstructions to prevent or control access to the area.
- Installing "no trespassing" or "limited use area" signs.

### Aggregate Cover

**Rule Definition**

"Aggregate Cover" means gravel, concrete, recycled road base, caliche or other similar material applied to non-cropland.

**Purpose**

Applying an aggregate cover to unpaved farm roads, parking areas and canal banks helps reduce the amount of soil particles exposed to the surface, thus helping to reduce the generation of PM10. Aggregate cover acts as a surface barrier to erosive forces like wind or vehicle traffic.

**Suggestions for Implementation**

- The aggregate should be one inch or larger in diameter.
- The aggregate should be applied a minimum of four inches deep.
- The aggregate material should be clean, hard and durable.

## Artificial Wind Barrier

**Rule Definition**

"Artificial Wind Barrier" means a physical barrier to the wind.

**Purpose**

Artificial wind barriers disrupt the erosive flow of wind over unprotected areas thus helping to reduce PM10.

**Suggestions for Implementation**

- Continuous board fences, burlap fences, crate walls, bales of hay and similar material can be used to control air currents and blowing soil.
- Barriers should be aligned across the prevailing wind direction. While 90 degrees or perpendicular is preferred, benefits can still be realized when barriers are aligned as close to perpendicular as possible.
- The distance of 10 times the barrier height is considered the protected area downwind of the barrier.

## Critical Area Planting

**Rule Definition**

"Critical Area Planting" means using trees, shrubs, vines, grasses, or other vegetative cover on non-cropland.

**Purpose**

Critical area planting helps control soil movement and protect the soil surface when adequate cover does not exist. Ground covers reduce dust and wind erosion by shielding the soil with vegetation and anchoring the soil with roots. This practice applies to field aprons, equipment parking areas, turn rows, canal banks, canal excavation spoil piles and bare areas where vegetation is difficult to establish by usual planting methods.

**Suggestions for Implementation**

Critical area planting consists of any vegetative cover that maintains more than 60 percent ground cover.

## Manure Application

**Rule Definition**

"Manure Application" means applying animal waste or biosolids to a soil surface.

**Purpose**

Applying manure to maintain or improve chemical and biological condition of the soil can help reduce wind erosion and PM10.

**Suggestions for Implementation**

- If the application or storage of manure is near a water source, precautions should be taken to prevent accidental leakage, spillage or runoff that will result in undesirable effects on soil, water and plants.
- Caution should be used when applying manure to ensure that state and local regulations are not violated.
- Caution should be used when certain manures are applied as they can volatilize and contribute to odor and ammonia emissions.
- Manures should be incorporated as quickly as possible to reduce odor and ammonia emissions, and to preserve nutrient value if the area is to be cropped in the future.

## Reduce Vehicle Speed

**Rule Definition**

"Reduce Vehicle Speed" means operating farm vehicles or farm equipment on unpaved private farm roads at speeds not to exceed 20 mph.


**Purpose**

Reduced speeds can decrease the amount of PM10 generated by vehicles or equipment on unpaved farm roads.

**Examples of methods to reduce vehicle speed include, but are not limited to:**

- Posting speed limit signs.
- Informing all employees, contractors and sub-contractors of speed limits.
- Placing signs in all farm vehicles stating the speed limits on farm roads.
- Installing speed bumps.

## Synthetic Particulate Suppressant

**Rule Definition**

"Synthetic Particulate Suppressant" means a manufactured product such as lignosulfate, calcium chloride, magnesium chloride, an emulsion of a petroleum product, an enzyme product, and polyacrylamide that is used to control particulate matter.

**Purpose**

Synthetic particulate suppressants provide a surface barrier or bind soil particles together to retard PM10 on unprotected areas, such as unpaved roads, rights-of-way and abandoned fields.

**Examples of synthetic particulate suppressant include, but are not limited to:**

- Calcium chloride (CaCl)
- Soybean feedstock (SBF) processing byproducts
- Calcium lignosulfonate (lignin)
- Polyvinyl acrylic polymer emulsion (PVA)
- Polyacrymide (PAM)
- Emulsified petroleum resin

Differences in traffic type and volume, soil types, roadway surface characteristics and topography between sites requiring dust control can cause product performance to vary. Consult the NRCD office or a dust control contractor for specific recommendations. All products should be applied strictly in accordance with manufacturers' specifications.

## Track-out Control System

### Rule Definition

"Track-out Control System" means a device to remove mud or soil from a vehicle before the vehicle enters a paved public road.

### Purpose

Using a track-out control system helps remove mud and soil from the tires of farm equipment and vehicles before they enter a paved public road, where the mud or soil can be crushed into fine particles and easily suspended in the air by passing vehicles.

### Suggestions for Implementation

Some examples of track-out control systems are:

- Grizzly - a device similar to a cattle guard, which is used to dislodge mud, dirt or debris from the tires and undercarriage of equipment and vehicles prior to leaving a farm.
- Gravel pad - a pad of crushed stone, coarse gravel or recycled road base located at the point of intersection of a paved public roadway and a farm entrance.

  It is recommended that:

  a) The stone or gravel is one inch or larger in diameter.
  b) The gravel pad is applied a minimum of four inches deep.
  c) The gravel pad is the full width of the farm entrance.
  d) The gravel pad is a minimum of 50 feet long.

- Pavement – an area of asphalt, concrete or similar material applied to a farm road at the intersection of a paved public roadway and a farm entrance.

  It is recommended that:

  a) The pavement is the width of the farm road.
  b) The pavement is a minimum of 100 feet long from the point of intersection with a paved public roadway.

The farm entrance should be maintained in a condition that will prevent tracking of mud and soil onto paved public roads. The farmer should conduct periodic inspections, maintenance, re-application of gravel and cleaning of paved access road surfaces to accomplish track-out control.

## Tree, Shrub, or Windbreak Planting

**Rule Definition**

"Tree, Shrub, or Windbreak Planting" means providing a woody vegetative barrier to the wind.

**Purpose**

Barriers placed perpendicular to the wind direction can reduce wind speeds by changing the pattern of airflow over the land surface, which helps reduce wind erosion and PM10.

**Suggestions for Implementation**

- The distance of 10 times the barrier height is considered the protected area downwind of the barrier.
- Single row plantings are most popular in field windbreaks because they use less water and occupy the least amount of land area for the amount of protection derived.
- Recommended species for planting can be obtained at all NRCD offices.
- The planting should be done at a time and manner to ensure survival and growth of selected species.
- Moisture conservation or supplemental watering should be provided for plant establishment and growth, as well as the use of drought tolerant species.
- Windbreaks should be aligned across the prevailing wind direction. While 90 degrees or perpendicular is preferred, benefits can still be realized when windbreaks are aligned as close to perpendicular as possible.
- The interval between windbreaks should be determined using current approved wind erosion technology, available at all NRCD offices.

## Watering

**Rule Definition**

"Watering" means applying water to non-cropland.

**Purpose**

Applying water from a truck, tractor or other portable spray system to bare soil surfaces, such as unpaved roadways and equipment yards where high traffic areas exist, can help reduce PM10. Watering the soil surface tends to compact the soil so that it is not dispersed into the air.

**Suggestions for Implementation**

Watering is effective during peak usage times, such as silage harvest time.

- Apply water so that the surface is visibly moist.

***Land on a commercial farm that:***

- ***Is within the timeframe of final harvest to plant emergence,***
- ***Has been tilled in a prior year and is suitable for crop production, but is currently fallow, or***
- ***Is a turn-row.***

## Best management practices for use on cropland

Artificial Wind Barrier
Cover Crop
Cross-Wind Ridges
Cross-Wind Strip-Cropping
Cross-Wind Vegetative Strips
Integrated Pest Management
Manure Application
Mulching
Multi-Year Crop
Permanent Cover
Planting Based on Soil Moisture
Residue Management
Sequential Cropping
Surface Roughening
Transgenic Crops
Tree, Shrub, or Windbreak planting

## Artificial Wind Barrier

### Rule Definition

"Artificial Wind Barrier" means a physical barrier to the wind.

### Purpose

Artificial wind barriers disrupt the erosive flow of wind over unprotected cropland fields thus helping to reduce PM10.

### Suggestions for Implementation

- Continuous board fences, burlap fences, crate walls, bales of hay and similar material can be used to control air currents and blowing soil.
- Barriers should be aligned across the prevailing wind direction. While 90 degrees or perpendicular is preferred, benefits can still be realized when barriers are aligned as close to perpendicular as possible.
- The distance of 10 times the barrier height is considered the protected area downwind of the barrier.

## Cover Crop

**Rule Definition**

"Cover Crop" means plants or a green manure crop grown for seasonal soil protection or soil improvement.

**Purpose**

Cover crops help control soil movement and protect the soil surface between crops. Cover crop reduces wind erosion by shielding the soil with vegetation and anchoring the soil with roots.

**Suggestions for Implementation**

It is recommended that:

- Cover crops consist of any vegetative cover that maintains more than 60 percent ground cover.
- Short-term cover be grown between major crops. Plants are then tilled into the soil prior to or during major crop planting.
- Longer-term cover may be maintained by periodic mowing to maintain at least 60 percent cover.
- Specific information on cover crops can be obtained from the Cooperative Extension Service or the NRCD office.

## Cross-Wind Ridges

**Rule Definition**

"Cross-Wind Ridges" means soil ridges formed by a tillage operation.

**Purpose**

Ridges formed by tillage operations create protective windbreaks that disrupt the erosive forces of high winds.

**Suggestions for Implementation**

It is recommended that:

- Ridges formed by tillage or planting should be aligned across the prevailing wind direction.
- While 90 degrees or perpendicular is preferred, benefits can still be realized with ridges as close to perpendicular as possible.
- If ridges deteriorate and become ineffective due to weathering or erosion, they should be reestablished, unless doing so would damage a growing crop.
- This practice is best adapted on soils, which are stable enough to sustain effective ridges, such as clayey, silty and sandy loam soils. It is not well adapted on unstable soils, such as sands, loamy sands and certain organic soils.

## Cross-Wind Strip-Cropping

**Rule Definition**

"Cross-Wind Strip-Cropping" means planting strips of alternating crops within the same field.

**Purpose**

Growing crops or managing residue as a protective cover in strips across the prevailing wind direction can break the effects of high wind events.

**Suggestions for Implementation**

It is recommended that:

- Cross-wind strip-cropping system consists of at least two crop or residue cover alternating strips.
- Strip widths should be at least 25 feet but no more than 330 feet.
- Strips should be aligned across the prevailing wind direction. While 90 degrees or perpendicular is preferred, benefits can still be realized when the strips are oriented as close to perpendicular as possible.
- Protective cover includes, but is not limited to a growing crop, grasses, legumes, grass-legume mixtures, standing stubble or tilled residue with enough surface cover to provide protection.

## Cross-Wind Vegetative Strips

**Rule Definition**

"Cross-Wind Vegetative Strips" means herbaceous cover established in 1 or more strips within the same field.

**Purpose**

Herbaceous cover creates a protective windbreak that disrupts the erosive forces of high winds, especially during critical wind erosion periods.

**Suggestions for Implementation**

It is recommended that:

- Herbaceous cover should be composed of perennial or annual vegetation, growing or dead.
- Strips consist of at least one row of plants, providing the porosity can be achieved with a single row that contains no gaps.
- When two or more rows are required to achieve the required porosity and to avoid gaps, the rows should be spaced no more than 36 inches apart.
- Annual vegetation strips be composed of more than one row.
- Strips designed for this purpose have a minimum expected height of two feet.
- Strips designed for this purpose achieve a minimum porosity of 40 to 50 percent.
- Spacing between strips (not within row) not exceed 12 times the expected height of the herbaceous cover.
- Spacing between strips be adjusted to accommodate widths of farm equipment to minimize partial or incomplete passes.

## Integrated Pest Management

### Rule Definition

"Integrated Pest Management" means the use of a combination of techniques including organic, conventional and biological farming practices.

### Purpose

Integrated pest management creates beneficial insect habitat that reduces the use of herbicides/ pesticides, thereby reducing the number of passes for spraying. It also reduces soil compaction and the need for additional tillage.

### Examples of Integrated Pest Management

- Monitoring crop for pests to accurately and effectively apply control measures.
- Incorporate biological practices into farming operation to reduce need for spraying.

## Manure Application

### Rule Definition

"Manure Application" means applying animal waste or biosolids to a soil surface.

### Purpose

Applying manure to maintain or improve chemical and biological condition of the soil can help reduce wind erosion and PM10.

### Suggestions for Implementation

- If the application or storage of manure is near a water source, precautions should be taken to prevent accidental leakage, spillage or runoff that will result in undesirable effects on soil, water and plants.
- Caution should be used when applying manure to ensure that state and local regulations are not violated.
- Caution should be used when certain manures are applied as they can volatilize and contribute to odor and ammonia emissions.
- Manures should be incorporated as quickly as possible to reduce odor and ammonia emissions, and to preserve nutrient value if the area is to be cropped in the future.

## Mulching

**Rule Definition**
"Mulching" means applying plant residue or other material that is not produced on site to a soil surface.

**Purpose**
Adding a protective layer to the soil surface reduces soil movement in high wind events.
This practice also conserves soil moisture, which can reduce surface movement of soil.

**Suggestions for Implementation**
It is recommended that:

- This practice can be used after low residue producing crops, like cotton, are harvested.
- Materials for mulching are acquired as waste products from other enterprises.
- These include, but are not limited to, wood bark, chips, shavings, and saw dust; food processing wastes; and small grain straw/chaff.
- Mulches are applied by blowers, hydro applicators, disk type straw punchers and spreaders.
- When small grain straw is used, spread at least 4,000 pounds straw per acre, distribute evenly and partially incorporate into the soil.
- When wood fibers are used, spread at least 2,000 pounds per acre or achieve 80 percent cover.

## Multi-Year Crop

**Rule Definition**
"Multi-Year Crop" means a crop, pasture, or orchard that is grown, or will be grown, on a continuous basis for more than one year.

**Purpose**
Surface covers, such as crops, pasture and orchards, that are grown and maintained for a long duration, protect the soil surface from erosive winds. The longer a crop or cover is protecting the soil surface, the less time the surface is susceptible to wind erosion.

**Examples of Multi-Year Crops are:**

- Alfalfa
- Citrus
- Roses
- Livestock pastures
- Nuts (Pecans)
- Sod

## Permanent Cover

### Rule Definition

"Permanent Cover" means a perennial vegetative cover on cropland.

### Purpose

Maintaining a long-term (perennial) vegetative cover on cropland that is temporarily not producing a major crop protects the soil surface from erosive winds.

### Suggestions for Implementation

It is recommended that:

- Perennial species of grasses and/or legumes be used to establish at least 60 percent cover.
- When perennial species are used, maintenance by periodic mowing or swathing/baling is encouraged.
- Specific information on permanent cover types can be obtained from the Cooperative Extension Service or all NRCD offices.

## Planting Based on Soil Moisture

### Rule Definition

"Planting Based on Soil Moisture" means applying water to soil before performing planting operations.

### Purpose

Planting based on soil moisture reduces PM10 during the planting operation and is effective from the time of planting until crop establishment. Planting based on soil moisture is one of the most efficient practices to reduce PM10 between planting and crop emergence. Moisture causes soil to crust and therefore PM10 is not easily transported into the air.

### Suggestions for Implementation

- Care should be taken to avoid over compaction of the soil, which could result in additional tillage operations.
- Irrigation should be applied as soon after soil preparation for planting as possible. After watering, a thin crust develops on the soil surface, which stabilizes the soil until planting
- The time between bed lifting, irrigation and planting should be minimized as much as possible.
- Use the soil moisture "feel method" to determine adequate soil moisture. See the Natural Resource Conservation Service publication #1619 "Estimating Soil Moisture by Feel and Appearance." This publication is available at all NRCD offices.

## Residue Management

**Rule Definition**

"Residue Management" means managing the amount and distribution of crop and other plant residues on a soil surface.

**Purpose**

Leaving crop and other plant residues on the soil surface can protect the soil between the time of harvest of one crop and emergence of a new crop, thus helping reduce wind erosion and the generation of PM10.

**Suggestions for Implementation**

Many different residue management systems have been developed. Some examples include:

- Reduced tillage systems, such as mulch-till, which partially incorporate surface residues and involve no plowing.
- No-till, this involves planting directly into the soil without any alteration to the seedbed. One example is planting a new crop directly into the grain stubble.
- Soil protection by crop residues can be increased by leaving residues on the soil surface as long as possible (e.g. by delaying tillage operations until just before planting).

It is recommended that:

- Stubble be left standing at six inches or more.
- Tillage be limited during this period to undercutting tools, such as blades, sweeps or deep tillage implements, such as a ripper or subsoiler.
- Loose residue be uniformly distributed on the soil surface.
- Residues from previous crops be left to maintain 60 percent ground cover.
- Specific information on determining small grain residue equivalents can be obtained from the Cooperative Extension Service or all NRCD offices.
- Consult NRCS Standard and Specification for Residue Management, # 329 and 344. This document is available at all NRCD offices.

## Sequential Cropping

**Rule Definition**

"Sequential Cropping" means growing crops in a sequence that minimizes the amount of time bare soil is exposed on a field.

**Purpose**

By reducing the amount of time bare soil is exposed, sequential cropping helps reduce the window of time that the cropland is susceptible to PM10 erosion.

**Some examples of sequential cropping include:**

- Planting a winter grain crop between final harvest of a cotton crop and the planting of the next cotton crop.
- Close rotations of vegetable crops.

**Suggestions for Implementation**

It is recommended that:

- The amount of time bare soil is exposed be limited to 30 days or less.
- Rotations be provided for acceptable substitute crops in case of crop failure or shift in planting intentions for weather related or economic reasons.

## Surface Roughening

### Rule Definition

"Surface Roughening" means manipulating a soil surface to produce or maintain clods.

### Purpose

The formation of clods helps disrupt the erosive force of the wind over an unprotected soil surface. Soil clods can be formed by tillage implements under appropriate soil moisture conditions.

### Suggestions for Implementation

- Not all soils are able to form clods. Review the local soil survey or contact the NRCD office to help determine a specific field's soil type.
- Caution should be used to determine the most opportune time to roughen the soil surface while considering the tillage needed prior to planting, crop to be grown and irrigation water management needs (surface roughening can dry the upper soil profile more rapidly than not disturbing the soil).

## Transgenic Crops

### Rule Definition

"Transgenic Crops" means the use of plants that are genetically modified.

### Purpose

Transgenic crops reduce the need for tillage or cultivation operations, as well as reduces soil disturbance. Can also reduce the number of chemical applications.

### Examples of Transgenic Crops

- Genetically altered seed
- Nematode resistant rootstock

## Tree, Shrub, or Windbreak Planting

**Rule Definition**

"Tree, Shrub, or Windbreak planting" means providing a woody vegetative barrier to the wind.

**Purpose**

Barriers placed perpendicular to the wind direction can reduce wind speeds by changing the pattern of airflow over the land surface, which helps to reduce wind erosion and PM10.

**Suggestions for Implementation**

- The distance of 10 times the barrier height is considered the protected area downwind of the barrier.
- Single row plantings are most popular in field windbreaks because they use less water and occupy the least amount of land area for the amount of protection derived.
- Recommended species for planting can be obtained at all NRCD offices.
- The planting should be done at a time and manner to insure survival and growth of selected species.
- Moisture conservation or supplemental watering should be provided for plant establishment and growth, as well as the use of drought tolerant species.
- Windbreaks should be aligned across the prevailing wind direction. While 90 degrees or perpendicular is preferred, benefits can still be realized when windbreaks are aligned as close to perpendicular as possible.
- The interval between windbreaks should be determined using current approved wind erosion technology available at all NRCD offices.

***Agricultural Best Management Practices General Permit Record***

*The following is an example of a form that you can use or duplicate. You are not required to use this form.*

Name of commercial farmer_____ Date_____

Mailing or physical address of the commercial farm

_____ Phone_____

_____

City_____State_____Zip_____ Email_____

Selected Best Management Practices. A commercial farmer must implement at least ***TWO*** practices from each category.

**CATEGORY I: Tillage & Harvest**

- ☐ Cessation of Night Tilling
- ☐ Chemical Irrigation
- ☐ Combining Tractor Operations
- ☐ Equipment Modification
- ☐ Green Chop
- ☐ Integrated Pest Management
- ☐ Limited Activity during High-wind Events
- ☐ Multi-year Crop
- ☐ Planting Based on Soil Moisture
- ☐ Precision Farming
- ☐ Reduced Harvest Activity
- ☐ Reduced Tillage System
- ☐ Tillage Based on Soil Moisture
- ☐ Timing of Tillage Operation
- ☐ Transgenic Crops

Notes:

**CATEGORY II: Non-Cropland**

- ☐ Access Restriction
- ☐ Aggregate Cover
- ☐ Artificial Wind-barrier
- ☐ Critical Area Planting
- ☐ Manure Application
- ☐ Reduce Vehicle Speed
- ☐ Synthetic Particulate Suppressant
- ☐ Track-out Control System
- ☐ Tree/Shrub/Windbreak Planting
- ☐ Watering

Notes:

**CATEGORY III: Cropland**

- ☐ Artificial Wind-barrier
- ☐ Cover Crop
- ☐ Cross-wind Ridges
- ☐ Cross-wind Strip-cropping
- ☐ Cross-wind Vegetative Strip
- ☐ Integrated Pest Management
- ☐ Manure Application
- ☐ Mulching
- ☐ Multi-year Crop
- ☐ Permanent cover
- ☐ Planting Based on Soil Moisture
- ☐ Residue Management
- ☐ Sequential Cropping
- ☐ Surface Roughening
- ☐ Transgenic Crops
- ☐ Tree/Shrub/Windbreak Planting

Notes:

Signature:_____

## Stakeholders and Collaborating Partners

Arizona Cotton Growers Association
Arizona Department of Agriculture
Arizona Department of Environmental Quality
Arizona Farm Bureau Federation
Arizona Nursery Association
Maricopa Association of Governments
Maricopa County Air Quality Department
Maricopa County Farm Bureau
Natural Resource Conservation Districts
USDA Agricultural Research Service
USDA Natural Resources Conservation Service
US Environmental Protection Agency Region IX
University of Arizona - College of Agriculture and Life Sciences
University of Arizona - Cooperative Extension, Maricopa County
Western Growers Association

# Notes...

# *Notes...*