ARIZONA WATER ATLAS
VOLUME 4
UPPER COLORADO RIVER PLANNING AREA

Arizona Department of Water Resources

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ARIZONA WATER ATLAS
VOLUME 4 - UPPER COLORADO RIVER PLANNING AREA

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Preface

Volume 4, the Upper Colorado River Planning Area, is the fourth in a series of nine volumes that comprise the Arizona Water Atlas. The primary objectives in assembling the Atlas are to present an overview of water supply and demand conditions in Arizona, to provide water resource information for planning and resource development purposes, and help identify the needs of communities.

The Atlas divides Arizona into seven planning areas (Figure 4.0-1). There is a separate Atlas volume for each planning area, an introductory volume composed of background information, and an executive summary volume. "Planning areas" are an organizational concept that provide for a regional perspective on supply, demand and water resource issues. A complete discussion of Atlas organization, purpose and scope is located in Volume 1.

Additional, more detailed data than those presented in this volume are available. They may be obtained by contacting the Arizona Department of Water Resources' Statewide Conservation and Strategic Planning Division.

4.0 Overview of the Upper Colorado River Planning Area

The Upper Colorado River Planning Area is composed of nine groundwater basins located in northwestern Arizona, south and east of the Colorado River. Elevation ranges from 450 feet to 8,417 feet. Most of the planning area is within Mohave County; the planning area includes smaller portions of Coconino, La Paz and Yavapai counties. Parts of the Fort Mojave and Hualapai Indian Reservations are within the planning area. The 2000 Census planning area population was approximately 153,800. Basin population ranged from 822 in the Meadview Basin to over 51,000 in the Lake Mohave Basin. Lake Havasu City is the largest metropolitan area with about 42,000 residents in 2000. Annual cultural water demand was about 173,650 acre-feet during the period 2001-2003. Agriculture is the largest water use sector in the planning area with an annual demand of approximately 95,850 acre-feet, almost entirely within the Lake Mohave Basin. Municipal demand accounts for about 55,200 acre-feet/year, and industrial demand is about 22,600 acre-feet/year.

4.0.1 Geography

The Upper Colorado River Planning Area encompasses about 11,860 square miles and includes the Big Sandy, Bill Williams, Detrital Valley, Hualapai Valley, Lake Havasu, Lake Mohave, Meadview, Peach Springs and Sacramento Valley basins. Basin boundaries, counties and prominent cities, towns and places are shown in Figure 4.0-2. The planning area is bounded on the north by the Colorado River, the state of Nevada and by the Western Plateau Planning Area, on the east by the Central Highlands Planning Area and the Prescott Active Management Area, on the south by the

Lower Colorado River Planning Area and a portion of the Central Highlands Planning Area and on the west by the Colorado River and the states of California and Nevada. The planning area includes all or part of five watersheds, which are discussed in section 4.0.2. Within the planning area, the Fort Mojave Indian Reservation encompasses about 23,500 acres and the Hualapai Indian Reservation encompasses about 553,000 acres. Elevation ranges from 450 feet along the Colorado River near Lake Havasu City to 8,417 feet at Hualapai Peak south of Kingman.

Arizona's three physiographic provinces are found in the planning area (See Volume 1, Figure 1-2). Most of the planning area is within the Basin and Range physiographic province, which is characterized by northwest-southeast trending mountain ranges separated by broad alluvial valleys. The Detrital Valley and Sacramento Valley basins are representative of this province. The northeastern portion of the planning area, primarily the Peach Springs Basin, falls within the Plateau Uplands physiographic province, characterized by high desert plateaus and incised canyons. The eastern portion of the planning area that includes the eastern, upland areas of the Big Sandy and Bill Williams basins is located within the Central Highlands physiographic province, characterized by rugged mountains of igneous, metamorphic and sedimentary rocks.

Unique geographic features of the planning area are the Colorado River and associated lakes impounded by several dams. The River and lakes define its northern and western boundaries and influence the cultural uses, groundwater conditions and habitat in a significant portion of the planning area.

4.0.2 Hydrology[1]

Groundwater Hydrology

The Upper Colorado River Planning Area is characterized by semi-arid, alluvial basins with few perennial streams. Anderson, Freethey and Tucci (1992) divided the alluvial basins in south-central Arizona into categories based on similar hydrologic and geologic characteristics. These categories are useful in describing general hydrologic characteristics. Although their study basins do not match the Department's groundwater basins exactly, the area encompassed by the Upper Colorado River Planning Area basins is included in their study with the exception of Peach Springs Basin. Four basin categories identified by Anderson, et al. are represented in the planning area. Basins are categorized as either "West", "Colorado River", "Highland" or "Southeast" and are discussed below.

West Basins

The West basins include the Detrital Valley, Hualapai Valley, and Meadview basins, most of the Sacramento Valley Basin and part of the Bill Williams Basin (see Figure 4.0-2). These basins are the most arid regions in the planning area. Groundwater inflow and outflow are small and there is almost no stream baseflow.

In the Detrital Valley Basin, groundwater occurs mostly in basin-fill material and in alluvial deposits along mountain washes. Intermediate and younger basin fill are above the water table

[1] Except as noted, much of the information in this section is taken from the Arizona Water Resources Assessment, Volume II, ADWR August, 1994.

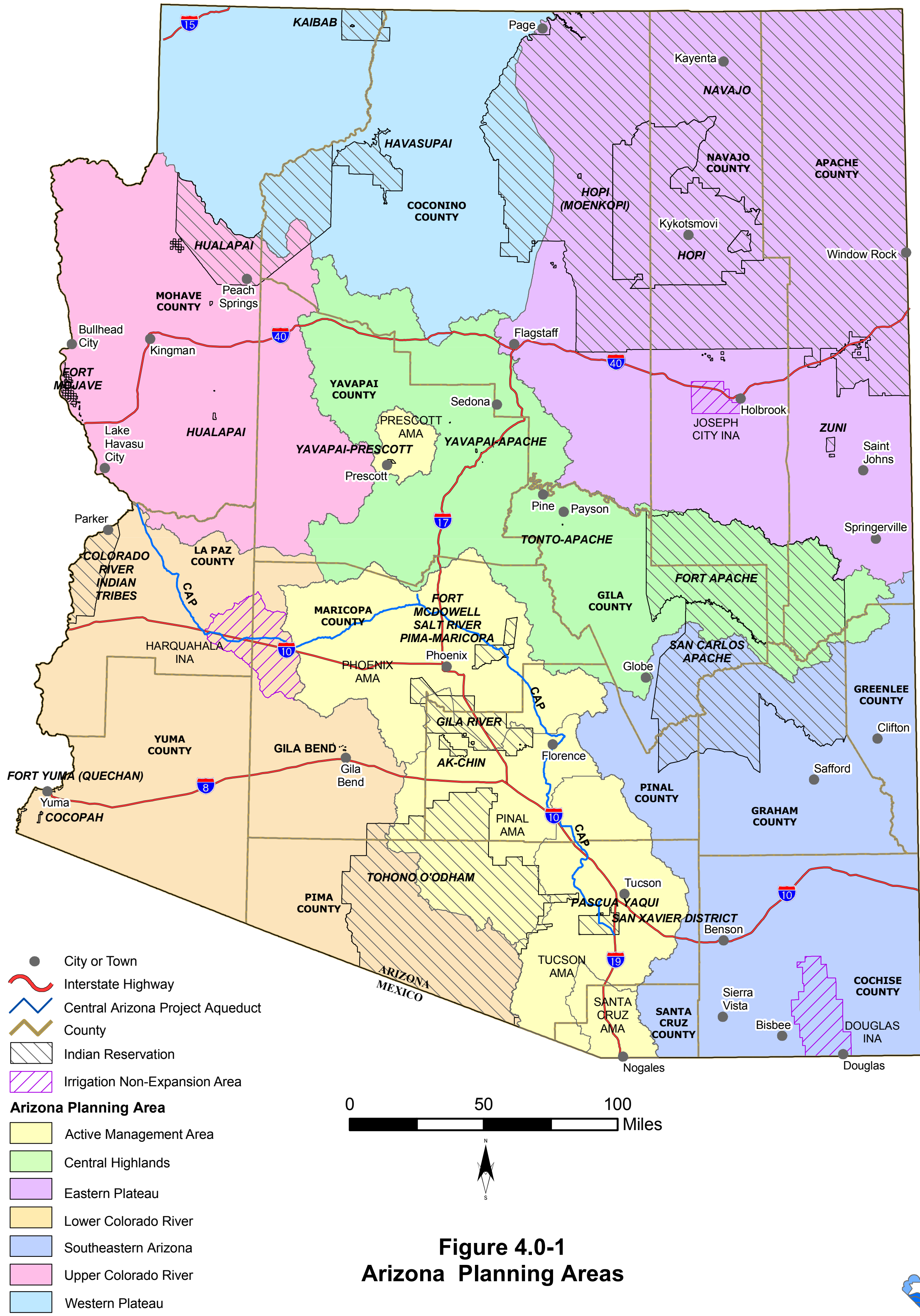


Figure 4.0-1
Arizona Planning Areas

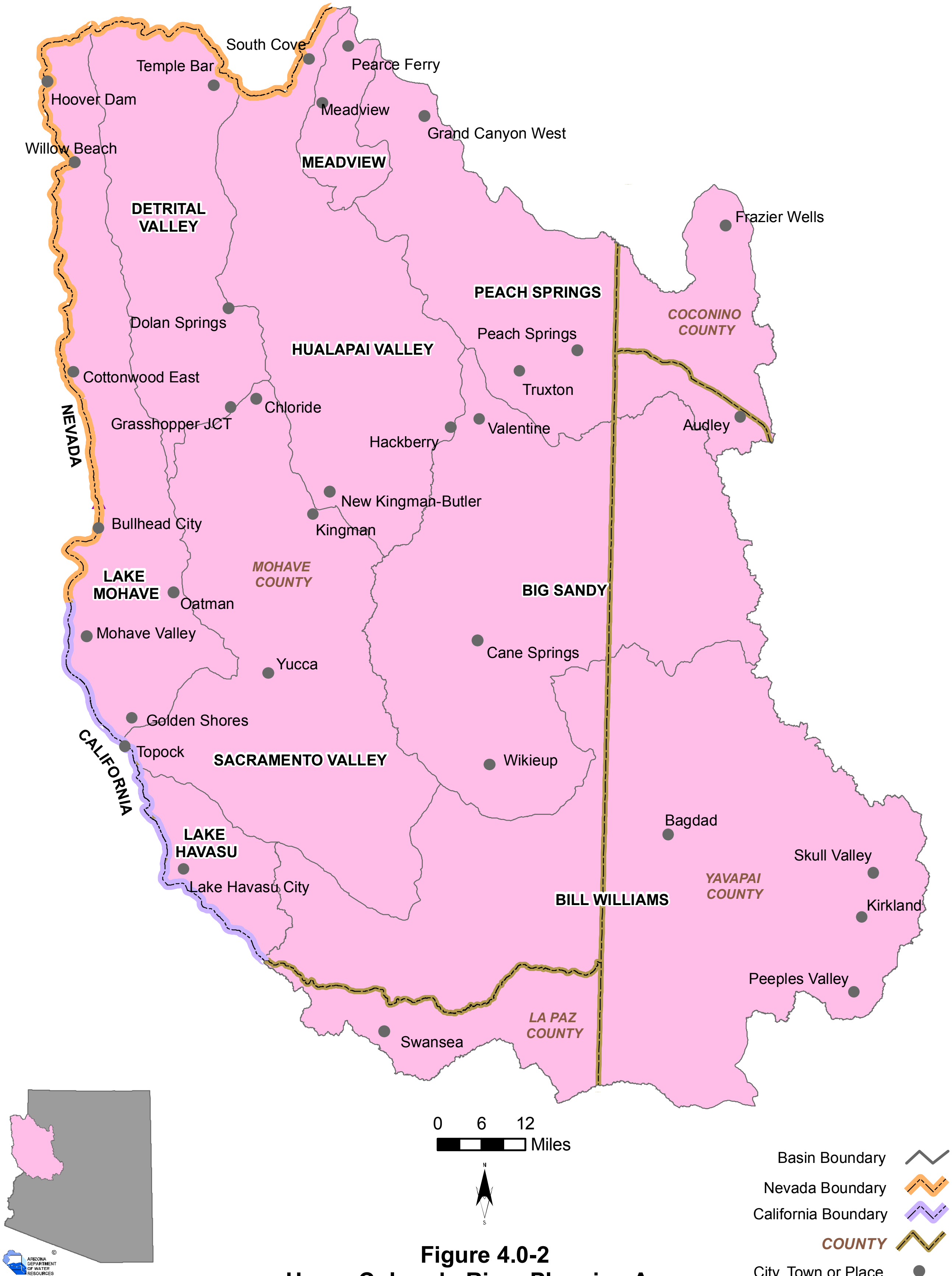


Figure 4.0-2
Upper Colorado River Planning Area

in most areas so the older basin fill aquifer is the primary water supply. In the northern part of the basin, the basin fill includes clastic (weathered) sediments, limestone, and basalt flows of the Muddy Creek and Chemehueve Formations (USGS, 2006). Depth to bedrock may exceed 6,000 feet at the deepest point. There is a clay unit that may extend from 600 to 1,400 feet below land surface in the central portions of the basin. It acts as an impediment to groundwater flow and reduces the amount of recoverable groundwater due to its low specific yield. The areal extent of this unit is not well known due to lack of data (ADWR, 2006).

The Hualapai Valley Basin has relatively deep, basin fill sediments categorized into three units. The younger alluvium unit includes recent streambed deposits in Hualapai Valley and in mountain canyons. This unit yields small volumes of water to stock and domestic wells. The intermediate alluvium, which is composed of coarse-grained sands, silts and clays, is a dependable aquifer only along the valley margins where the unit intersects the water table. As with other basins in this category, the older alluvium is the primary water supply. Similar to the Detrital Valley Basin located to the west, the northern part of the valley includes clastic sediments, limestone and basalt flows of the Muddy Creek and Chemehueve Formations within the basin fill (USGS, 2006). Recharge to the aquifer comes primarily from streambed infiltration. Groundwater is highly mineralized in some areas near the mountains and near Red Lake, a dry lakebed. Chromium has been detected in some wells in the basin.

The main aquifer in the Meadview Basin is the Muddy Creek Formation composed of three units. The upper limestone unit yields water to shallow wells and springs. The middle sandstone unit has a high clay content that limits its ability to transmit water. The lower unit is a conglomerate with high hydraulic conductivity. Most well development is in this lower unit. Groundwater recharge is relatively small due to low rainfall and high evaporation rates. Groundwater quality is generally good in the basin.

Older alluvium is the principal aquifer in the Sacramento Valley Basin. Aquifer recharge is from infiltration of runoff in washes and along mountain fronts, except in the vicinity of the Colorado River where infiltration of river water is the main source of recharge. There are fractured and faulted volcanic rocks in the vicinity of Kingman that separate this basin from the Hualapai Valley Basin. Little water is pumped from wells located in these volcanics. The fractured granite aquifer beneath the community of Chloride is insufficient to meet its needs and water must be hauled from Kingman. In addition, concentrations of radionuclides in Chloride wells have exceeded Safe Drinking Water Act maximum contaminant levels (City of Kingman, 2003). Otherwise, groundwater quality is generally good in the basin except along the base of the mountains where waters of high mineral content are common.

Anderson, Freethey and Tucci (1992) categorized most of the western portion of the Bill Williams Basin as a “West” basin, which generally corresponds to the Alamo Reservoir and Clara Peak sub-basins (see Figure 4.2-6). Groundwater in this area occurs primarily in younger alluvial deposits and in basin fill. The water-bearing ability of these units varies within the basin. The younger alluvium consists of gravel, sand and silt along the Bill Williams River and its major tributaries. The main water-bearing unit is the basin fill and water quality within this unit is generally good. Basin fill deposits more than 5,000 feet thick are found in the Bullard Wash-Date Creek Area southeast of Alamo Lake State Park. Recharge is from streamflow and mountain front precipitation.

<u>Colorado River Basins</u>
The Colorado River Basins include the Lake Havasu and Lake Mohave basins and portions of the Sacramento Valley and Bill Williams basins in the vicinity of the Colorado River. In these areas the direction and occurrence of groundwater are influenced by the amount of streamflow in the Colorado River. Infiltration of river water is the main source of inflow to aquifers. The aquifers are composed primarily of stream alluvium deposits that are hydraulically connected to the underlying older alluvium. Groundwater occurs under unconfined conditions in both the stream and older alluvium.

In the Lake Havasu Basin the basin fill alluvium, consisting of sand, silt and gravel, overlies the Bouse Formation (siltstone and fine-grained sandstone) and a conglomerate unit. Most wells in the basin penetrate the upper 100-200 feet of the basin fill. There is a direct hydraulic connection between the Colorado River, Lake Havasu and groundwater in the basin.

The principal water-bearing formations in the Lake Mohave Basin are alluvial sand, silt and gravel deposits adjacent to Lake Mohave and the Colorado River. The regional groundwater level is higher than it was prior to filling Lake Mohave upstream of Davis Dam, but the general groundwater flow direction is still toward the west. A granite ridge extends across the Colorado River and basin near Davis Dam, restricting recharge from the lake to the south. In general all groundwater is unconfined in the basin. Compared with aquifer recharge from the lake, mountain front recharge is negligible. There are occurrences of high total dissolved solids (TDS) and fluoride along the mountain fronts. Thermal and other springs occur downstream of Hoover Dam and represent the only surface water in the basin other than the lake and the Colorado River.

<u>Highland Basins</u>
The aquifers of the Highland basins, which generally encompass the northeastern portions of the Big Sandy and Bill Williams basins, consist of hydraulically connected basin fill and younger alluvium. These aquifers tend to be discontinuous and limited in extent. Groundwater inflow is from adjacent consolidated rock aquifers, stream channels, and mountain front recharge. Groundwater outflow is due to evapotranspiration and baseflow to streams (Anderson, et al. 1992).

In this portion of the Big Sandy Basin, generally the Fort Rock sub-basin, (see Figure 4.1-6), the primary hydrologic unit consists of sedimentary rocks composed of Redwall Limestone (a coarse-grained, massive limestone) and the Martin Formation (a fine- to coarse-grained dolomitic limestone). The limestone forms a regional aquifer that extends north and east. There is little water development in this portion of the Big Sandy Basin.

Groundwater in the northeastern portion of the Bill Williams Basin, generally the Burro Creek, Santa Maria and Skull Valley sub-basins (see Figure 4.2-6), is found in basin fill, in fractured and porous volcanic rocks and in younger alluvial deposits. In the Peeples Valley area, the younger alluvium is the main water-bearing unit. An important water-bearing unit in the Copper Basin area east of Skull Valley is a 1,000 foot thick layer of volcanic rocks with reportedly high yields in the upper 350 to 400 feet. Recharge occurs from streamflow and mountain front precipitation. Other sources of groundwater are from faults in granite and metamorphic rocks. Springs are found in volcanic and crystalline rocks in the area including along Burro Creek.

Southeast Basins

With the exception of its northeastern portion, most of the Big Sandy Basin was categorized as a "Southeast" basin by Anderson, Freethey and Tucci (1992). This area generally corresponds to the Wikieup sub-basin south of Interstate 10 (see Figure 4.1-6). Southeast basins are characterized by moderately thick pre-Basin and Range sediments and an overlying layer of lower basin fill to depths of over 1,000 feet. Aquifers generally consist of two or more water-bearing units separated by a fine-grained unit that forms a leaky confining layer over the lower basin fill. Primary water development in the Big Sandy Basin is along the central valley, primarily in the upper basin fill that varies from loosely consolidated silty gravel to sandy silt. The floodplain alluvium in the central valley is 30-40 feet thick and is an unconsolidated deposit of gravel and sand. In the Wikieup area, wells greater than 40 feet in depth tap the upper basin fill, which is estimated to be 300 feet deep in that area. North of Wikieup, the upper basin fill is estimated to be 150 to 200 feet deep.

Peach Springs Basin

The Peach Springs Basin was not included in the study conducted by Anderson, Freethey and Tucci (1992). This basin is characterized by an upland area, the Hualapai Plateau, in the western part of the basin, composed of interbedded limestones, shales and sandstones, and by Aubrey and Truxton Valleys that are filled with recent lava flows and alluvial material (See Figure 4.8-1). The Muav limestone is the main water-bearing unit on the Hualapai Plateau where depths to groundwater may be as much as 1,300 feet. Groundwater flow is toward the northeast. It exits the basin at springs emanating from the Muav limestone in the Grand Canyon. Groundwater is limited to a few permeable layers in the basin's two primary valleys. In the Aubrey Valley in the far northeastern part of the basin near Frazier Wells, groundwater is found in gravel beds at relatively shallow depth. In the Truxton Valley area, lake-bed deposits are a local source of groundwater. In some areas of the basin, Precambrian rocks, isolated volcanic rocks and local alluvial sands in washes provide small amounts of water.

Surface Water Hydrology

The U.S. Geological Survey (USGS) divides and subdivides the United States into successively smaller hydrologic units based on hydrologic features. These units are classified into four levels. From largest to smallest these are: regions, subregions, accounting units and cataloging units. A hydrologic unit code (HUC) consisting of two digits for each level in the system is used to identify any hydrologic area (Seaber et al., 1987). The 6-digit unit code corresponds to accounting units, which are used by the USGS for designing and managing the National Water Data Network. One USGS 6-digit HUC watershed is completely within the planning area - Bill Williams. In addition, there are portions of four others: the Lower Colorado-Lake Mead; the Lower Colorado below Lake Mead; the Lower Gila-Agua Fria; and the Verde (Figure 4.0-3).

Lower Colorado-Lake Mead

The Lower Colorado-Lake Mead watershed is located in the Western Plateau Planning Area and in the northern portion of the Upper Colorado River Planning Area. Included within the Upper Colorado River Planning Area portion of the watershed are the Hualapai Valley and Meadview basins, almost all of the Detrital Valley Basin, all but the far eastern portion of the Peach Springs Basin and the northern-most part of the Big Sandy Basin.

The major north-flowing tributaries to the Colorado River in the Upper Colorado River Planning Area portion of the watershed are Hualapai Wash in the Hualapai Valley Basin, and Detrital Wash in the Detrital Valley Basin. These washes are ephemeral and contribute little to the flow of the Colorado River. The other major wash is Truxton Wash in the Peach Springs and Hualapai Valley basins, which flows north to Red Lake, a dry lake. The Colorado River is the only perennial water supply in the watershed portion of the planning area (AGFD, 1993 & 1997). There is only one intermittent stream, a portion of Truxton Wash, located in Peach Springs Basin.

Lake Mead, created by Hoover Dam, has affected groundwater conditions in adjacent basins in the watershed. There is outflow from the lake into the surrounding aquifers. Lake Mead extends from Hoover Dam in the Lake Mohave Basin, along the planning area boundary to Peach Springs Basin. Maximum storage in Lake Mead is 29.7 million acre-feet (maf). Of this, 2,378,000 maf is "dead storage" - the reservoir capacity from which stored water cannot be evacuated by gravity. The average storage during the period from 1996 to 2005 was 20.3 maf.

Twenty-four major springs (springs with a measured discharge rate of 10 gallons per minute [gpm] or greater at any time) are found in the watershed, primarily located in the Peach Springs and Meadview basins. Generally, springs with the greatest discharge are located in the Hualapai Plateau in the Peach Springs Basin, where discharges of 1,730 gpm at Spencer Spring and 1,233 gpm at Meriwhitica Spring have been measured. With the exception of a number of springs measured in the early 1990s, particularly in the Peach Springs Basin, most of the spring measurements were recorded over 30 years ago and may not reflect current conditions. For example, recent discharge measurements taken at two "major" springs in the Peach Springs Basin were less than 10 gpm. (See Springs tables in each basin section.)

There is only one streamgage in the watershed at Spencer Creek near Peach Springs. Median flows at this gage are about 1,500 acre-feet per year.

Lower Colorado below Lake Mead

This watershed consists of two sections in Arizona. The northern portion is within the Upper Colorado River Planning Area (north watershed) and the southern portion is located in the Lower Colorado River Planning Area. Groundwater basins included in the north watershed are the Lake Havasu Basin and most of the Lake Mohave and Sacramento Valley basins. A very small portion of Detrital Valley Basin also lies within the north watershed. Sacramento Wash an emphemeral wash in the Sacramento Valley Basin is the only major contributing tributary to the Colorado River in the north watershed. Sawmill Canyon, located at the northeastern edge of the Sacramento Valley Basin, is the only intermittent stream.

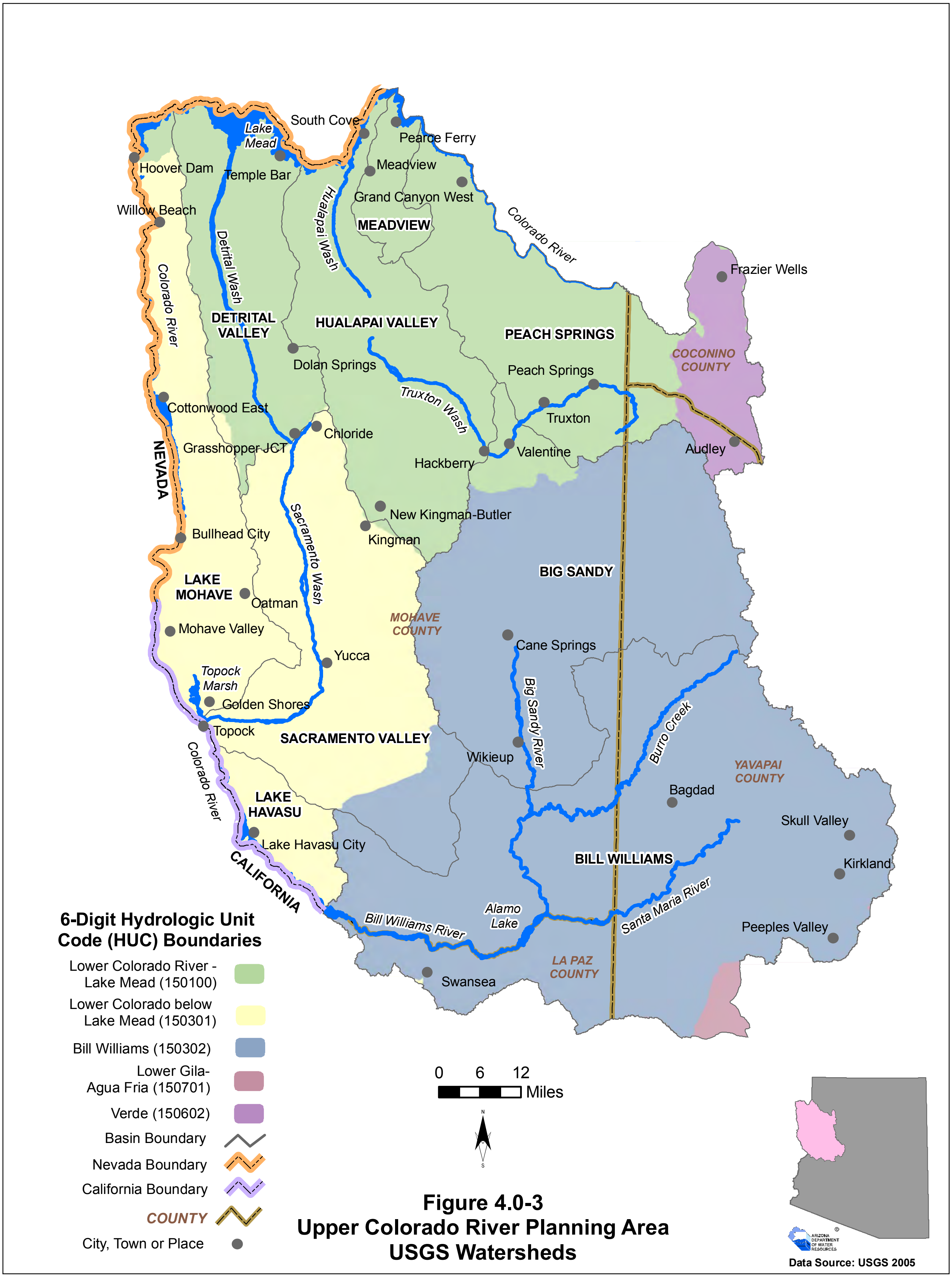


Figure 4.0-3
Upper Colorado River Planning Area
USGS Watersheds

Parker and Davis dams have created lakes that affect groundwater conditions along the Colorado River. Parker Dam is located in the Lower Colorado River Planning area but the lake it creates, Havasu, extends into the Upper Colorado River Planning Area. Davis Dam, north of Bullhead City, creates Lake Mohave. There is outflow from the river and lakes into the surrounding aquifers. Maximum storage in Lake Mohave is about 1.8 maf (including dead storage) and average storage from 1996 to 2005 was 1.65 maf. Maximum storage in Lake Havasu is 651,000 acre-feet (including dead storage) and average storage from 1996-2005 was about 572,000 acre-feet.

The only streamgages in the north watershed are along the Colorado River. Streamflow is largely subject to releases from upstream dams. A gage at Topock reports median annual flow of 8.9 maf, a gage below Davis Dam reports median annual flow of 8.5 maf, and median annual flows below Hoover Dam are 9.2 maf.

Twenty-four major springs (those with a measured discharge rate of 10 gpm or greater at any time) are found in the north watershed. These springs are located in the northern half of the Sacramento Valley Basin and in the Lake Mohave Basin along the Colorado River immediately below Hoover Dam. Only three of the major springs have had a measured discharge rate of 100 gpm or greater. There are a relatively large number of minor springs (42) in the Sacramento Valley Basin. The most recent spring measurements were taken in 1979 and some measurements date to the 1940s.

<u>Bill Williams</u>

The Bill Williams watershed has a drainage area of about 5,393 sq. miles (NEMO, 2005). The watershed drains into Lake Havasu just upstream of Parker Dam near the southern boundary of the planning area. The greatest elevational range in the planning area, from 8,417 feet at Hualapai Peak to 450 feet north of Parker Dam, is found in the watershed. The watershed includes the Bill Williams Basin, most of the Big Sandy Basin and the southern portion of the Sacramento Valley Basin. The watershed is drained by the Bill Williams River and its major tributaries, the Big Sandy and the Santa Maria Rivers and by Burro Creek. A number of perennial streams exist in the watershed including segments of the Big Sandy River, the Bill Williams River, Burro Creek, Kirkland Creek, the Santa Maria River, and Trout Creek. Numerous intermittent streams also are present.

Construction of Alamo Dam on the Bill Williams River in 1968 significantly impacted streamflow below the dam. The dam is operated in a manner to benefit downriver wildlife refuges and vegetation along the river. According to NEMO (2005), only about 185 miles of perennial streamflow exist in the watershed, mostly restricted to the main stem of the Bill Williams River. Water levels in the Bill Williams River below Alamo Dam occasionally are affected by the water levels in Lake Havasu. Alamo Lake is the largest lake in the watershed with about 13,400 acres of open water surface.

Median annual streamflow in the Bill Williams River below Alamo Dam is about 34,000 acre-feet, but a maximum flow of almost 702,000 acre-feet was recorded in 1993. By comparison, the median annual flow at a gage on the Santa Maria River upstream of the dam is about 10,000 acre-feet a year. The median annual flow recorded at a gage south of Wikieup on the other major tributary to the Bill Williams River, the Big Sandy River, is about 27,000 acre-feet.

Within the watershed, perennial streams originate from spring water discharges from crystalline rocks. Most of the public water supply for the town of Bagdad comes from spring flow that discharges to Francis Creek, a tributary to Burro Creek. Twelve large springs have been identified in the watershed, with the largest located in the Big Sandy Basin. Discharge from an unnamed spring south of Cane Springs has had a discharge of 1,600 gpm. The largest spring in the Bill Williams Basin was measured at 228 gpm. There are no large springs reported in the Sacramento Valley Basin portion of the watershed. Most springs are located in the vicinity of Valentine, along the Big Sandy River, and near the eastern boundary of the Bill Williams Basin. All measurements were taken prior to 1980 and some measurements are as old as 1943; therefore, the reported discharges may no longer be representative of current conditions.

<u>Verde</u>
A very small portion of the Verde watershed extends into the easternmost portion of the Peach Springs Basin. There are no major tributaries, perennial or intermittent streams, or springs in this area.

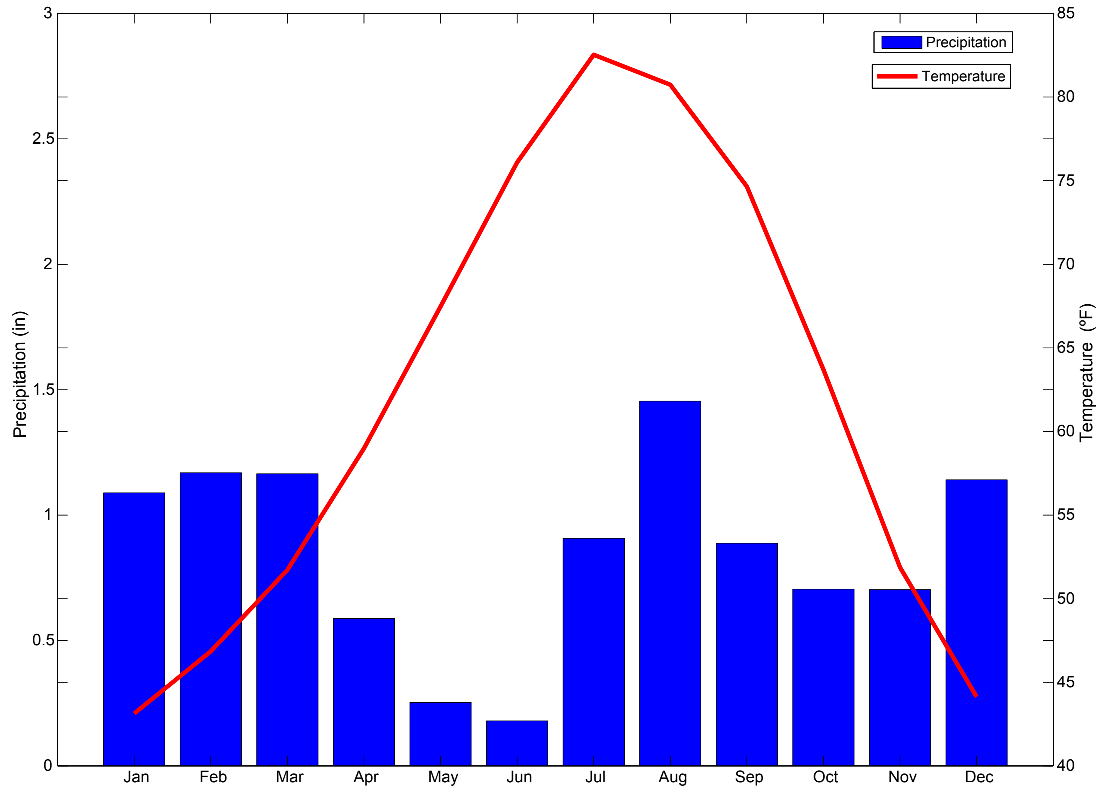
<u>Lower Gila-Agua Fria</u>
A very small portion of this watershed extends into the extreme southeastern portion of the Bill Williams Basin. There are no major tributaries, perennial or intermittent streams, or springs in this area.

4.0.3 Climate

The Upper Colorado River Planning Area has a distinctive bi-modal precipitation pattern found in other regions of the state, though this planning area is overall relatively dry. Summer precipitation peaks in August during the summer monsoon thunderstorm season. There is a secondary peak during December, and the May-June period is typically extremely dry. The area receives 58% of its precipitation on average during winter months (November-April), and higher elevations (e.g. Hualapai and Cerbat Mountains) typically receive some snow. From 1930-2002, average precipitation in Kingman was 10.2 inches, with 32% coming in July, August, and September (Figure 4.0-4). Average precipitation along the Colorado River is much lower, with an average of 4.9 inches recorded at Lake Havasu City from 1967-1991 and an average of 2.9 inches from 1991 to 2003. Kingman is the only location in the planning area with long-term weather records.

Precipitation patterns in Kingman generally are representative of the planning area. As in other areas of Arizona, precipitation is extremely variable, both spatially and temporally. For example, in 1988 Kingman recorded 13.3 inches of precipitation; in 1989 the total was 4.3 inches. This variability also may be observed on longer time scales. The 1950s and 1960s were relatively dry decades with an average annual precipitation deficit of -0.95 inches, while the 1980s was a relatively wet decade with an average annual precipitation surplus of 1.42 inches (Figure 4.0-5).

Figure 4.0-4 Average monthly precipitation and temperature in Kingman, Arizona, 1930-2002

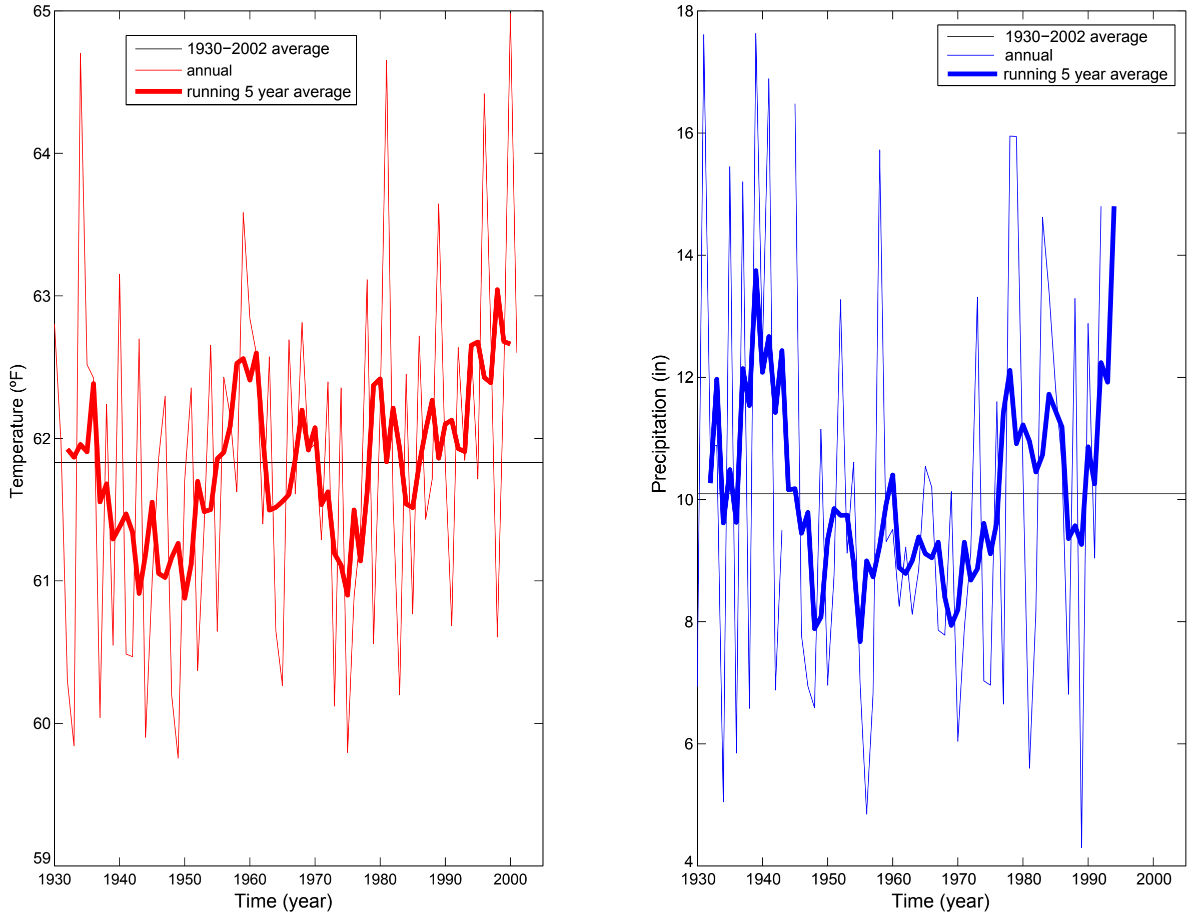


Data are from the U.S. Historical Climatology Network   Figure author: Ben Crawford, CLIMAS

Winter precipitation records dating to 1000 A.D. have been reconstructed from tree rings. They show extended periods of above- and below- average precipitation in every century in the area defined by the National Oceanic and Atmospheric Administration (NOAA) as Climate Division 1, which corresponds to Mohave County (Figure 4.0-6). A climate division is a region within a state that is generally climatically homogeneous. Arizona is divided into 7 climate divisions.

Precipitation variability on time scales of 10-30 years likely is related to shifts in Pacific Ocean circulation patterns, such as the El Niño Southern Oscillation (ENSO) or the Pacific Decadal Oscillation (PDO). The ENSO phases, El Niño and La Niña, impact precipitation in the planning area. During El Niño episodes, there are greater chances for above-average winter precipitation as storm tracks across North America shift farther south than normal. La Niña conditions usually are associated with below-average winter precipitation.

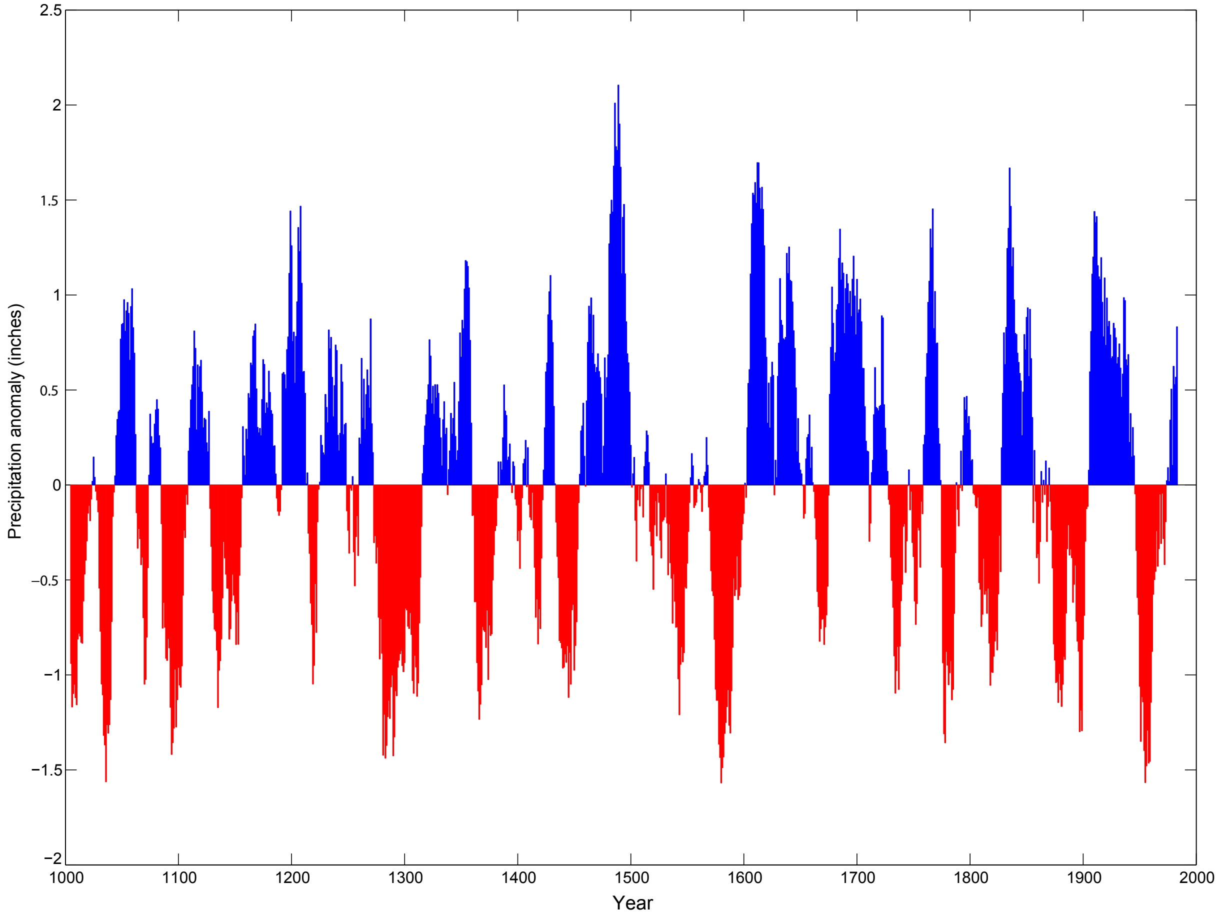
Figure 4.0-5 Average temperature (left) and total precipitation in Kingman, Arizona from 1930-2002



Horizontal lines are average temperature (61.9 °F) and precipitation (10.2 inches), respectively. Light lines are yearly values and highlighted lines are 5-year moving average values. Data are from U.S. Historical Climatology Network. Figure author: Ben Crawford, CLIMAS

Annual average temperature in Kingman is 61.9° F, compared to the statewide average of 59.9° F. The annual average temperature in Bullhead City for the period 1977 to 2006 was 74.2°F. As in other planning areas, temperatures have been increasing the past several decades (Figure 4.0-5), consistent with global temperature trends. Some warming may be attributed to changes in land-cover resulting from population growth.

Figure 4.0-6 Arizona NOAA Climate Division 1 (Mohave County) winter (November-April) precipitation departures from average, 1000-1988, reconstructed from tree rings



Data are presented as a 20-year moving average to show variability on decadal time scales. The average winter precipitation for 1000-1988 is 5.4 inches. Data: Fenbiao Ni, University of Arizona Laboratory of Tree-Ring Research and CLIMAS. Figure author: Ben Crawford, CLIMAS.

4.0.4 Environmental Conditions

Four of Arizona's five ecoregions are represented in the Upper Colorado River Planning Area: the Mohave Desert, Sonoran Desert, Colorado Plateau and the Apache Highlands (North). Therefore, the planning area is extremely diverse in terms of biotic communities, ranging from lowland Sonoran desertscrub to pine forests. Much of the area vegetation is Mohave and Sonoran desertscrub and semidesert grassland.

The largest yucca species, the Joshua tree, characterizes the Mohave Desert. The Mohave is a transitional desert between the higher and cooler Great Basin Desert and the lower, hotter Sonoran Desert. The Sonoran Desert ecoregion occurs in the extreme southern part of the planning area where the saguaro is the characteristic plant and biodiversity is quite high. In the Colorado Plateau and Apache Highlands ecoregions, desert grasslands occur between elevations of 3,500 and 5,000 feet where annual precipitation is between 10 to 15 inches. These grasslands, which also contain shrubs and small trees, usually occur in basins and valleys near hills and mountain ranges between the desert and the woodlands. Pinyon-juniper woodlands cover areas between 5,500 and 7,000 feet and receive 12 to 20 inches of precipitation annually. The pine forest habitat, dominated by Ponderosa pine, occurs at elevations between 6,000 and 9,000 feet where precipitation is approximately 18 to 26 inches annually (Arizona Game and Fish, 2004).

Arizona Water Protection Fund Programs

Six riparian restoration projects in the Upper Colorado River Planning Area have been funded by the Arizona Water Protection Fund Program (AWPF) through 2005. The objective of the AWPF program is to provide funds for protection and restoration of Arizona's rivers and streams and associated riparian habitats. There are funded projects in three of the nine planning area basins. Four projects have been funded in the Bill Williams Basin and one each in the Big Sandy and Lake Mohave basins. A list of projects and types of projects funded in the Upper Colorado River Planning Area through 2005 is located in Appendix A of this volume. (A description of the program, a complete listing of all projects funded, and a reference map is found in Appendix C of Volume 1).

Instream Flow Claims

Seven applications for instream flow claims have been filed in the Upper Colorado River Planning Area, listed in Table 4.0-1 and shown on Figure 4.0-7. An instream flow right is a non-diversionary appropriation of surface water for recreation and wildlife use. Claims were filed only in the Bill Williams Basin, and certificates or permits were issued for claims on the Bill Williams River, Kirkland Wash and People's Canyon Creek.

Table 4.0-1 Instream flow claims in the Upper Colorado River Planning Area

Map Key	Stream	Applicant	Application No.	Permit No.	Certificate No.	Filing Date
1	Big Sandy River	BLM (Phoenix)	33-96348.0	Pending	Pending	2/8/1994
2	Bill Williams River	U.S. Fish & Wildlife Service	33-96300.0	96300	96300	9/13/1993
3	Bill Williams River	BLM (Phoenix)	33-94245.0	Pending	Pending	4/4/1988
4	Burro Creek	BLM (Phoenix)	33-89119.0	Pending	Pending	4/3/1984
5	Francis Creek	BLM (Phoenix)	33-96510.0	Pending	Pending	4/3/1984
6	Kirkland Wash	W & L Collier Ranch LP	33-95476.1	95476	95476	9/13/1990
7	People's Canyon Creek	BLM (Phoenix)	33-90410.0	90410	NA	3/24/1986

Source: ADWR 2005a
NA = Not Applicable

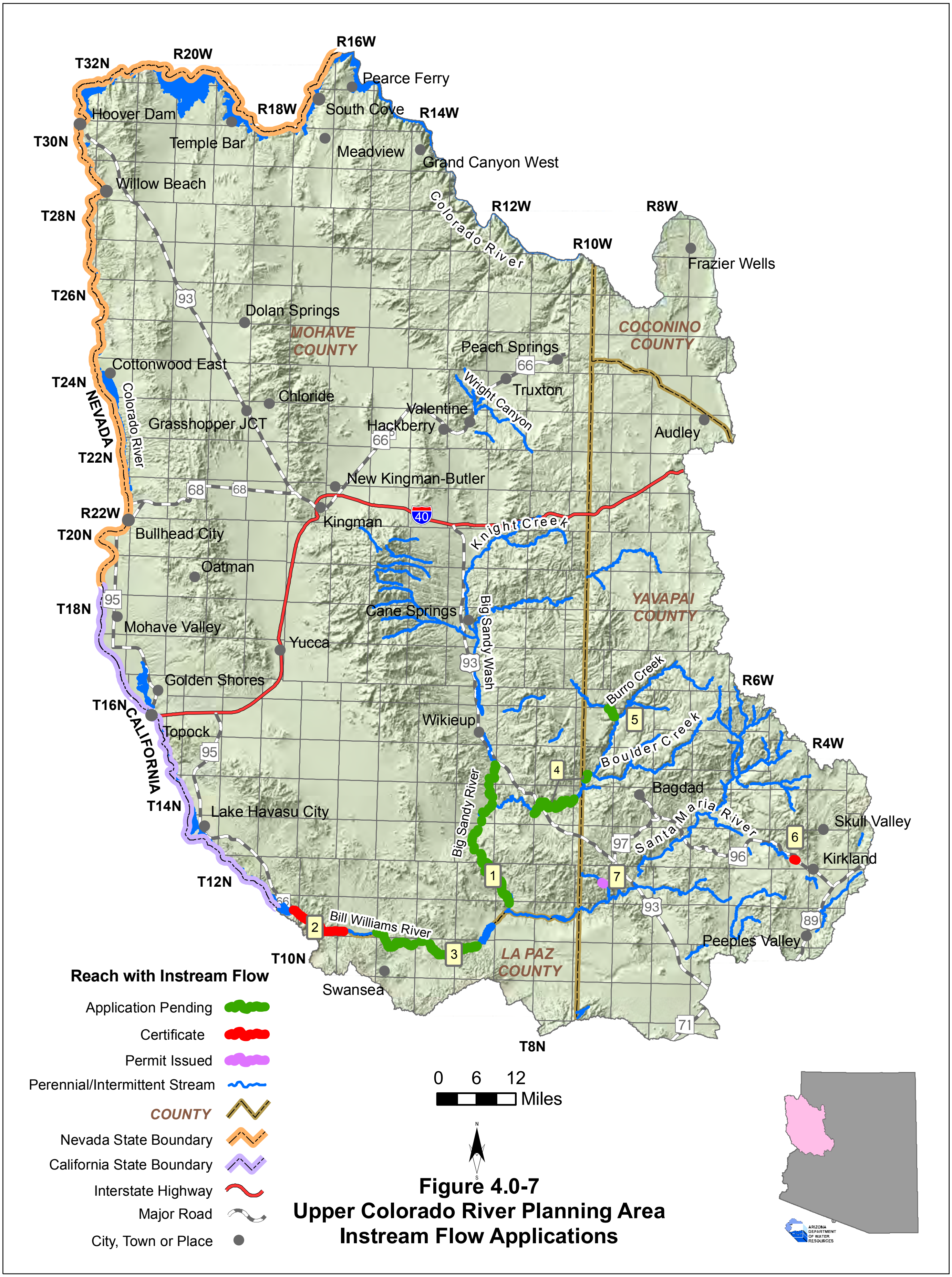


Figure 4.0-7
Upper Colorado River Planning Area
Instream Flow Applications

Threatened and Endangered Species

Listed threatened and endangered species appear to be present in the Upper Colorado River Planning Area. The species listed by the U.S. Fish and Wildlife Service (USFWS) as of May 2006 are shown in Table 4.0-2.[2] Presence of a listed species may be a critical consideration in water resource management and supply development in a particular area. The USFWS should be contacted for details regarding the Endangered Species Act (ESA), designated critical habitat and current listings.

Table 4.0-2 Listed threatened and endangered species in the Upper Colorado River Planning Area

Common Name	Threatened	Endangered	Elevation/Habitat
Arizona cliffrose		X	< 4,000 ft/ white soils of tertiary limestone lakebed deposits
Bald Eagle	X		Varies/large trees or cliffs near water
Bonytail chub		X	<4,000 ft/warm, swift, turbid mainstem rivers of the Colorado River area
California brown pelican		X	Varies/lakes and rivers
California condor		X	Varies/high desert canyon lands and plateaus
Desert pupfish		X	<5,000 ft/shallow springs, small streams and marshes
Desert tortoise, Mohave population	X		500-5100 ft/Mohave desertscrub north and west of the Colorado River
Gila topminnow		X	<4,500 ft/small streams, springs and cienegas
Hualapai mexican vole		X	3,500-7,000 ft/grass forb habitats in ponderosa pine
Mexican spotted owl	X		4,100-9,000 ft/canyons and dense forests
Razorback sucker		X	<6,000 ft/riverene and lacustrine areas, not in fast water
Southwestern willow flycatcher		X	<8,500 ft/cottonwood/willow and tamarisk vegetation along rivers and streams
Yuma clapper rail		X	<4,500 ft/fresh water and brackish marshes

Source: USFWS 2006

The Colorado River Multi-Species Conservation Program (MSCP) is a cooperative effort to address threatened and endangered species that may be affected by the operation and maintenance of the Colorado River from Lake Mead to the international border. Conservation actions implemented through the MSCP occur throughout the planning area on the Colorado River and on adjacent lands. The MSCP plan for the Lake Mead area includes conservation measures for two plants listed by the State of Nevada, for conservation of relict leopard frog, and for conservation of a number of riparian obligate species. In addition, razorback sucker larvae are collected from Lake Mead and raised to a size less vulnerable to predation prior to release back into the lake.

Lake Mohave functions as genetic refugia for razorback sucker. Under the MSCP, plan for the Lake

2 An "endangered species" is defined by the USFWS as "an animal or plant species in danger of extinction throughout all or a significant portion of its range," while a "threatened species" is "an animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range."

Mohave area razorback sucker larvae are collected and reared prior to release back into that lake or elsewhere, including Lake Havasu. Suitable habitat within Havasu NWR adjacent to Topock Marsh is maintained for southwestern willow flycatcher and Yuma clapper rail. In addition, Beal Lake, just west of Topock Marsh, is managed as a refuge for native razorback sucker and bonytail chub. There is experimental planting to create cottonwood-willow habitat suitable for southwest willow flycatcher and other riparian obligate species on lands adjacent to Beal Lake.

Recreation Areas, Wildlife Refuges and Wilderness Areas

A significant portion of the Lake Mead National Recreation Area (NRA), created in 1964 and administered by the National Park Service, is located in the northwestern portion of the Upper Colorado River Planning Area. The NRA stretches from Davis Dam at Bullhead City in the Lake Mohave Basin to the western boundary of Grand Canyon National Park in Meadview Basin and includes Lake Mead, Lake Mohave, the Colorado River and adjacent areas. NRA lands also are located in Detrital Valley and Hualapai Valley Basins. The Peach Springs Basin contains a section of Grand Canyon National Park.

There are two National Wildlife Refuges (NWR) in the planning area, the Havasu NWR in the Lake Havasu Basin and the Bill Williams River NWR in the Bill Williams Basin. The Havasu NWR, managed by the USFWS, was established in 1941 at the time of construction of Parker Dam as a refuge for migratory birds and other wildlife. The refuge protects 30 river miles of the Colorado River from Needles, CA to Lake Havasu City, AZ and contains one of the last remaining natural stretches of the lower Colorado River through the 20-mile long Topock Gorge. A portion of the refuge in Arizona is designated as the Needles Peak Wilderness. The Bill Williams River NWR, located along the Bill Williams River at its confluence with Lake Havasu, includes lands originally set aside as Havasu NWR and additional lands purchased by USFWS since then. The refuge protects one of the last stands of natural cottonwood-willow habitat along the lower Colorado River (USFWS, 2002). The refuge provides habitat for at least two endangered species, the Yuma clapper rail and the southwestern willow flycatcher (NEMO, 2005).

Alamo Wildlife Area, managed by Arizona Game and Fish, is located at the confluence of the Big Sandy, Santa Maria, and Bill Williams Rivers and includes lands withdrawn and acquired by the U.S. Army Corps of Engineers for Alamo Lake at the time of construction of Alamo Dam in 1968. Arizona State Parks manages Alamo Lake State Park on the south shore of Alamo Lake.

The Bill Williams River Corridor Steering Committee coordinates activities regarding the operation of Alamo Dam and management of resources from Alamo Lake downstream along the Bill Williams River to Lake Havasu. Information can be found at http://billwilliamsriver.org/. In general, water is released in a manner that mimics natural flooding to promote establishment of native riparian woodland vegetation, including cottonwood and willow, and to ensure sufficient baseflow to support riparian vegetation between Alamo Dam and Lake Havasu.

A prominent feature of the planning area is the large number of Wilderness Areas administered by the Bureau of Land Management. These areas are designated under the 1964 Wilderness Act to preserve and protect the designated area in its natural condition. Designated areas, their size, basin location and a brief description are listed in Table 4.0-3. Wilderness areas represent about 6% of the total planning area lands and almost 12% of the lands within the Bill Williams Basin.

Several "unique waters", designated by the Arizona Department of Environmental Quality (ADEQ) pursuant to A.A.C. R18-11-112, as having exceptional recreational or ecological significance and/or providing habitat for threatened or endangered species, have been identified in some of these wilderness areas. Designated unique waters include sections of Peoples Canyon, Francis Creek and Burro Creek in the Bill Williams Basin.

Table 4.0-3 BLM Wilderness Areas in the Upper Colorado River Planning Area

Wilderness Area	Acres	Basin	Description
Arrastra Mountain	129,800	Bill Williams	Includes portions of the Big Sandy and Santa Maria Rivers, and Peoples Canyon riparian area, classified as a unique water.
Aubrey Peak	15,400	Bill Williams	Mohave/Sonoran Desert transition zone, volcanic formations, caves and tinajas
Mt. Nutt	27,660	Lake Mohave, Sacramento Valley	Highest portions of the Black Mountains, steep canyons, bighorn sheep
Mt. Tipton	30,760	Detrital Valley, Hualapai Valley	Highest peaks in the Cerbat Mountains and Cerbat Pinnacles
Mt. Wilson	23,900	Detrital Valley	Most prominent range in Hoover Dam area, bighorn sheep
Rawhide Mountains	38,470	Bill Williams	8 miles of the Bill Williams River and gorge
Swansea	16,400	Bill Williams	Buckskin Mountains and 6 miles of Bill Williams River
Tres Alamos	8,300	Bill Williams	Colorful Tres Alamos monolith and Black Mountains
Upper Burro Creek	27,440	Bill Williams	Perennial, lower elevation stream, basalt mesas. Francis Creek, and Burro Creek from Francis Creek to Boulder Creek, are classified as unique waters.
Wabayuma Peak	40,000	Sacramento Valley	One of highest peaks in region, wide range of ecosystems
Warm Springs	112,400	Lake Mohave, Sacramento Valley	Black Mesa, canyons and springs
Total Acres	470,530		

Source: BLM 2006, A.A.C 18-11-112

4.0.5 Population

Census data for 2000 show about 153,800 residents in the Upper Colorado River Planning Area. Arizona Department of Economic Security (DES) population projections forecast that the planning area population will double by 2050, to about 303,500 residents. Historic, current and projected populations for each basin are shown in the basin cultural water demand tables. Projections may not accurately reflect the most recent proposed developments, which include large master-planned communities in the Detrital Valley and Hualapai Valley basins.

The most populous basins reported in the 2000 Census are the Lake Mohave (51,549), Lake Havasu (44,591), Hualapai Valley (31,543), and Sacramento Valley (16,276) basins. The remaining basins have populations of less than 5,000 residents. The 2000 Census population of the Fort Mojave Reservation was 773, with 1,353 residents on the entire Hualapai Indian Reservation.

Shown in Table 4.0-4 are incorporated and unincorporated communities in the planning area with 2000 Census populations greater than 1,000 and growth rates for two time periods. Only three incorporated communities exist within the planning area, Lake Havasu City, Bullhead City, and Kingman. Communities are listed from highest to lowest population according to the most recent reported year (2000 or 2005). Mohave County was the fastest growing county in Arizona between 1990 and 2000, growing at a rate of 65.8% during that period. The planning area population, which includes parts of other counties, grew by 62.6% during this time. Mohave County is the fourth most “urban” county in the state, with 75.3% of its residents residing in “urban clusters,” defined by the U.S. Census Bureau as densely settled areas with a population of 2,500 to 49,999. There are no Census defined “urbanized areas” in the planning area, which are densely settled areas containing at least 50,000 people (U.S. Census, 2005). Communities with more than 1,000 residents grew at a rate of 58.3% compared to 9.9% outside these areas.

Population Growth and Water Use

<u>Growing Smarter and Local Planning</u>

The State has limited mechanisms to address the connections between land use, population growth and water supply. The Growing Smarter Plus Act of 2000 (Act) is a legislative attempt to link growth and water management planning. It requires counties with a population greater than 125,000 (2000 Census) to include a water resources element in their comprehensive plans. Both Mohave and Yavapai counties fit the population criteria. There is little population or water development within the Yavapai County section of the planning area. The Mohave County water resources element includes an overview of water resources, information on wells, surface water flows, water quality, Colorado River entitlement holders, water issues and projected water use.

The Act requires that 23 communities outside AMAs include a water resources element in their general plans. For the Upper Colorado River Planning Area these communities are: Bullhead City, Kingman and Lake Havasu City.

The Bullhead City water resource element focuses on Colorado River entitlements within its planning area and identifies as goals: 1) to acquire water resources to meet anticipated future needs and 2) to continue water conservation measures. The Kingman element discusses its groundwater supplies in the Hualapai Valley and Sacramento Valley basins, future wellfield development and potential use of alternative supplies, including effluent. The Lake Havasu City General Plan includes policies to acquire additional water supplies and implement water conservation strategies to ensure that implementation of the general plan, which guides development, does not negatively impact Lake Havasu City's water resources. Water resource elements may contain useful information for planning and are listed in basin references in this volume.

Table 4.0-4 Communities in the Upper Colorado River Planning Area with a 2000 Census population greater than 1,000

Communities	Basin	1990 Census Pop.	2000 Census Pop.	Percent Change 1990-2000	2005 Pop. Estimate	Percent Change 2000-2005	Projected 2050 Pop.
Lake Havasu City	Lake Havasu	24,363	41,938	72.1	53,435	27.4	94,457
Bullhead City	Lake Mohave	21,951	33,769	53.8	38,210	13.1	71,423
Kingman	Sacramento Valley	12,722	20,069	57.8	25,860	28.8	38,737
New Kingman-Butler	Hualapai Valley	11,627	14,810	27.4	NA	---	39,033
Mohave Valley	Lake Mohave	6,962	13,694	9.7	NA	---	22,160
Golden Valley	Lake Mohave	2,619	4,515	7.2	NA	---	5,504
Desert Hills	Lake Havasu	1,700	2,183	28.4	NA	---	2,285
Dolan Springs	Detrital Valley	1,090	1,867	7.1	NA	---	2,054
Bagdad	Bill Williams	1,858	1,578	-15.1	NA	---	1,879
Total >1,000		84,892	134,423	58.3	NA	---	277,532
Other		9,722	19,381	9.9	NA	---	25,938
Total		**94,614**	**153,804**	**62.6**	NA	---	**303,470**

Source: DES, 2005: www.workforce.az.gov, U.S. Census Bureau, 2006
Notes: 2005 population estimates not available for unincorporated communities
NA = not available

Water System Plans and Annual Reports

Beginning in 2007, all community water systems in the state are required to submit Annual Water Use Reports and System Water Plans. The reports and plans are intended to reduce community water systems' vulnerability to drought, and to promote local water resource planning. The information will also allow the State to provide regional planning assistance.

The Annual Water Use Report includes information on water pumped or diverted, water received, water delivered to customers, and effluent used or received. The System Water Plan will be updated and submitted every five years. It consists of three components, a Water Supply Plan, a Drought Preparedness Plan and a Water Conservation Plan. Systems with populations of more than 1,850 were required to submit plans by January 1, 2007. Systems with populations smaller than 1,850 are required to submit plans by January 1, 2008. Plans have been submitted by most of the larger systems in the planning area and were used in the preparation of this document.

Water Adequacy Program

The Department's Water Adequacy Program also connects water supply and demand to growth to some extent but does not control growth. Developers of subdivisions outside of AMAs must obtain a determination of whether there is sufficient water of adequate quality available for 100 years. If the supply is inadequate, the developer may sell lots, but must disclose the condition of the water supply in promotional materials and sales documents. Subdivision adequacy determinations (Water Adequacy Reports), including the reason for the inadequate determination, are provided in the basin sections of this volume and are summarized for each basin in Table 4.0-5.

Table 4.0-5 Water Adequacy Determinations in the Upper Colorado River Planning Area as of 12/2006.

Basin	Number of Subdivisions	Number of Lots[1]	Adequate	Inadequate	Percent Inadequate
Big Sandy	4	≥608	UNK	608	UNK
Bill Williams	7	≥99	≥99	0	0
Detrital Valley	27	≥3994	0	≥3,994	100
Hualapai Valley	40	≥17,632	10,969	≥6,663	38
Lake Havasu	13	≥1,564	≥1,564	UNK	UNK
Lake Mohave	254	≥31,898	≥31,626	272	<1
Meadview	5	2,989	0	2,989	100
Peach Springs	none	none	none	none	none
Sacramento Valley	29	≥4,083	1,012	≥3,071	>75
TOTAL	**379**	**≥62,768**	**≥45,171**	**≥17,597**	**28**

Source: ADWR 2006b, ADWR 2006c

Notes:

[1] Data on number of lots are missing for some subdivisions, actual number is larger

UNK = Unknown

The service areas of eight water providers in the planning area have been designated as having an adequate water supply. If a subdivision is served by one of these designated water providers, a separate adequacy determination is not required. As of January 1, 2007 these designated providers and area served included:

- Cerbat Water Company (Cerbat Ranches, Hualapai Valley Basin)
- Golden Valley Water Improvement District (Golden Valley, Sacramento Valley Basin)
- Joshua Valley Utility Company (Meadview, Meadview Basin)
- City of Kingman (Hualapai Valley and Sacramento Valley Basins)
- Lake Havasu City (Lake Havasu Basin)
- Valley Pioneer Water Company (Golden Valley, Sacramento Valley Basin)
- City of Bullhead City (Arizona-American Water Works, Bermuda Water Company, North Mohave Valley Corporation; Lake Mohave Basin)
- Walnut Creek Water Company (Walnut Creek Estates, Sacramento Valley Basin)

As of February 2007, applications were pending to modify the designations of the City of Bullhead City and Golden Valley Water Improvement District. The current designation for the City of Bullhead City is pursuant to A.R.S. 45-108D, which allows designation of a city or town without it being a water provider if it has a Colorado River allocation and other conditions are met. Bullhead City is now seeking to become a water provider and wants to modify its designation to reflect that change. In addition, because of recent requests for service, the City of Kingman may need to modify its designation of water adequacy.

There is considerable development pressure occurring in the northwestern part of the planning area. This area is relatively near Las Vegas, NV, one of the fastest growing communities in the United States. The completion of a bridge across the Colorado River south of Hoover Dam, slated for 2010, will facilitate access to the area from Las Vegas. A type of adequacy application, not displayed in Table 4.0-5, is an Analysis of Adequate Water Supply (AAWS). This application typically is associated with large, master-planned communities. AAWS applications for two large developments in the planning area have been approved by the Department within the last nine months. The Ranch at White Hills, a 25,000 residential lot development in the Detrital Valley Basin was approved in June 2006 and a 23,000 residential lot development, Mardian Ranch in the Hualapai Valley Basin, was approved in January 2007. An additional 12 AAWS applications totaling more than 295,000 lots were pending review by the Department as of the end of February 2007. These pending applications include approximately 33,000 lots in the Detrital Valley Basin, approximately 17,000 lots in the Big Sandy Basin, and approximately 245,000 lots in the Hualapai Valley Basin. Information regarding the status of pending and approved applications is available at the Department's website.

4.0.6 Water Supply

Water supplies in the Upper Colorado River Planning Area include Colorado River water, other surface water, groundwater, and effluent. Colorado River water serves as the primary water supply in the Lake Havasu and Lake Mohave basins. It is also used to meet environmental water demands for the Havasu National Wildlife Refuge in the Sacramento Valley Basin. Elsewhere, groundwater is the primary water supply. A discussion of Colorado River water entitlements and accounting is presented below. However, for the purpose of the Atlas, the subsequent individual basin discussions will report the use of Colorado River water as either groundwater, if it is pumped from a well within the hydraulically connected aquifer, or as surface water when it is directly diverted from the river.

Colorado River Water

Decree Accounting

The right or authorization to beneficially use Colorado River water is defined as an entitlement. Entitlements held by Colorado River water users are created by decree of the United States Supreme court in *Arizona v. California et al.* (Decree), through a contract with the Secretary of the Interior (Secretary) under Section 5 of the Boulder Canyon Project Act (BCPA) of December 21, 1928, or by Secretarial Reservation.

Table 4.0-6 shows the annual total amount of Colorado River water that was consumptively used for each category of water use within each basin in the planning area based on an accounting system established by Decree. Article V of the Decree directs the U.S. Bureau of Reclamation (Reclamation) to prepare an annual report of diversions from the mainstream, return flow of water to the mainstream that makes water available for downstream consumptive use in the U.S. or in satisfaction of the Mexican Treaty obligation, and the consumptive use of such water. The Article V report lists diversions and return flow separately by diverter, point of diversion and state, for each of the lower basin states.

According to the Article V report, consumptive use of Colorado River water in the planning area for agricultural, municipal, industrial and environmental purposes averaged 126,167 acre-feet annually for the 2001-2003 time period. The table shows the quantities of water diverted by surface water diversions, in-river pumps, or pumped from wells assumed to be located within the hydraulically connected aquifer of the Colorado River. When determining consumptive water use, the Article V accounting system considers measured return flow and estimates of unmeasured return flows to the mainstream.

Reclamation has made a preliminary delineation of the lateral and vertical extent of the Colorado River aquifer to provide a basis for accounting of withdrawals against river water allocations. On August 18, 2006, Reclamation initiated a rulemaking process for *Regulating Non-Contract Use of Colorado River Water in the Lower Basin* (71 Federal Register 47763 et seq.) to prevent non-contract Colorado River water use from depleting the river and taking water from holders of Colorado River water entitlements. Reclamation's most current assessment indicates that most existing non-contract water use results from water withdrawn from wells located within the hydraulically connected aquifer of the Colorado River or from river pumps.

Because of the complexity of the accounting system and its unique methodology, the cultural water demand tables in sections 4.2, 4.3, 4.5, 4.6 and 4.9 (those basins that utilize this supply), reflect the amount of water pumped from wells and diverted from streams. The tables do not attempt to distinguish whether the water is used pursuant to the entitlement system.

Table 4.0-6 *Arizona v. California* Decree accounting of the consumptive use of Colorado River water in the Upper Colorado River Planning area (in acre-feet/year)

Basin/Year [1]	1971-75	1976-80	1981-85	1986-90	1991-95	1996-00	2001-03	Current Entitlement
Bill Williams								
Agricultural				None				
Industrial				None				
Municipal	0	0	0	0	20	18	26	84
Environmental				None				
Detrital								
Agricultural				None				
Industrial				None				
Municipal	0	0	0	0	116	146	126	Unspecified
Environmental				None				
Lake Havasu								
Agricultural				None				
Industrial				None				
Municipal	5,554	8,075	8,872	11,604	13,376	15,053	14,619	29,254
Environmental [2]	14,300	14,064	7,828	15,456	15,927	12,561	7,577	16,317
Lake Mohave								
Agricultural	20,209	47,172	73,885	83,109	96,123	107,700	79,039	144,535
Industrial	216	220	158	103	80	0	3,600[3]	175
Municipal	295	298	581	6,062	7,857	9,669	9,328	44,192
Environmental [2]	14,300	14,064	7,828	15,456	15,927	12,561	7,577	16,317
Sacramento								
Agricultural				None				
Industrial				None				
Municipal				None				
Environmental [2]	8,066	7,934	4,416	8,719	8,984	7,086	4,274	9,205
TOTAL	62,939	91,826	103,567	140,507	158,409	164,793	126,167	260,079
Central Arizona Project [4]	0	0	33,502	499,917	717,514	1,330,109	1,596,626	Unspecified

Source: BOR 2007a

Notes:

1 It should be noted that the reported consumptive use for individual users may not cover an entire 5 year period, the average is based on the years of record.

2 The Havasu National Wildlife Refuge spans an area that is located in the Lake Mohave, Lake Havasu, and Sacramento Valley basins. The consumptive use has been prorated based on the percentage of the Refuge land area in each basin.

3 The Fort Mojave entitlement does not contain a division between agricultural and non-agricultural use. The amount shown here is an average of approximately 3,600 af per year used by the Fort Mojave Reservation for operation of the South Point Power Plant between mid 2001-2003. This amount has been subtracted from the total agricultural use for 2001-2003.

4 The Central Arizona Project diverts water out of Lake Havasu (located in the Bill Williams Basin) for multiple uses in Maricopa, Pinal, and Pima counties.

Entitlement Priority Levels

Rights to Colorado River water include the following several priority levels:

a. 1st Priority: Satisfaction of Present Perfected Rights as defined in the *Arizona v. California* decree
b. 2nd Priority: Satisfaction of Secretarial Reservations and Perfected Rights established prior to September 30, 1968
c. 3rd Priority: Satisfaction of entitlements pursuant to contracts between the United States and water users in Arizona executed on or before September 30, 1968 (2nd and 3rd priority are coequal)
d. 4th Priority: i) Contracts, Secretarial Reservations and other arrangements between the U.S. and water users in Arizona entered into after September 30, 1968, for a total quantity not to exceed 164,652 acre-feet of diversions annually and ii) contract No. 14-06-W-245, dated December 15, 1972, as amended, between the United States and the Central Arizona Project (CAP). Entitlements having a 4th priority as described in (i) and (ii) are coequal.
e. 5th Priority: Unused entitlement
f. 6th Priority: Surplus water

In general, the lower priority entitlements will be the first to be impacted when the Secretary declares a shortage on the Colorado River system. Within the planning area, entitlement holders with a first priority or present perfected rights include the Fort Mojave Indian Reservation and several private entities within the Mohave Valley Irrigation and Drainage District. Second and third entitlement holders (which are coequal during a shortage), include Havasu National Wildlife Refuge, Bureau of Reclamation (Davis Dam), and the National Park Service. Fourth priority entities include Arizona-American Water Company (Lake Havasu), Bullhead City, Golden Shores Water Conservation District, Lake Havasu City, Mohave Water Conservation District, Mohave Valley Irrigation and Drainage District, and the Mohave County Water Authority. Lake Havasu City and the Mohave County Water Authority also have fifth and sixth priority entitlements.

Mohave County Water Authority

The Mohave County Water Authority (MCWA) was organized pursuant to A.R.S.§ 45-2201 primarily for the purpose of acquiring the city of Kingman's unused 18,500 acre-feet entitlement and making it available to other authority members for municipal and industrial water uses. Authority members include Arizona-American Water Company, Bullhead City, Golden Shores Water Conservation District, Kingman, Lake Havasu City, Mohave County, Mohave Valley Irrigation and Drainage District and Mohave Water Conservation District. As well as providing other services and functions, the Authority can acquire additional water supplies, including effluent, and it may store, recharge and recover these supplies for the benefit of Mohave County water users. The Authority can also assist members with the development and operation of water diversion, conveyance, treatment, storage and recharge facilities and the development of augmentation and conservation programs.

Arizona Water Banking Authority

The Arizona Water Banking Authority (AWBA) was created in 1996 to protect Arizona's Colorado River interests and to provide for interstate water banking opportunities. Among its statutory authorities is the requirement to reserve a reasonable number of long-term storage credits developed with general fund appropriations for the benefit of Municipal and Industrial (M&I) water users located near the Colorado River (on-river users), during times of shortage. Fourth priority Colorado River M&I water users have no alternate water supply during times of shortage. Regardless of whether water is diverted from the Colorado River water or pumped from within the hydraulically connected river aquifer, the limit of an entity's water right is its Colorado River entitlement. On January 1, 1998, the AWBA adopted 420,000 acre-feet as the reasonable number of long-term storage credits for on-river M&I "firming." Contractors may recover this firmed or stored water in times of shortage. (See Volume 1, Appendix A for more information on the AWBA).

The manner in which the general fund credits would be reserved, and then recovered and distributed during a shortage, has long been an issue of concern to the on-river users. In recognition of the concerns, the AWBA and the MCWA entered into the Agreement to Firm Future Supplies (Agreement to Firm). The Agreement to Firm recognizes that the MCWA can enter into subcontracts with on-river M&I water users having the same priority as the CAP. These are the same water users for whom the AWBA must firm M&I supplies. Upon execution of the subcontracts and payment of the appropriate fees, the AWBA would reserve the appropriate quantity of long-term storage credits as described in the Agreement to Firm.

The parties executed the Agreement to Firm on February 4, 2005. The MCWA offered all entities in Mohave County the option to participate in the Agreement. Subcontract entities included in the Agreement to Firm are Arizona State Parks, Bullhead City, Lake Havasu City, and Mohave Water Conservation District. Pursuant to the Agreement to Firm, 230,280 acre-feet of the current 396,499 acre-feet of credits in the General Fund Account were transferred to a sub-account in MCWA's name. The remaining credits in the General Fund Account could still be available to firm on-river supplies.

<u>Drought</u>

The Colorado River reservoirs are operated in accordance with the Colorado River Basin Project Act of 1968 (P.L. 90-537). Hydrologic conditions in the Colorado River Basin affect reservoir operation. The Colorado River Basin experienced five consecutive years of extreme drought during water years 2000-2004 and, while there was above average inflow to Lake Powell and record-breaking tributary flows in the Lower Colorado Basin in 2005, there was below average streamflow again in 2006 (BOR, 2006a). During this period, storage in Colorado River reservoirs dropped from near capacity to 60 percent of capacity by the end of 2006. Reclamation lacks specific operation guidelines to address the operation of Lake Mead and Lake Powell during drought. To address this situation, in February, 2007, Reclamation released a draft environmental impact statement on proposed adoption of specific interim guidelines for Lower Basin shortages and coordinated operation of the two reservoirs. One of the purposes of the proposed action is to provide greater predictability regarding the amount of annual water deliveries to mainstream Colorado River water users in the Lower Division states (BOR, 2007b). The effect of drought and other hydrologic conditions on water levels in Lake Mead is shown in Figure 4.0-8. Lowering water levels have resulted in closure and relocation of boat marinas at Lake Mead.

Figure 4.0-8 Lake Mead end of month elevation 1980-2006

Surface Water

Surface water demand was about 66,300 acre-feet in 2003. Surface water is the primary water supply in the Lake Mohave Basin (65,100 acre-feet/year) where it is the principal supply for agricultural and industrial use. About 500 acre-feet of surface water from springs near Bagdad in the Bill Williams Basin provide a municipal and industrial supply for the town of Bagdad and the Bagdad mine. Small volumes of surface water are used in the Detrital Valley and Lake Havasu basins. Surface water may be used elsewhere but records are not available. There are few springs in proximity to water demand centers and, with the exception of the Colorado River, perennial streams are located only in the Bill Williams and Big Sandy basins. The location of surface water resources are shown on surface water condition maps, maps showing perennial and intermittent streams and major springs for each basin, and in basin tables containing data on streamflow, flood ALERT equipment, reservoirs, stockponds and springs in the Water Resource Characteristics sections for each basin.

Groundwater

Groundwater pumpage was about 104,150 acre-feet in 2003. Groundwater is found at varying depths in the planning area, generally in the 200 to 600-foot range although water levels of more than 1,000 feet below land surface are found in the Hualapai Valley, Peach Springs and northern Sacramento Valley basins. Groundwater is pumped from basin fill material in most basins with the exception of the Meadview and Lake Mohave basins. Recent stream alluvium also is a potentially important aquifer in the Big Sandy, Bill Williams, Detrital Valley and Lake Mohave basins. Sedimentary rocks are principal aquifers in five north and northeastern basins including the Big Sandy, Detrital Valley, Hualapai Valley, Peach Springs and Meadview. In the Bill Williams and

Sacramento Valley basins, aquifers in volcanic rock also are utilized. Groundwater is limited due to water quality and quantity issues at the town of Chloride, north of Kingman in the Sacramento Valley Basin.

Estimated volumes of groundwater in storage may be limited in some basins and estimates may range significantly depending on the data source. The USGS, in conjunction with the Department, is currently conducting an investigation of groundwater conditions in the Detrital Valley, Hualapai Valley and Sacramento Valley basins in light of proposed developments. The Department has recently released a revised estimate of the volume of groundwater in storage in the Detrital Valley Basin (ADWR, 2006). Groundwater storage estimates for these basins are: 1.4 to 3.7 maf in the Detrital Valley, 5 to 5.3 maf in the Hualapai Valley, and 7 to 8.3 maf in the Sacramento Valley, to a depth of 1,200 feet.

In order to better understand the water supply situation in areas of the state where data are lacking, the Department has established automated groundwater monitoring sites that record water levels in wells. This information is available through an interactive map on the Department's website to allow access to local information for planning, drought mitigation, and other purposes (http://arcims.azwater.gov/website/AutomatedSites/AutoSites_disclaimer.htm). The location criteria used to site these devices were based on areas of growth, subsidence, type of land use, proximity to river/stream channels, proximity to water contamination sites or areas affected by drought. Figure 1-18 of Atlas Volume 1 shows the location of automatic water-level recording sites as of 2005. At that time there were three sites, one of which was a USGS site, in the planning area. There currently are four automated Department-operated sites in the planning area for record water levels four times daily.

Index well hydrographs, which display long-term water level behavior in 61 planning area index wells that are measured annually, also are available on the Department's website through an interactive map (http://arcims.azwater.gov/website/IndexWell/IndexWell_disclaimer.htm). Information on major aquifers, well yields, estimated natural recharge, estimated water in storage, aquifer flow direction, and water level changes are found in groundwater data tables, groundwater conditions maps, hydrographs and well yield maps for each basin in the Water Resource Characteristics sections.

Effluent

Effluent is a potential water supply at locations throughout the planning area, but is currently utilized in only the Lake Havasu and Lake Mohave basins where about 3,200 acre-feet/year are used for turf irrigation. Approximately 2,600 acre-feet of effluent was produced in the Lake Havasu Basin in 2006 and more than 2,300 acre-feet was used. Lake Havasu City delivers about 1,300 acre-feet of effluent to end users in the City and approximately 1,000 acre-feet to end users outside of the City area. Lake Havasu City is evaluating new sources of effluent demand as well as effluent recharge. Approximately 3,000 acre-feet of effluent is produced in the Lake Mohave Basin each year. Within the basin, Bullhead City annually delivers about 500 acre-feet of effluent and Arizona-American Water Company delivers about 300 acre-feet.

The Kingman-Hilltop Wastewater Treatment Plant, located in the Hualapai Valley Basin, generates about 1,800 acre-feet of effluent per year which is currently disposed in a wetland and evaporation ponds. The treatment system in the Peach Springs Basin in the community of Peach Springs is essentially a sewer collection system with secondary treatment and disposal in evaporation ponds and unlined impoundments. There are four wastewater treatment plants in the Sacramento Valley Basin, one in Kingman, one at the Griffith power plant and two in the vicinity of Franconia, located about midway between Topock and Yucca. Information is available on only two plants in the basin, which produce a total of about 400 acre-feet of effluent, all of which is disposed of in evaporation ponds or in a watercourse.

No wastewater treatment facilities were identified by the Department in the Big Sandy, Bill Williams or Meadview basins. A facility exists at Temple Bar in the Detrital Valley Basin but information on volume treated and disposal method was not available to the Department.

Contamination Sites

Sites of environmental contamination may impact the availability of water supplies. An inventory of Department of Defense, Superfund (Environmental Protection Agency designated sites), Resource Conservation and Recovery Act (RCRA), Water Quality Assurance Revolving Fund (WQARF, state designated sites), Voluntary Remediation Program (VRP), and Leaking Underground Storage Tank (LUST) sites was conducted for the planning area. Of these various types of sites, only LUST, VRP and RCRA sites are found in the planning area. The location of all contamination sites is shown on Figure 4.0-9.

There are five active VRP sites in the planning area, primarily associated with crude oil contamination of soil. Table 4.0-7 lists the VRP sites, their contaminants and affected media, and respective basins.

Table 4.0-7 Active contamination sites in the Upper Colorado River Planning Area

SITE NAME	MEDIA AFFECTED AND CONTAMINANT	GROUNDWATER BASIN
Resource Conservation and Recovery Act (RCRA) Sites		
McCulloch Corporation	Soil and groundwater - chromium, other metals	Lake Havasu
Snavely Lease	Soil	Sacramento Valley
Voluntary Remediation Sites		
Inactive Bruce Mine	Groundwater-copper, zinc, pH, other metals or organic contaminants	Bill Williams
Juniper Pump Station	Soil-crude oil	Big Sandy
New Kingman Pump Station	Soil-crude oil	Big Sandy
Oatman Pump Station	Soil-crude oil	Lake Mohave
Old Kingman Pump Station	Soil-crude oil	Sacramento Valley

Sources: ADEQ 2002, ADEQ 2006a, ADEQ 2006b

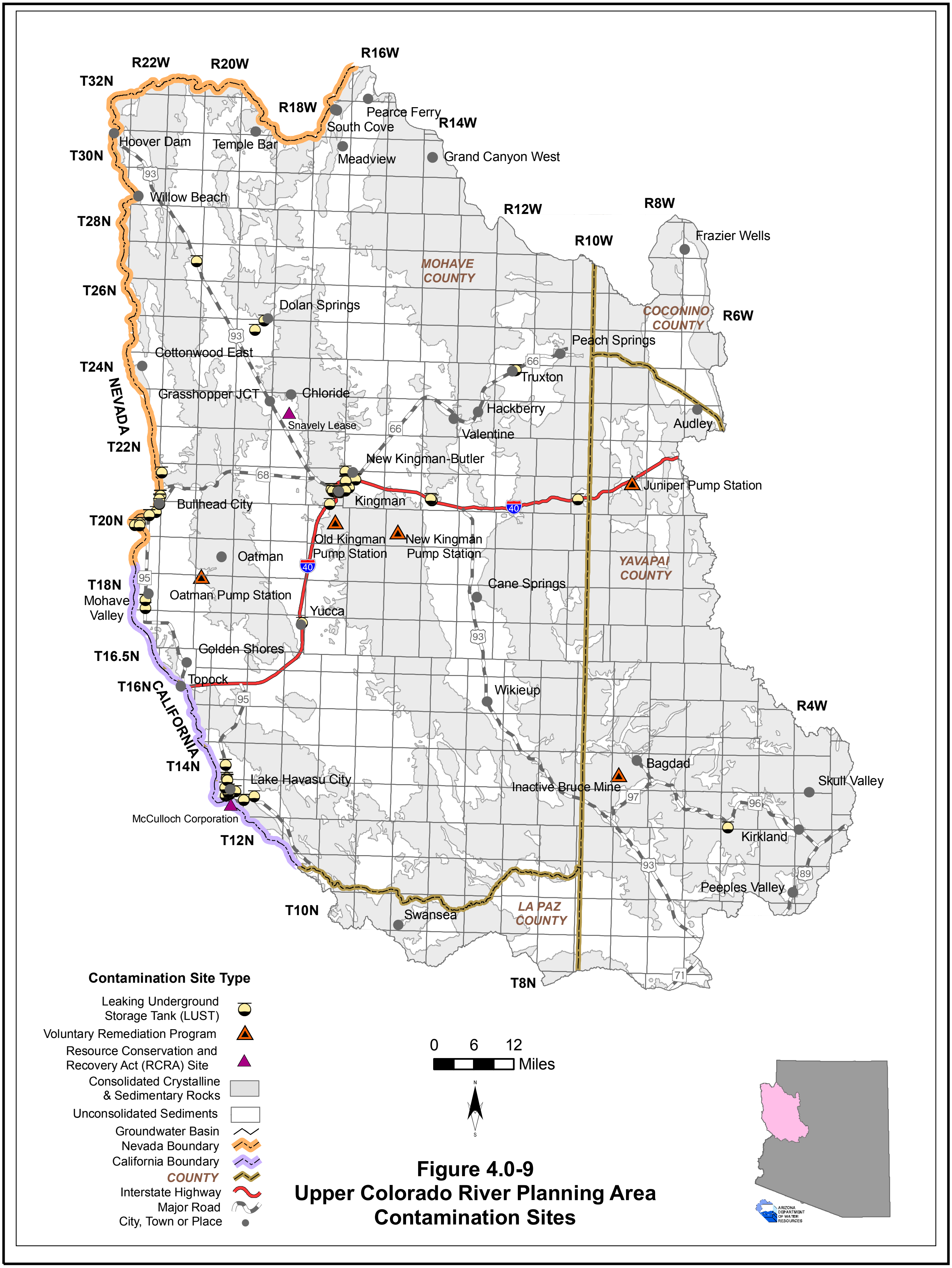


Figure 4.0-9
Upper Colorado River Planning Area Contamination Sites

The VRP is a state-administered and -funded voluntary cleanup program. Any site that has soil and/or groundwater contamination, provided that the site is not subject to an enforcement action by another remediation program, is eligible to participate. To encourage participation, ADEQ provides an expedited process and a single point of contact for projects that involve more than one program (Environmental Law Institute, 2002).

As of 2002, there were two federal RCRA sites in the planning area. (See Table 4.0-7) The program regulates the management of hazardous waste handlers which includes generators, transporters and facilities for treatment, storage and disposal. (ADEQ, 2002)

There are 153 active LUST sites in the planning area. There are 60 sites in the Kingman area in the Sacramento Valley Basin, 30 sites in and around Bullhead City in the Lake Mohave Basin, and 47 sites in the vicinity of Lake Havasu City in the Lake Havasu Basin.

4.0.7 Cultural Water Demand

Total cultural water demand in the Upper Colorado River Planning Area averaged approximately 173,650 acre-feet per year in the period from 2001-2003. As shown in Figure 4.0-10, agricultural demand is the largest use sector with approximately 95,850 acre-feet of demand per year due almost entirely to farming in the Lake Mohave Basin. Municipal demand is the next largest water demand sector at approximately 55,200 acre-feet per year of primarily groundwater. About 1,300 acre-feet of surface water and about 3,200 acre-feet of effluent are also used for municipal

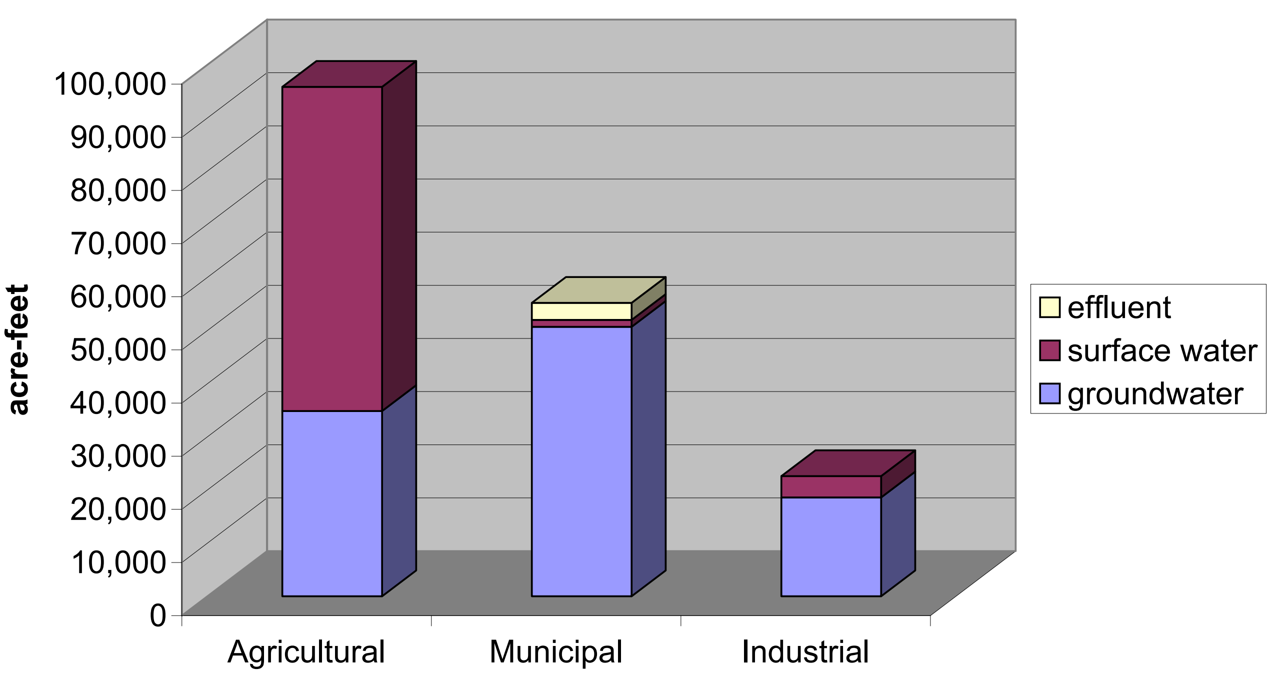
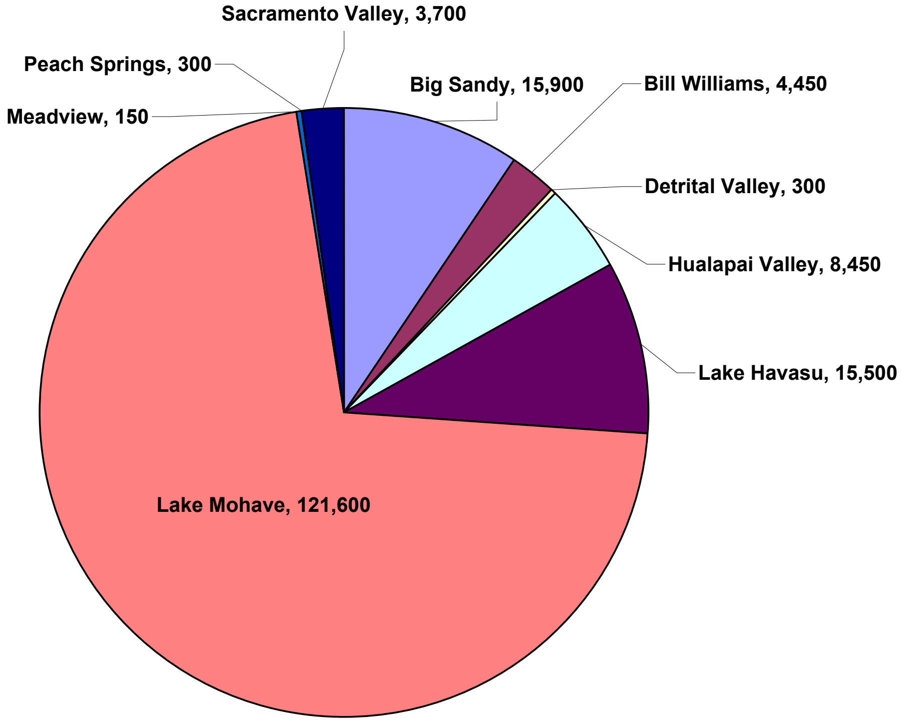


Figure 4.0-10 Upper Colorado River Planning Area cultural water demand by sector, 2001-2003 in acre-feet

purposes. Industrial demand, primarily for mining, is about 22,600 acre-feet per year. Of this, about 4,000 acre-feet of surface water is used. Cultural demand volumes vary substantially between the planning area basins and range from about 150 acre-feet a year in the Meadview Basin to about 121,600 acre-feet a year in the Lake Mohave Basin (see Figure 4.0-11).

Figure 4.0-11 Average total basin water demand per year in acre-feet, 2001-2003



Tribal Water Demand

The Fort Mojave Indian reservation includes lands in Arizona, Nevada and California but almost 70% of its landbase (23,500 acres), is located within Arizona in the Lake Mohave Basin. The Tribal headquarters are located in Needles, CA. In Arizona, the tribal population is approximately 800 and the primary water demand is farming. A small casino, with associated services is located in Mohave Valley while a large hotel/casino and golf course are located in Laughlin, NV. The Fort Mojave Tribal Utilities Authority serves about 850 customers in parts of Mohave Valley. The Bermuda Water Company apparently provides service to parts of Fort Mojave. In 2005, the tribal utility pumped about 260 acre-feet of groundwater (ACC, 2005). In 1999, the tribe entered into an agreement to allow construction of a gas-fired power plant on the reservation. The South Point Energy Center came on line in 2001 and was the first "merchant plant" built by an independent power company on tribal land (Calpine, 2001). All power generated is sold on the open market. Fort Mojave receives electricity generated at Parker Dam. The plant is designed to capture waste heat to generate a second phase of electricity, making it 40% more efficient than older natural gas plants. Water use by the plant is estimated at 4,000 acre-feet per year of surface water (BIA, 1998).

The Hualapai Indian Reservation encompasses about 552,800 acres in the planning area, primarily in the Peach Springs Basin. There also are small tracts of tribal lands in the Big Sandy, Hualapai Valley and Meadview basins. The reservation, created in 1883, has a current population of about 1,500. Peach Springs is the tribal capital. Tribal water use is estimated to be less than 300 acre-feet a year. The tribal economy is based on cattle ranching, tourism, timber sales and big game hunting. The Hualapai Department of Public Works operates water and sewer systems in Peach Springs. The Hualapai Water Resource Program develops non-community water sources and is responsible for a wetland and water quality monitoring program. The Range Water Program performs pipeline maintenance to cattle districts. (Hualapai Tribe, 2007)

The Hualapai Nation operates a tourist development at Grand Canyon West where a recently completed glass walkway, "Skywalk" extends 70 feet beyond the canyon edge almost a mile above the Colorado River. Water is an issue at the site and is currently trucked in. The tribe anticipates that Skywalk will promote further development at the site, requiring a local source of water (Cart, 2007). The tribe has considered drilling a local well, extending a water pipeline 26 miles from wells on the west side of the Reservation, or pumping water to the rim from the Colorado River. An exploratory well drilled near Grand Canyon West located water at more than 2,600 feet with an estimated flow of just 12 gpm (Hualapai Tribe, 2007). While the U.S. asserted tribal claims to the Colorado River in *Arizona v. California*, the Court only decided the claims of those tribes below Hoover Dam. There presently is no court action pending to adjudicate any Hualapai claims.

Municipal Demand

Municipal demand is about 55,200 acre-feet/year; 32% of the total cultural water demand. Municipal water demand is summarized by groundwater basin and water supply in Table 4.0-8. Water pumped from wells is the primary water supply for municipal use throughout the planning area as reflected in the cultural water demand tables for each basin. Approximately 50,700 acre-feet of groundwater was used in the planning area c. 2003. The largest volume of municipal groundwater use is in the Lake Mohave Basin with almost 24,000 acre-feet/year of demand-almost half of the total groundwater use. About 1,300 acre feet/year of surface water is used. The town

Table 4.0-8 Municipal water demand in the Upper Colorado River Planning Area (c. 2003)

Basin	Groundwater	Surface Water	Effluent[1]
Big Sandy	<300	0	0
Bill Williams	600	500	0
Detrital Valley	<300	<300	0
Hualapai Valley[2]	8,300	0	0
Lake Havasu	15,200	<300	2,357
Lake Mohave	24,000	500	842
Meadview	<300	0	0
Peach Springs	<300	0	0
Sacramento Valley	2,000	0	0
Total Municipal	50,700	1,300	3,199

Sources: USGS 2005, ADWR 2007, Malcolm Pirnie, Inc 2006, BOR 2006a, Lake Havasu City 2006
Notes:
[1] Effluent figures are for golf course and other turf irrigation in 2006
[2] The City of Kingman in the Sacramento Valley Basin obtains most of its water from well fields in the Hualapai Valley Basin

of Bagdad in the Bill Williams Basin uses about 500 acre-feet of surface water diverted from springs as its primary municipal supply. About 3,200 acre-feet of effluent is used annually for turf irrigation.

Principal municipal demand centers are Lake Havasu City, Bullhead City, and the Kingman area. There is little population or municipal demand in a number of basins in the planning area including the Big Sandy, Detrital Valley, Meadview and Peach Springs basins. Municipal demand on the Fort Mojave and Hualapai reservations is estimated at less than 300 acre-feet/year.

Only nine water providers in the planning area served 450 acre-feet of water or more in 2000 or 2003**.** These providers and their demand in 1991, 2000 and 2003 are shown in Table 4.0-9. Municipal gallon per capita per day (gpcd) rates in 2004/2005, which include golf course demand and lost water but not effluent, are estimated to be about 250 gpcd in Lake Havasu City, 300 gpcd in Bullhead City, and 193 gpcd in Kingman. Municipal utilities serve Lake Havasu City and the City of Kingman while other communities, including Bullhead City, are served by private water companies. Bullhead City is served by Arizona-American Water Company, Bermuda Water Company and North Mohave Valley Water Company and is intending to become a municipal water provider (BOR, 2006b). Municipal water utilities have more flexible water rate-setting ability than private water companies, which are regulated by the Arizona Corporation Commission. In addition, municipal utilities have the authority to enact water conservation ordinances. These authorities may enable municipal utilities to better manage water resources within water service areas. Water provider issues are discussed in section 4.0.8.

Table 4.0-9 Water Providers serving 450 acre-feet or more of water per year in 2000 or 2003, excluding effluent, in the Upper Colorado River Planning Area

Water Provider	1991 (acre-feet)	2000 (acre-feet)	2003 (acre-feet)
Bill Williams			
Phelps Dodge Bagdad, Inc, Utilties Dept.	871	749	732
Lake Havasu			
Lake Havasu City	11,961	14,630	15,660
Willow Valley Water (Mohave Valley)	542	455	414
Lake Mohave			
Bermuda Water Company (Bullhead City)	915	951	3,040
Arizona American Water (Bullhead City)	4,012	6,220	7,420
Golden Shores Water Company	353	452	550
North Mohave Valley Water (Bullhead City)	269	642	721
Sacramento Valley			
City of Kingman	5,950	7,294	8,662
Valley Pioneers Water Company	316	500	526

Sources: ADWR 1994b, ADWR 2004, ADWR 2005c, ADWR 2007
Notes:
Demand for the Town of Bagdad may include some industrial demand by the Bagdad Mine.

With the exception of three golf courses, all golf courses in the planning area are served from a municipal water supply, which may include effluent. All golf courses are shown in Table 4.0-10 with estimated demand and source of water. Golf courses that irrigate with water pumped from facility wells are considered "industrial" golf courses and this use is accounted for as an industrial demand. Demand was not reported for a number of golf courses and in those cases estimates are based on turf water needs, elevation and duration of the irrigation season. Most golf courses are located in the Lake Havasu or Lake Mohave basins. There are two golf courses in the Kingman area in the Hualapai Valley Basin, and one in Bagdad in the Bill Williams Basin.

Table 4.0-10 Golf course demand in the Upper Colorado River Planning Area (c. 2006)

Facility	Basin	# of Holes	Demand (acre-feet)	Water Supply
Mesa View Golf Club	Bill Williams	9	211	Groundwater
Cerbat Cliffs Golf Course	Hualapai Valley	18	423	Groundwater
Valle Vista Country Club	Hualapai Valley	18	423	Groundwater
Refuge Golf Course	Lake Havasu	18	441	Effluent
Bridgewater Link/Queens Bay	Lake Havasu	9	220	Groundwater
London Bridge Golf Course	Lake Havasu	36	1,288	Effluent
Nautical/ Havasu Island Inn Golf Club	Lake Havasu	18	560	Effluent
Chaparral Country Club	Lake Mohave	9	220	Groundwater/Effluent
Desert Lakes Golf Club*	Lake Mohave	18	441	Groundwater/Effluent
El Rio Country Club*	Lake Mohave	18	441	Groundwater
Laughlin Ranch	Lake Mohave	18	425	Effluent
Riverview Golf Club*	Lake Mohave	9	220	Groundwater/Effluent
Total Demand			**5,313**	

Source: ADWR 2005b, BOR 2006a, Lake Havasu City 2006
Notes:
* These golf courses are served by their own wells and considered to be industrial users

Fifty-four percent of the golf course demand in the planning area is met with effluent. Effluent is utilized in Bullhead City, Lake Havasu City and in Mohave Valley. In the Lake Havasu Basin, almost 2,300 acre-feet of effluent was used in 2006 to irrigate three facilities that use 100% effluent: the Refuge Golf Course, London Bridge Golf Course, and Nautical/Havasu Island Inn Golf Club. In addition, about 68 acre-feet of effluent was used for other turf irrigation. This total volume is almost all the effluent produced in the basin. In the Lake Mohave Basin, about 840 acre-feet of effluent is used to irrigate four golf courses and one park. Bullhead City delivers about 600 acre-feet of effluent per year to Chaparral Country Club, Laughlin Ranch, and Rotary Park. Arizona-American Water Company delivers about 170 acre-feet of effluent per year to the Riverview Golf Course and about 130 acre-feet to the Desert Lakes Golf Course in Mohave Valley. Both courses are defined as industrial facilities that also use groundwater. It is anticipated that effluent use for turf irrigation will increase in the planning area.

Agricultural Demand

Agricultural demand is about 95,850 acre-feet/year; 55% of the total cultural water demand. Ninety-six percent of the agricultural demand occurs in the Lake Mohave Basin where principal crops include cotton, alfalfa, hay and wheat. Relatively small amounts of agricultural water demand are reported in the Big Sandy and Bill Williams basins. Surface water and groundwater use for agriculture in selected years for the entire planning area is shown in Table 4.0-11. As shown, total agricultural demand declined by over 12,000 acre-feet between 1991 and 2003. About 64% of the demand was met with surface water in 2003.

In the Lake Mohave Basin, agricultural irrigation occurs in the Mohave Valley on the Fort Mojave

Indian Reservation and on private lands located within the Mohave Valley Irrigation and Drainage District (MVIDD). In the southern end of the valley, tribal and district lands are interspersed in a checkerboard pattern. About 15,000 acres of reservation lands were recently under cultivation (ITCA, 2003), which may include non-Indian agricultural lessees. There are a total of about 31,500 acres within the MVIDD boundaries, of which about 3,800 acres are reported in cultivation. MVIDD does not divert or deliver water to its water users. District farmers operate and maintain their own production wells, pumps and distribution systems (ADWR, 1998).

Table 4.0-11 Agricultural demand in the Upper Colorado River Planning Area

	1991	2000	2003
	Water Use (acre-feet)		
Surface Water	56,600	68,100	61,000
Groundwater	51,550	38,850	34,850
TOTAL	108,150	106,950	95,850

Source: USGS 2005b, ADWR 2005d

Agricultural demand in the Lake Mohave Basin has increased substantially since the early 1970s when less than 20,000 acre-feet/year was used. Since 1990, annual agricultural demand has remained relatively constant, with up to 102,600 acre-feet/year used on average during the 1996-2000 time period. The increase is primarily due to Fort Mojave Indian agricultural water use. It is estimated that approximately 60-65% of the total current irrigation demand is attributable to tribal irrigation.

In the Big Sandy and Bill Williams basins irrigation is primarily for pasture. Irrigation in the Big Sandy Basin has been estimated at less than 300 acre-feet of groundwater per year since 1991, consisting of small pasture in the vicinity of the Big Sandy River. In the Bill Williams Basin, irrigation has declined from an average of 15,600 acre-feet per year during the 1991-1995 period to just 3,200 acre-feet per year from 2001-2003. This decline is primarily a result of cessation of farming at Planet Ranch, downstream from Alamo Dam, where flooding in 1993 washed out much of the irrigation infrastructure. Reportedly, only one cotton farm remains along the Bill Williams River below Alamo Dam. Most of the other remaining agricultural lands are located in the vicinity of Kirkland and Skull Valley (see Figure 4.2-10).

Industrial Demand

Annual industrial demand is approximately 22,600 acre-feet; 13% of the total cultural water demand. Industrial water demand in the planning area includes mining, electrical power generation, dairy/feedlot and golf course irrigation served by a facility water system. These use categories served by a municipal water system are accounted for as municipal demand. Industrial demand is summarized in Table 4.0-12 for selected years.

Mining is the largest industrial user in the planning area, primarily due to activities at the Phelps Dodge Bagdad Mine in the Bill Williams Basin. Most of the water used at the mine is apparently pumped from a series of wells along a 10-mile reach of the Big Sandy River north of Wikieup in the Big Sandy Basin, and delivered via pipeline to the mine site. A small volume of surface water (probably <300 acre-feet/year) from Francis Creek springs and wells in the vicinity of Bagdad may also be used at the mine site although it is believed these sources primarily provide water for potable use in the company town of Bagdad. The volume of water used at the mine is proprietary and recent estimates were based on reported copper production and known processing methods.

Table 4.0-12 Industrial demand in selected years in the Upper Colorado River Planning Area

	1991	2000	2003
Type	**Water Use (acre-feet)**		
Mining Total	**16,673**	**19,287**	**16,568**
Big Sandy			
Groundwater	16,000	18,291	15,717
Bill Willams			
Groundwater	<300	<300	<300
Hualapai Valley			
Groundwater	<300	<300	<300
Lake Havasu			
Groundwater	9	118	66
Lake Mohave			
Groundwater	64	78	89
Peach Springs			
Groundwater	<300	<300	<300
Sacramento Valley			
Groundwater	<300	350	246
Power Plant Total	**0**	**0**	**5,600**
Lake Mohave			
Surface Water	0	0	4,000
Sacramento Valley			
Groundwater	0	0	1,600
Golf Course Total	**527**	**356**	**356**
Lake Mohave [1]			
Groundwater	527	356	356
Dairy/Feedlot Total	**76**	**76**	**76**
Sacramento Valley			
Groundwater	76	76	76

Source: ADEQ 2005, ADMMR 2005, ADWR 1994b, ADWR 2005b, ADWR 2007, BIA 1998,USGS 2005b

Notes:

[1] Two golf courses also receive effluent, see Table 4.0.9 for more information.

Claims were first staked at the Bagdad Mine property in 1882 with open pit mining beginning in 1945. Historically, mining operations were relatively small-scale due to the low grade copper ore. However, advances in ore processing have resulted in increased copper production at the site. Water use has increased from approximately 2,000 acre-feet/year in the early 1970s to an estimated 15,600 acre-feet/year on average. The mine consists of a porphyry copper open-pit copper mine and concentrator. Molybdenum is a by-product of the mining operation. The site is recognized as the world's first commercial-scale concentrate leach processing facility (beginning in 2003) and is the longest continuously operating SX/EW (solution extraction/electrowinning) plant in the world (since 1970). Phelps Dodge Corporation acquired the property in 1999 from Cyprus Amax Minerals Co. (Phelps Dodge Corporation, 2007).

The Mineral Park Mine, located in the Sacramento Valley Basin northwest of Kingman, operated a milling operation from 1964 to 1980 that produced a total of 646.4 million pounds of copper, 46.8 million pounds of molybdenum and 5 million ounces of silver as concentrate. Milling operations ceased in 1980 due to changes in ownership and low metals prices. Mercator Minerals Ltd. has recently acquired the property and plans to increase copper production from the current level of approximately 6 million pounds of copper per year through a phased expansion to include enlarging the existing SX/EW plant capacity and eventual construction of a milling operation to process copper-molybdenum resources found at lower depths (Mercator Minerals, 2005). Current water use is about 250 acre-feet a year.

The only other mining activities in the planning area are associated with small mines/quarries, principally sand and gravel operations in the Hualapai Valley, Lake Havasu, Lake Mohave and Peach Springs basins. Some of these operations are identified on the cultural demand maps for these basins. Water is used for aggregate washing, dust control, vehicle washing, and equipment cooling. Typically, there is relatively little water consumed at these sites.

There are four power plants in the planning area. The hydroelectric plants at Hoover Dam and Davis Dam in the Lake Mohave Basin are not considered direct consumers of water so their associated water demand is not included in Table 4.0-12. However, they are prominent industrial facilities in the planning area and are briefly described below.

The Hoover Dam and power plant were authorized by the Boulder Canyon Project Act of 1928 with electrical generation as one of its purposes. The power plant generators are used primarily to generate a low-cost peaking resource. The demand for Hoover power generation is seasonal, with the low-demand period in the winter months, and is a direct function of river flow and downstream water demands. The power plant generators operate in conjunction with the Davis and Parker power plants to provide maximum power generation with efficient use of water resources. The plant has a net generation capacity of more than 4,719,323 megawatt hours (MWh) (BOR, 2006c). Davis Dam was authorized under provisions of the Reclamation Project Act of 1939. Power generated from the power plant is marketed to wholesale customers in Arizona, Southern California, and Southern Nevada after priority use power obligations have been met. Davis generation is the direct result of downstream irrigation needs. Net power generation is about 968,615 MWh (BOR, 2005).

The South Point power plant is located on the Fort Mojave Indian Reservation in the Lake Mohave Basin. The 540-megawatt natural gas-fired plant with two gas-combustion turbines began operations in 2001. It is operated as a "merchant plant", meaning that the energy generated at the plant is sold on the open market. The Fort Mojave Tribe has a 50-year lease with Calpine, an independent power company, for both the site and the water that the plant uses. The average annual use during 2001-2003 was estimated at about 3,600 acre-feet per year of Fort Mojave Indian Colorado River entitlement water (BIA, 1998).

The 600-megawatt Griffith power plant, also a merchant plant, is located about 15 miles southwest of Kingman. It began commercial operation in January 2002 and was sold in May, 2006 to LS Power Equity Partners. An estimated 1,600 acre-feet of groundwater is used at the plant each year.

Because of the relative remoteness of the area and its proximity to regional power grids, the Upper Colorado River Planning Area has become an attractive location for new power plants. LS Power is proposing to construct a 175-megawatt peaking plant adjacent to the Griffith plant that would come on line by 2008 or 2009. The source of water would be a portion of the groundwater already allocated to the Griffith plant through the Mohave County Water Authority. A 720-megawatt plant proposed in the Big Sandy Basin near Wikieup was turned down by the Arizona Corporation Commission (ACC) in November, 2001 primarily due to concerns about environmental impacts. It was the first plant to be denied a certificate by the ACC (ACC, 2001).

There are three “industrial” golf courses in the planning area, all located in the Lake Mohave basin. Industrial courses receive at least some water from facility wells and not from a municipal water provider. The Desert Lakes Golf Club, El Rio Country Club and Riverview Golf Club in the Lake Mohave Basin are considered industrial facilities. Industrial groundwater demand is about 356 acre-feet/year for the three golf courses. The Desert Lakes Golf Club and the Riverview Golf Club also use municipal effluent as shown in Table 4.0-10.

A dairy operated in the Sacramento Valley from 1947 to 2005. During that time, the dairy facility used about 76 acre-feet of groundwater a year.

4.0.8 Water Resource Issues in the Upper Colorado River Planning Area

Water resource issues have been identified in the Upper Colorado River Planning Area by community watershed groups, through the distribution of surveys, and from other sources. As discussed further below, primary issues are: limited water supplies, projected growth, limited groundwater data, aging water infrastructure and drought.

Planning and Conservation

Mohave County was the fastest growing county in Arizona between the 1990 and 2000 Census and proposed developments in the northwestern part of the planning area are causing concerns about the availability of water supplies to meet future needs. Mohave County has indicated it will oppose developments without a demonstration of adequate water supply. General and comprehensive plans and the water supply plans mentioned in Section 4.0.5 help planning area jurisdictions and water systems better prepare for the challenges associated with rapid growth.

Lake Havasu City has had a water conservation plan credited with reducing per capita water use for a number of years. Components include an increasing block rate water rate structure, low water use landscape requirements for certain lot sizes, no-turf policy for commercial, industrial and multi-family property and effluent reuse (Lake Havasu City, 2006). The City of Bullhead City also has a water conservation program and has entered into subcontract agreements with the three water companies that serve water within the City to implement water conservation practices. Practices include turf restrictions, an incentive program to use reclaimed water and leak detection and repair. There also is an incentive program to retrofit existing homes and commercial buildings with low-flow plumbing fixtures (BOR, 2006b). The City also offers a Landscape Rebate Program to convert grass to low water use plants.

The Hualapai Tribe has adopted several ordinances to protect water resources including a Water Resource Ordinance to ensure water quality, a Wetlands Protection and Preservation Ordinance, and a Drought Contingency Plan that establishes drought declaration criteria and identifies response actions (Hualapai Tribe, 2007).

Watershed Groups and Studies

Two watershed groups have formed in the planning area to address a variety of water resource issues. One of the groups, the Northwest Arizona Water Council, is currently active. A complete description of group participants, activities and issues is found in Appendix B. Primary issues identified by the two groups are summarized as follows:

Growth:
- Large master-planned communities planned in Detrital Valley, Hualapai Valley and Sacramento Valley basins as a result of completion (2010) of the bypass bridge across the Colorado River
- Unregulated lot splits

Water Supplies and Demand:
- Limited groundwater data
- Limited groundwater supplies

Legal:
- Concerns regarding proposed development that may use Colorado River water

Water Quality:
- Concerns related to mining activities
- Concerns regarding hexavalent chromium

Funding:
- Limited funding resources for planning, projects, infrastructure, and studies

Drought:
- Impacts on private water companies and water haulers
- Vulnerability of surface and groundwater supplies

Other:
- Potential for subsidence due to rapid growth
- Infrastructure of some private water provider systems in poor shape

In response to concerns by local governments, waters providers and citizens groups about the impacts of groundwater development, the Department, in collaboration with the USGS and with funding assistance from Mohave County, began conducting hydrogeologic investigations in 2005 to improve the understanding of water resources in three basins within the planning area; the Detrital Valley, Hualapai Valley and Sacramento Valley basins. These investigations will assess existing data collection networks and examine the current state of knowledge of the groundwater system; improve understanding of geologic units and their relationship to groundwater storage and movement; improve knowledge of groundwater budget factors including recharge and storage; evaluate groundwater quality; establish a hydrologic monitoring network for on-going assessment of the aquifer; and inform the hydrologic community and area residents about hydrologic conditions

(USGS, 2006). As part of this effort, the Department has released a preliminary estimate of groundwater in storage for the Detrital Valley Basin (ADWR, 2006)

Issue Surveys

The Department conducted a rural water resources survey in 2003 to compile information for the public and help identify the needs of growing communities. This survey also was intended to gather information on drought impacts to incorporate into the Arizona Drought Preparedness Plan, adopted in 2004. Questionnaires were sent to almost 600 water providers, jurisdictions, counties and tribes. A report of the findings from the survey was completed in 2004 (ADWR, 2004).

There were 18 water provider and jurisdiction respondents in the Upper Colorado River Planning Area, and 11 of those numerically ranked issues. Respondents were asked to rank 18 issues, which can be grouped into three categories: infrastructure, water supply, and water quality. As shown in Table 4.0-13, issues related to water infrastructure and to water supply were ranked among the top five issues by a majority of respondents. Infrastructure concerns were related primarily to aging infrastructure in need of replacement and inadequate capital for infrastructure improvements. Water supply concerns ranked highly due primarily to concerns about adequate future supplies. Two respondents identified drought as one of their top concerns, which illustrates the often highly localized sensitivity to drought.

The Department conducted a second, more concise survey of water providers in 2004. This was done to supplement the information gathered in the 2003 survey in support of developing the Arizona Water Atlas, and to reach a wider audience by contacting each water provider directly. Through this effort, 30 water providers in the Upper Colorado River Planning Area, with a total of approximately 69,000 service connections, participated and provided information on water supply, demand, infrastructure and to rank a list of seven issues.

Table 4.0-13 Water resource issues ranked by 2003 survey respondents in the Upper Colorado River Planning Area (10 water providers and 1 jurisdiction)

Issue	Ranked as one of the top 5 issues (out of 18)	Percent of respondents
Need for additional supplies to meet future demand	6	55
Inadequate capital to for infrastructure improvements	4	36
Aging infrastructure in need of replacement	6	55

Source: ADWR 2004

With regard to the question of groundwater level trends in their service area, 16 respondents to this question reported as follows: 7 stable; 8 falling, and 1 variable. No provider reported rising water levels. Responses are shown by those basins with respondents in Table 4.0-14.

Table 4.0-14 Groundwater level trends reported by 2004 survey respondents by groundwater basin (16 respondents)

Basin	Stable	Falling	Variable
Bill Williams	1		
Detrital Valley		1	
Hualapai Valley		1	
Lake Havasu	2		
Lake Mohave	1	1	1
Meadview		1	
Peach Springs	1		
Sacramento Valley	2	4	

Source: ADWR 2005c

As part of the 2004 survey, water providers were asked to rank issues from 0 to 3 with 0 = no concern, 1 = minor concern, 2 = moderate concern and 3 = major concern. Of the 30 water providers that responded to this survey, 23 ranked issues. Although responses to the 2003 questionnaire are not directly comparable to the 2004 survey due to differences in the form and wording of the surveys, responses to issues are similar as shown in Table 4.0-15. Responses indicate that infrastructure concerns, drought, and concerns regarding inadequate supplies to meet future demands rank high among the respondents.

Table 4.0-15 Water resource issues ranked by 2004 survey respondents in the Upper Colorado River Planning Area (23 water providers)

Issue	Moderate concern	Major concern	Total	Percent of respondents reporting issue was a major or moderate concern
Inadequate storage capacity to meet peak demand	5	2	7	30
Inadequate well capacity to meet peak demand	2	4	6	26
Inadequate supplies to meet current demand	1	3	4	13
Inadequate supplies to meet future demand	3	5	8	35
Infrastructure in need of replacement	6	3	9	39
Inadequate capital to pay for infrastructure improvements	5	5	10	44
Drought related water supply problems	5	4	9	39

Source: ADWR 2005c

Table 4.0-16 shows how respondents to the 2004 survey within individual basins ranked the issues. Respondents from seven basins ranked issues, but only in six basins did respondents rank issues as of moderate or major concern. Concern about infrastructure and storage capacity was noted by respondents in all responding basins, and concerns about future supplies, well capacity and drought were noted in all but one basin.

Table 4.0-16 Number of 2004 survey respondents, by groundwater basin, that ranked the survey water resource issues a moderate or major concern (23 water providers total)

Issue	Detrital Valley (1)	Hualapai Valley (3)	Lake Havasu (5)	Lake Mohave (4)	Peach Springs (1)	Sacramento Valley (8)
Inadequate storage capacity to meet peak demand	1	1	2	1	1	3
Inadequate well capacity to meet peak demand	1	1	1	1		2
Inadequate supplies to meet current demand	1	1	1			2
Inadequate supplies to meet future demand	1	1	2	1		3
Infrastructure in need of replacement	1	1	3	1	1	4
Inadequate capital to pay for infrastructure improvements	1	1	6	2	1	4
Drought related water supply problems	1	1	1	2		5

Source: ADWR 2005c

4.0.9 Groundwater Basin Water Resource Characteristics

Sections 4.1 through 4.9 present data and maps on water resource characteristics of the nine groundwater basins in the Upper Colorado River Planning Area. A description of the data sources and methods used to derive this information is found in Section 1.3 of Volume 1 of the Atlas. This section briefly describes general information that applies to all of the basins and the purpose of that information. The information is organized according to the order in which the characteristics are discussed in Sections 4.1 through 4.9.

Geographic Features

Geographic features maps are included to present a general orientation to principal land features, roads, counties and cities, towns and places in the groundwater basin.

Land Ownership

The distribution and type of land ownership in a basin have implications for land and water use. Large amounts of private land typically translate into opportunities for land development and associated water demand, whereas federal lands are typically maintained for a purpose with little associated water use. State-owned land may be sold or traded, and is often leased for grazing and farming. The extent of state -owned lands is due to a number of legislative actions. The

State Enabling Act of 1910 and the Act that established the Territory of Arizona in 1863 set aside sections 2, 16, 32 and 36 in each township to be held in trust by the state for educational purposes. Other legislation authorized additional state trust lands for specified purposes, which are identified for each basin. (Arizona State Land Department, 2006).

Climate

Climate data including temperature, rainfall, evaporation rates and snowfall are critical components of water resource planning and management. Averages and variability, seasonality of precipitation, and long-term climate trends are all important factors in demand and supply planning.

Surface Water Conditions

Depending on physical and legal availability, surface water may be a potential supply in a basin. Stream gage, flood gage, reservoir, stockpond, and runoff contour data provide information on physical availability of this supply. Seasonal flow information is relevant to seasonal supply availability. Annual flow volumes provide an indication of potential volumetric availability.

The criteria for including stream gage stations in the basin tables are that there is at least one year of record, and annual streamflow statistics are included only if there are at least three years of record. There are different types of stations and those that only serve repeater functions were not included.

Flood gage information is presented to direct the reader to sources of additional precipitation and flow information that can be used in water resource planning. Large reservoir storage information provides data on the amount of water stored in the basin, its uses, and ownership. Because of the large number of small reservoirs, and less reliable data, individual small reservoir data is not provided. The number of stockponds is a general indicator of small scale surface water capture and livestock demand. Runoff contours reflect the average annual runoff in tributary streams. They provide a generalized indication of the amount of runoff that can be expected at a particular geographic location.

Perennial and Intermittent Streams and Major Springs

A map of perennial and intermittent streams is provided for each basin. For some basins, more than one source of information was used. Stream designations may not accurately reflect current conditions in some cases. Spring data were compiled from a number of sources in an effort to develop as comprehensive a list as possible. Spring data is important to many researchers and to the environmental community due to their importance in maintaining habitat, even from small discharges.

Groundwater Conditions

Several indicators of groundwater conditions are presented for each basin. Aquifer type can be a general indicator of aquifer storage potential, accessibility of the supply, aquifer productivity, water quality, and aquifer flux. Well yield information for large diameter wells is provided and is generally measured when the well is drilled and reported on completion reports. It was assumed that large diameter wells were drilled to produce a maximum amount of water and, therefore, their reported pump capacities are indicative of the aquifer's potential to yield water to a well. However, many factors can affect well yields including well design, pump size and condition, and the age of the well. Reported well yields are only a general indicator of aquifer productivity. Specific information is available from well measurements conducted as part of basin investigations.

Natural recharge is typically the least well-known component of a water budget. Many of the estimates in the Atlas are derived from studies of larger geographic areas and all deserve further study. Similarly, estimates of storage are based on rough estimates and considerably more study is needed in most basins. Components of storage include aquifer depth and specific yield.

Water level data is from measured wells, usually collected during the period when the wells were not actively being pumped or only minimally pumped. Depth to water measurements are shown on mapped wells if there was a measurement taken during 2003-2004. The basin hydrographs show water-level trends for selected wells over the 30-year period from January 1975 to January 2005. Not all basins have a sufficient number of representative hydrographs.

The flow directions that are shown generally reflect long-term, regional aquifer flow in the basin and are not meant to depict temporary or local-scale conditions. However, flow directions in some basins indicate how localized pumping has altered regional flow patterns.

Water Quality

Water quality conditions impact the availability of water supplies. Water quality data was compiled from a variety of sources as described in Volume 1 Section 1.3. The data indicate areas where water quality exceedences have occurred previously, however additional areas of concern may currently exist where water quality samples have not been collected or sample results were not reviewed by the Department (e.g. samples collected in conjunction with the ADEQ Aquifer Protection Permit programs). It is important to note also that the exceedences presented may or may not reflect current aquifer or surface water conditions.

Cultural Water Demand

Cultural water demand is an important component of a water budget. However, without mandatory metering and reporting of water uses, accurate demand data is difficult to acquire. Municipal demand includes water company and domestic (self-supplied) demand estimates. Basin demand information comes from several sources in order to prepare as accurate an estimate as possible. Annual demand estimates have been averaged over a specific time period. This provides general trend information without focusing on potentially inaccurate annual demand estimates due to incomplete data.

Locations of major cultural water uses comes primarily from a 2004 USGS land cover study using LANDSAT satellite imagery collected between 1999 and 2001. This study may not represent recent changes. Supplementary data have been used in some basins, as noted. The cultural demand maps provide only general information about the location of water users.

Effluent generation data were compiled from several sources to provide an estimate of how much of this renewable resource might be available for use. However, effluent reuse is often difficult both logistically and economically since a potential user may be far from a wastewater treatment plant.

Water Adequacy Determinations

Information on water adequacy and inadequacy determinations for subdivisions, with the reason for the inadequacy determination provides information on the number and status of subdivision lots. Listing the reason for the inadequacy identifies which subdivisions have a demonstrated physical or legal lack of water or may have elected not to provide the necessary information to the Department. Briefly, developers of subdivisions outside of AMAs are required to obtain a determination of whether there is sufficient water of adequate quality available for 100 years. If the supply is determined to be inadequate, lots may still be sold, but the condition of the water supply must be disclosed in promotional materials and in sales documents.

In addition to these subdivision determinations for which a water adequacy report is issued, water providers may apply for adequacy designations for their entire service area. There are eight Designations of Adequate Water Supply in the planning area. If a subdivision is to be served water from one of these water providers, then a separate adequacy determination is not required. (See Section 4.0.5).

Developers of large, master-planned communities outside of AMAs typically apply for an Analysis of Adequate Water Supply (AAWS). This type of application is used generally to prove that water will be physically available for the master-planned community. AAWS are issued based on the development plan or plat. If an AAWS is issued for groundwater, it reserves a specific volume of water for 10 years (for purposes of other adequacy reviews) only for the specific property that is the subject of the AAWS. (See Appendix A, Volume 1 for more information about the Adequacy Program).

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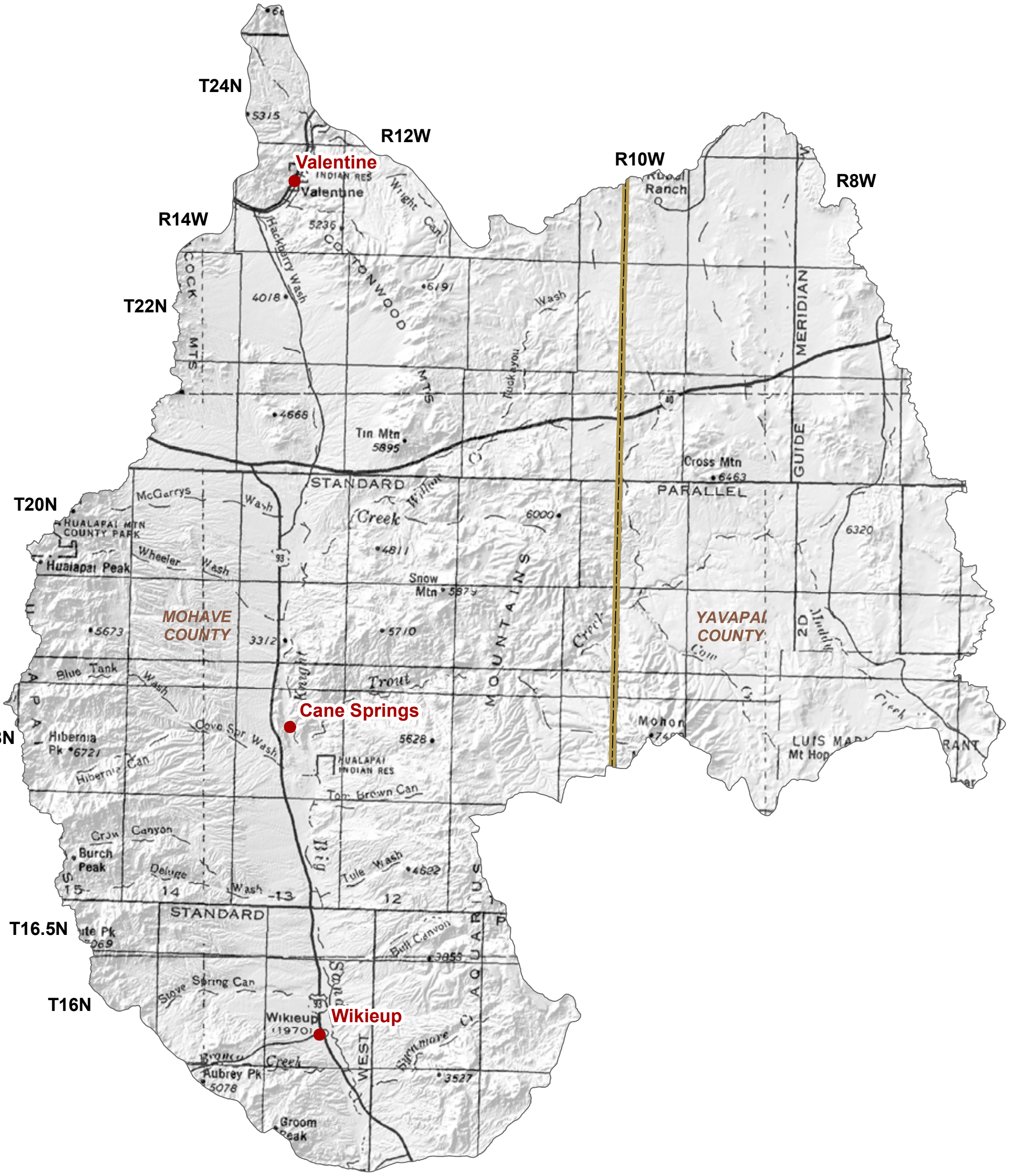
Section 4.1
Big Sandy Basin

4.1.1 Geography of the Big Sandy Basin

The Big Sandy Basin, located in the east central part of the planning area, is the second largest basin at 1,988 square miles. Geographic features and principal communities are shown on Figure 4.1-1. The basin is characterized by a large valley, and by mid-elevation mountain ranges and plateaus. Vegetation types include Sonoran desertscrub, semidesert grassland, chaparral, woodland and montane conifer forests. Riparian vegetation is found along streams and includes cottonwood/willow, mesquite and tamarisk along the Big Sandy River and mesquite, cottonwood/willow and mixed broadleaf along sections of Trout Creek.

- Principal geographic features shown on Figure 4.1-1 are:
  - Basin communities of Wikieup, Valentine and Cane Springs
  - Big Sandy River running north to south through Cane Springs and Wikieup
  - The lowest point in the basin, about 1,650 feet, is south of Wikieup along the Big Sandy River
  - Hackberry Wash south of Valentine
  - Trout Creek, a major tributary to the Big Sandy River, flowing east to west in the middle of the basin
  - The Aquarius Mountains east of the Big Sandy River
  - The Cottonwood Mountains south of Valentine
  - The Hualapai Mountains along the western boundary of the basin, which contains the highest point in the basin and planning area, Hualapai Peak at 8,417 feet.



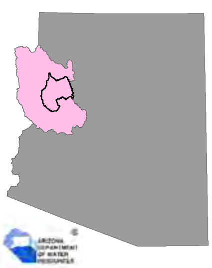


Figure 4.1-1
Big Sandy Basin
Geographic Features

4.1.2 Land Ownership in the Big Sandy Basin

Land ownership, including the percentage of ownership by category, for the Big Sandy Basin is shown in Figure 4.1-2. A principal feature of land ownership in this basin is the large amount of private and federal lands interspersed with state trust lands creating a checkerboard pattern. For a discussion of how this land pattern was created see section 4.0.9. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

Private

- 40.6% of the land is private.
- The majority of the private land is interspersed throughout state trust, national forest and BLM lands.
- There are a number of larger parcels of private land along the northeastern, northwestern and southeastern basin boundaries.
- Land uses include domestic, commercial, ranching and farming.

U.S. Bureau of Land Management (BLM)

- 29.7% of the land is federally owned and managed by the Kingman Field Office of the Bureau of Land Management.
- All BLM lands are located in the western portion of the basin.
- Primary land uses are grazing and recreation.

State Trust Land

- 28.5% of the land in this basin is held in trust for the public schools and seven other beneficiaries under the State Trust Land system.
- The majority of the state trust land occurs in a checkerboard pattern interspersed with private and federal land. Larger contiguous portions of state trust land are found in the northern portion of the basin.
- Primary land use is grazing.

National Forest and Wilderness

- 0.9% of the land is federally owned and managed as National Forest and Wilderness.
- All forest lands in the basin are part of the Prescott National Forest.
- All forest lands are intermingled with private land.
- Land uses include grazing, timber production and recreation.

Indian Reservation

- 0.2% of the land is under ownership of the Hualapai Tribe.
- Tribal lands are located in a small strip along Highway 93 north of Wikieup and around Valentine.
- Land uses include domestic, commercial and grazing.

Other (Game and Fish, County and Bureau of Reclamation Lands)

- 0.1% of the land is owned and managed by Mohave County as the Hualapai Mountain

Park.

- The Hualapai Mountain Park is located in T20N, R15W on the western basin boundary.
- Primary land use is recreation.

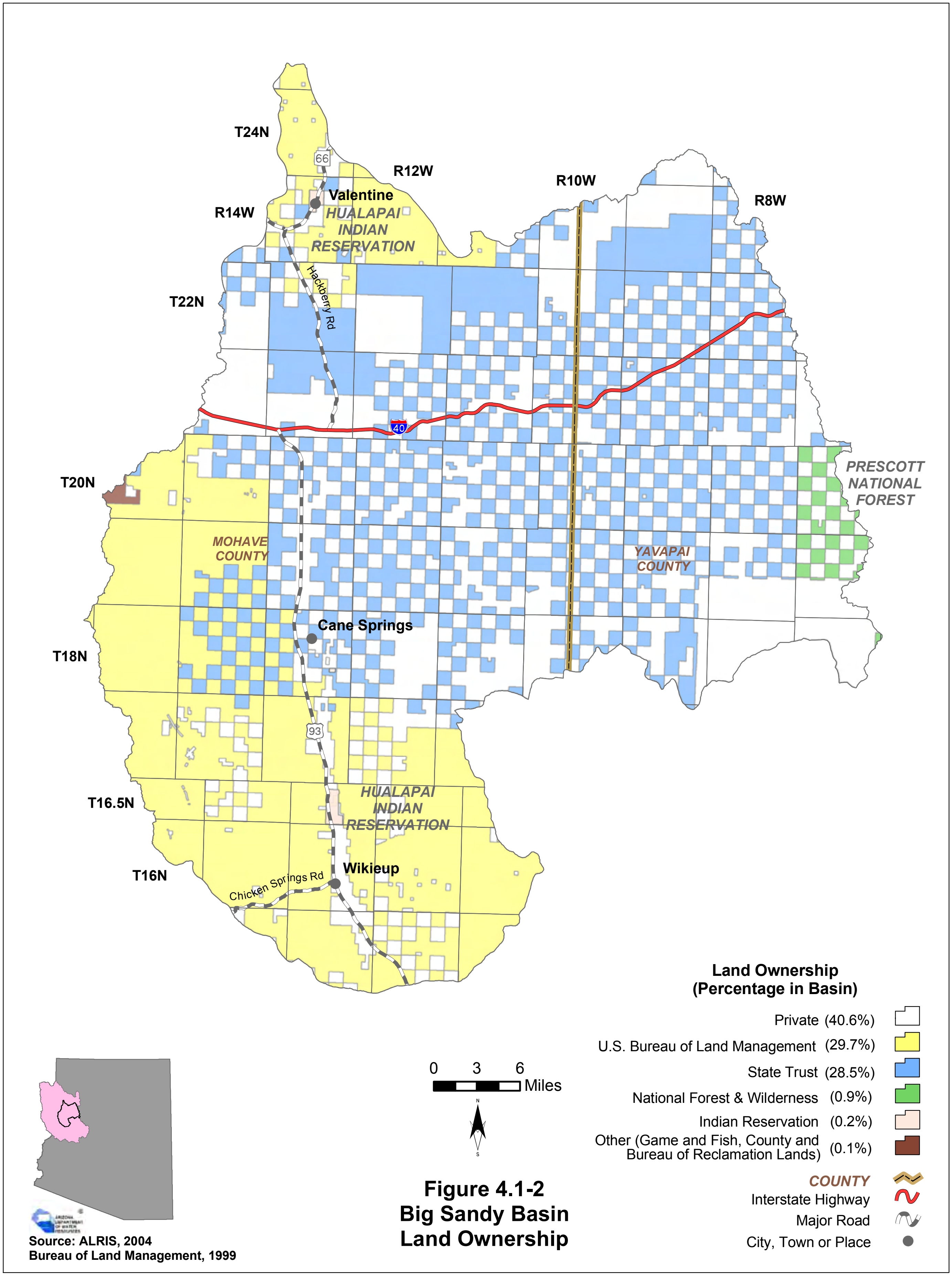


**Figure 4.1-2
Big Sandy Basin
Land Ownership**

4.1.3 Climate of the Big Sandy Basin

Climate data from NOAA/NWS Co-op Network stations are complied in Table 4.1-1 and the locations are shown on Figure 4.1-3. Figure 4.1-3 also shows precipitation data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Big Sandy Basin does not contain Evaporation Pan, AZMET and SNOTEL/Snowcourse stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 4.1-1A
- There are two NOAA/NWS Co-op network climate stations in the basin, Truxton Canyon and Wikieup.
- Of the two stations, data from different periods of record may be used as shown. The variety of periods may be due to discontinued measurements, date of installation or other availability issues.
- The stations are located at 3,820 feet and 2,010 feet.
- Maximum average temperatures are 86.4°F at Wikieup and 80.5°F at Truxton Canyon.
- Minimum average temperatures are 40.9°F at Truxton Canyon and 48.4°F at Wikieup.
- Station precipitation varies between the two stations with an annual average precipitation of 9.88 inches at Wikieup and 11.56 inches at Truxton Canyon.
- All stations report highest annual rainfall in the winter season (January - March), however, the Truxton Canyon station reports high precipitation in the summer (July-September) as well.
- The driest season for all stations is spring (April – June).

SCAS Precipitation Data

- See Figure 4.1-3
- Additional precipitation data shows rainfall as high as 22 inches at the southeastern-most tip of the basin (T18N, R7W) in the Juniper Mountains and as low as eight inches in the areas south of Wikieup and north of Valentine.
- In general, precipitation increases as altitude increases in this basin. This basin has one of the highest average annual precipitation rates in the planning area and the highest average low precipitation in the planning area. The range of 14 inches between areas of highest and lowest average precipitation is high for the planning area.

Table 4.1-1 Climate Data for the Big Sandy Basin

A.NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Truxton Canyon	3,820	1948-1980[1]	80.5/Jul	40.9/Jan	3.87	1.34	3.86	2.48	11.56
Wikieup	2,010	1971-2000	86.4/Jul	48.4/Jan	4.34	0.69	2.75	2.10	9.88

Source: WRCC, 2003.

Notes:
[1]Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

Source: WRCC, 2003.

C. AZMET:

Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (*number of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content *(Number of measurements to calculate average)*					
			Jan	Feb	March	April	May	June
None								

Source: Natural Resources Conservation Service, 2005

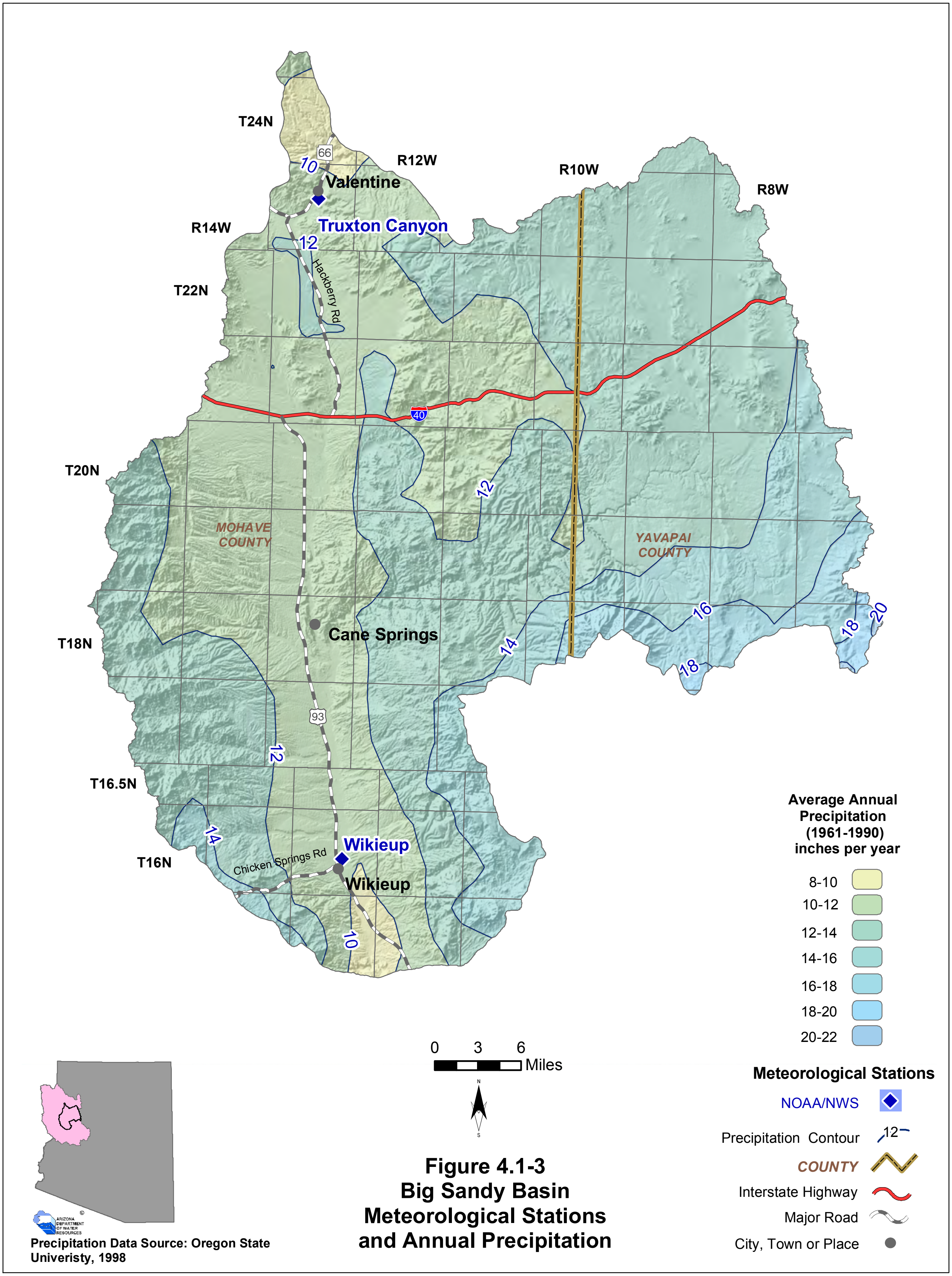


Figure 4.1-3
Big Sandy Basin
Meteorological Stations
and Annual Precipitation

4.1.4 Surface Water Conditions in the Big Sandy Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 4.1-2. Flood ALERT equipment in the basin is shown in Table 4.1-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.1-4. The location of streamflow gages, using the USGS number, is shown on Figure 4.1-4. The location of large reservoirs and flood ALERT equipment as well as USGS runoff contours are also shown on Figure 4.1-4. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Streamflow Data

- Refer to Table 4.1-2.
- Data from two stations located at Truxton Wash and Cottonwood Wash are shown in the table and on Figure 4.1-4. The Cottonwood Wash Station was discontinued in 1978.
- The average seasonal flow for both stations is highest in the summer (July-September) when 61% of the annual average seasonal flow occurs at the Truxton Station and 44% occurs at the Cottonwood Wash station. The average seasonal flow is lowest in the spring (April-June) and the fall (October-December).
- Maximum annual flow was 2,527 acre-feet in 1995 at the Truxton Wash station and 8,326 acre-feet in 1976 at the Cottonwood Wash station. Minimum annual flow was 22 acre-feet in 2002 at the Truxton Wash station and 601 acre-feet in 1975 at the Cottonwood Wash station.

Flood ALERT Equipment

- Refer to Table 4.1-3.
- As of October 2005 there were four stations in the basin, all stations are in Mohave County.
- Of the four stations two are precipitation only stations and two stations are weather stations.

Reservoirs and Stockponds

- Refer to Table 4.1-4.
- The basin contains one large reservoir with a maximum capacity of 2,284 acre-feet. Lake Mary Reservoir, created by the Oro Ranch Dam, is used for fire protection or as a stock or farm pond.
- Surface water is stored or could be stored in 10 small reservoirs in the basin.
- Total maximum storage for the three small reservoirs with greater than 15 acre-feet and less than 500 acre-feet is 492. The total surface area for the remaining seven small reservoirs is 92 acres.
- There are an estimated 426 stockponds in this basin.

Runoff Contour

- Refer to Figure 4.1-4.
- Average annual runoff is one inch per year in the in the south-central portion of the basin near Cow Creek and decreases to 0.1 inches to the north and west.

Table 4.1-2 Streamflow Data for the Big Sandy Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9404343	Truxton Wash near Valentine	380.3	4,630	3/1993-current	26	8	61	5	22 (2002)	543	875	2,527 (1995)	9
9424200	Cottonwood Wash No. 1 near Kingman	143.0	5,350	2/1964-9/1978 (discontinued)	37	7	44	12	601 (1975)	2,867	3,026	8,326 (1976)	13

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Notes:
Statistics based on Calendar Year
Annual Flow statistics based on monthly values
Summation of Average Annual Flows may not equal 100 due to rounding.
Period of record may not equal Year of Record used for annual Flow/Year statistics due to only using years with a 12 month record

Table 4.1-3 Flood ALERT Equipment in the Big Sandy Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
1570	Hualapai Mountain	Weather Station	NA	Mohave County FCD
1580	Cedar Hills	Precipitation	NA	Mohave County FCD
7640	Greenwood Village	Precipitation	NA	Mohave County FCD
7650	Wikieup	Weather Station	NA	Mohave County FCD

Notes:
FCD = Flood Control District
NA = Information is not available to ADWR at this time

Table 4.1-4 Reservoirs and Stockponds in the Big Sandy Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE[1]	JURISDICTION
1	Lake Mary (Oro Ranch Dam)	Private	2,284	P	State

B. Other Large Reservoirs (50 acre surface area or greater)[2]

MAP KEY	RESERVOIR/LAKE NAME	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE	JURISDICTION
None identified by ADWR at this time					

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 3
Total maximum storage: 492 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)[2]

Total number: 7
Total surface area: 92 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 426 (from water right filings)

Notes:
[1] P=fire protection, stock or farm pond
[2]Capacity data not available to ADWR

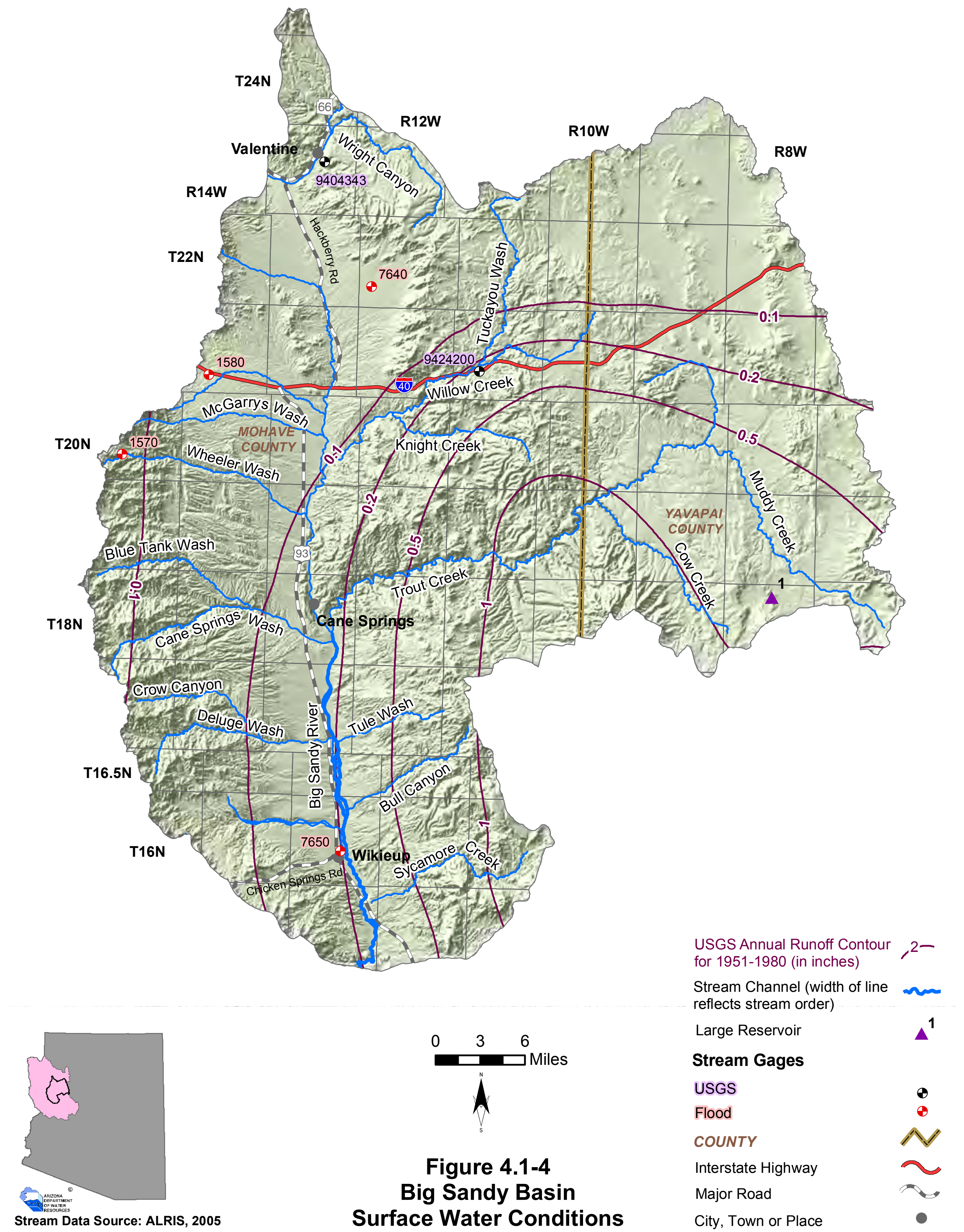


Figure 4.1-4
Big Sandy Basin
Surface Water Conditions

4.1.5 Perennial/Intermittent Streams and Major Springs in the Big Sandy Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 4.1-5. The locations of major springs as well as perennial and intermittent streams are shown on Figure 4.1-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- There are three perennial streams located in the center of the basin, Cottonwood Creek, Big Sandy River and Trout Creek.
- Numerous intermittent streams are located throughout the basin with a large concentration of intermittent streams along the western basin boundary.
- Reaches of the Big Sandy River and Trout Creek in this basin are both perennial and intermittent.
- There are six major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time.
- Listed discharge rates may not be indicative of current conditions. All of the measurements were taken during or prior to 1982.
- Major springs are found in the vicinity of perennial and intermittent streams with a cluster of three major springs in the northern tip of the basin around Valentine. The greatest discharge rate was measured at the beginning of an intermittent reach of the Big Sandy River south of Cane Springs (Unnamed, 1,600 gpm).
- All but one of the major springs discharge at least 200 gallons per minute (gpm).
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 4.1-5B. There are 11 minor springs identified in this basin.
- The total number of springs identified by the USGS varies from 165 to 179, depending on the database reference.

Table 4.1-5 Springs in the Big Sandy Basin

A. Major Springs (10 gpm or greater):

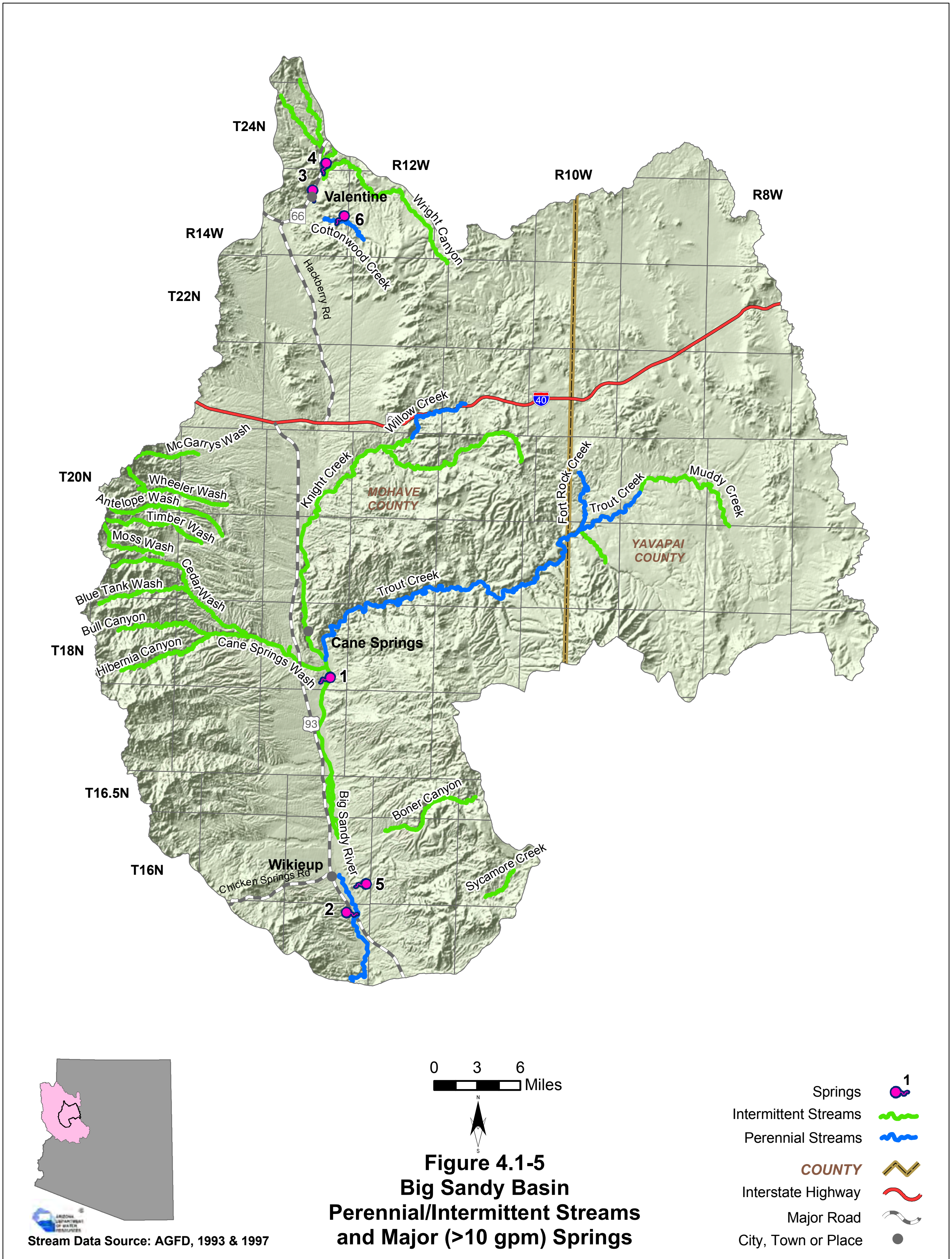
Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Unnamed[2]	345407	1133724	1,600	8/21/1980
2	Unnamed[2]	344002	1133513	400	8/20/1980
3	Valentine[2]	352325	1133920	400	10/1/1943
4	Unnamed[2]	352505	1133830	330	During or prior to 1943
5	Cofer Hot	344144	1133423	200	During or prior to 1982
6	Unnamed[2]	352159	1133713	10	During or prior to 1964

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Unnamed[2]	352350	1134039	5	1/1965
Unnamed	352340	1134034	5	1/1965
Unnamed	352420	1133930	3	1/1965
Unnamed	352013	1134342	3	1/1965
Unnamed	352354	1133814	3	1/1965
Unnamed	352232	1134101	3	1/1965
Unnamed	352230	1134159	3	1/1965
Unnamed	352301	1133740	2	1/1965
Unnamed	352827	1134217	2	During or prior to 1965
Cane	345524	1133950	1	6/1/1980
Unnamed	352311	1133955	1	2/1965

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and USGS, 2006): 165 to 179

Notes:
[1]Most recent measurement identified by ADWR
[2]Spring is not displayed on current USGS topo maps



Stream Data Source: AGFD, 1993 & 1997

Figure 4.1-5
Big Sandy Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

4.1.6 Groundwater Conditions of the Big Sandy Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 4.1-6. Figure 4.1-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 4.1-7 contains hydrographs for selected wells shown on Figure 4.1-6. Figure 4.1-8 shows well yields in five yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields, is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 4.1-6 and Figure 4.1-6.
- Major aquifers in the basin include recent stream alluvium, basin fill and sedimentary rock (R Aquifer).
- This basin contains two sub-basins, Wikieup and Fort Rock.
- Flow direction is generally from the north to the south.

Well Yields

- Refer to Table 4.1-6 and Figure 4.1-8.
- As shown on Figure 4.1-8 well yields in this basin range from less than 100 gallons per minute (gpm) to greater than 2,000 gpm.
- One source of well yield information, based on 87 reported wells, indicates that the median well yield in this basin is 300 gpm.
- Well yields vary throughout the basin.

Natural Recharge

- Refer to Table 4.1-6.
- The estimate of natural recharge for this basin is 22,000 acre-feet per year.

Water in Storage

- Refer to Table 4.1-6.
- There are three storage estimates for this basin, ranging from 9.5 million acre-feet to 21 million acre-feet. The most recent estimate, from a 1990 ADWR study, indicates the basin has 9.5 million acre-feet in storage to a depth of 1,200 feet.
- The predevelopment storage estimate is 10 million acre-feet to a depth of 1,200 acre-feet.

Water Level

- Refer to Figure 4.1-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures eight index wells in this basin.
- In 1995, the year of the last water level sweep, 126 wells were measured.
- The deepest recorded water level in the basin is 488 feet near the northeastern basin boundary and the shallowest is 15 feet south of Wikieup.
- Hydrographs corresponding to selected wells shown on Figure 4.1-6 but covering a longer time period are shown in Figure 4.1-7.

Table 4.1-6 Groundwater Data for the Big Sandy Basin

Basin Area, in square miles:	1,988	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Recent Stream Alluvium	
	Basin Fill	
	Sedimentary Rock (R Aquifer)	
Well Yields, in gal/min:	6.6 (1 well measured)	Measured by ADWR and/or USGS
	Range 1-2,250 Median 300 (87 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 30-1,000	ADWR (1990 and 1994)
	Range 0-500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	22,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	9,500,000 (to 1,200 ft)	ADWR (1990)
	10,000,000[1] (to 1,200 ft)	Freethey and Anderson (1986)
	21,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
Current Number of Index Wells:	8	
Date of Last Water-level Sweep:	1995 (126 wells measured)	

Notes:
[1]Predevelopment Estimate

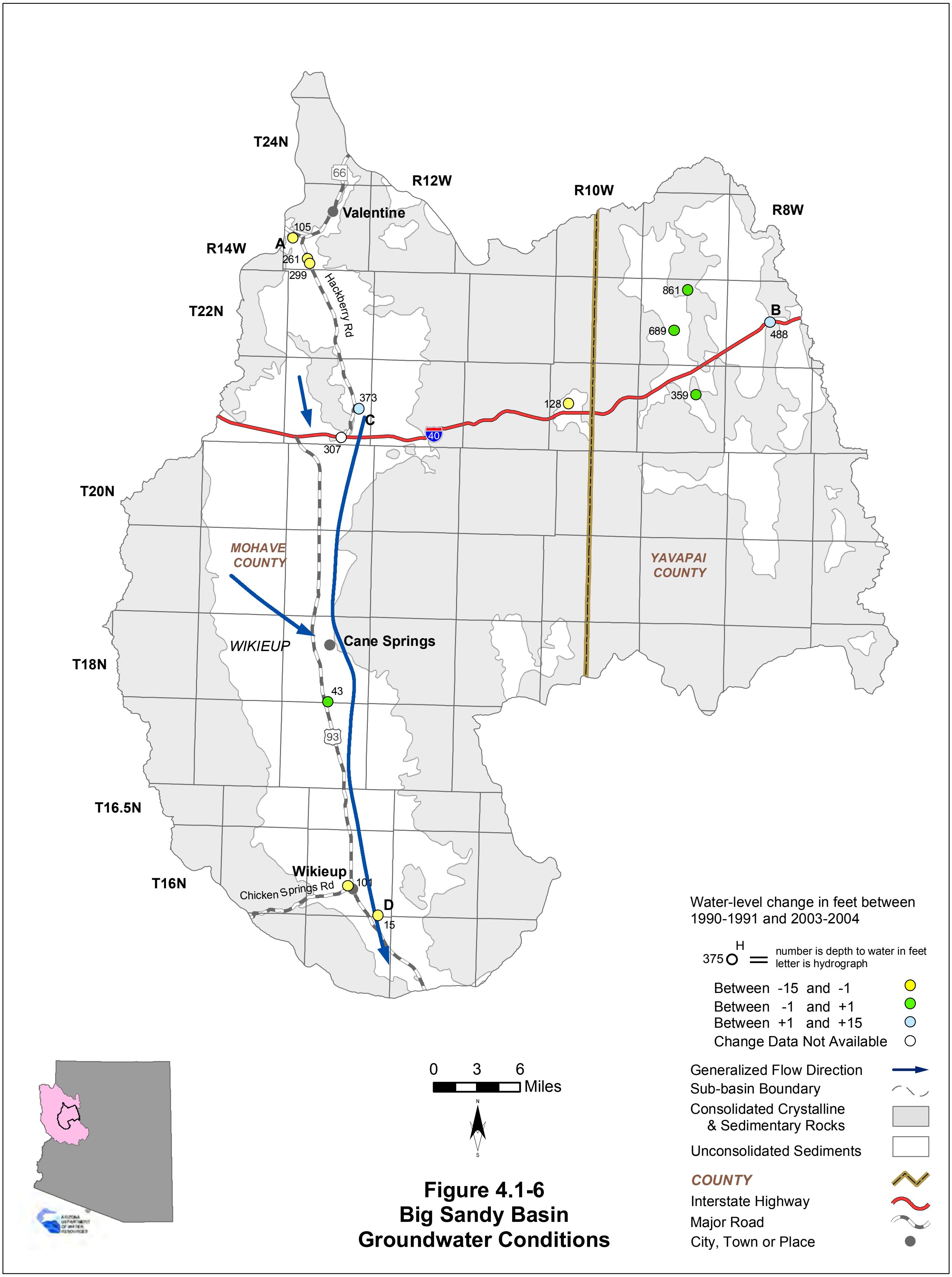
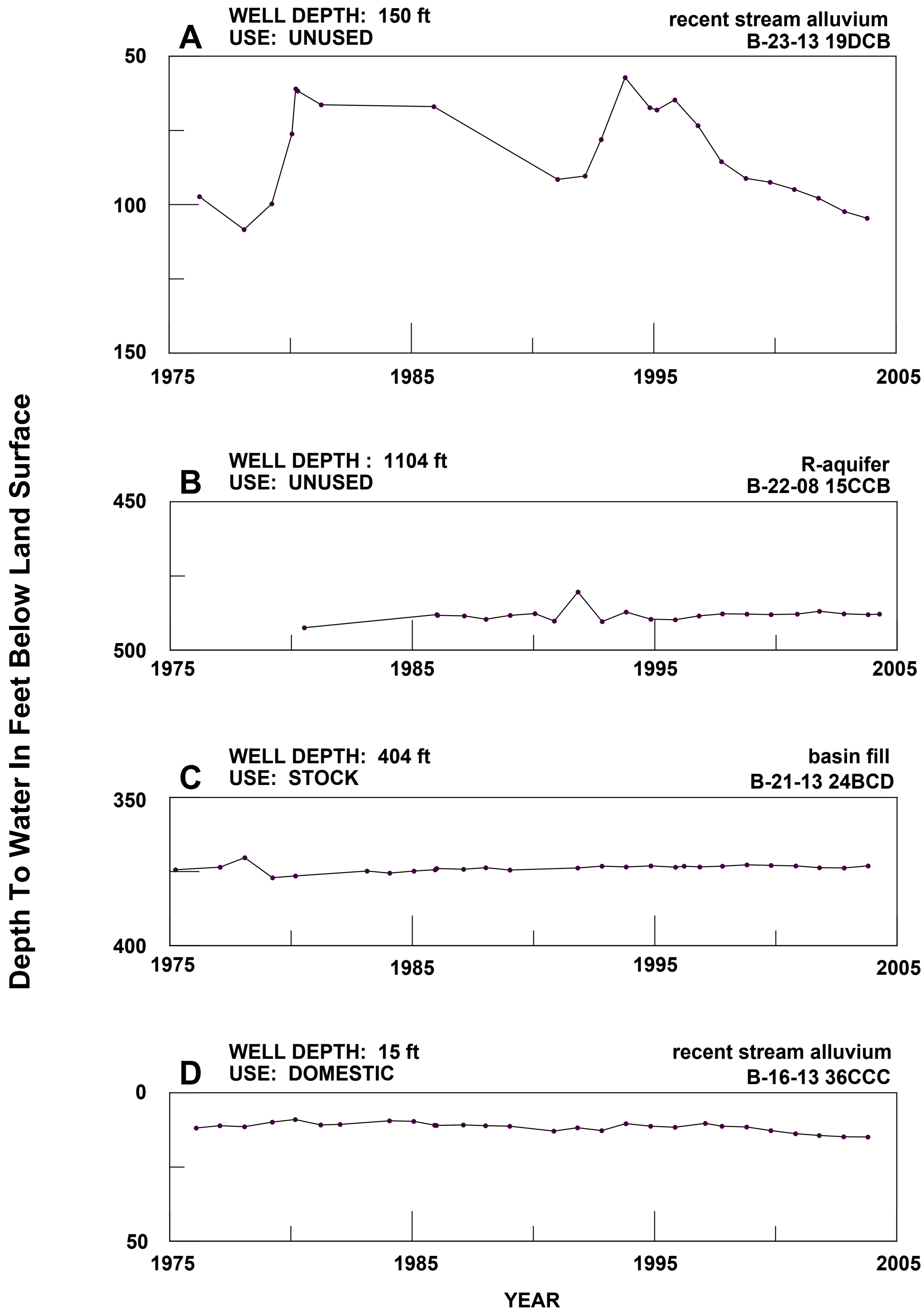


Figure 4.1-6
Big Sandy Basin
Groundwater Conditions

Figure 4.1-7
Big Sandy Basin
Hydrographs Showing Depth to Water in Selected Wells



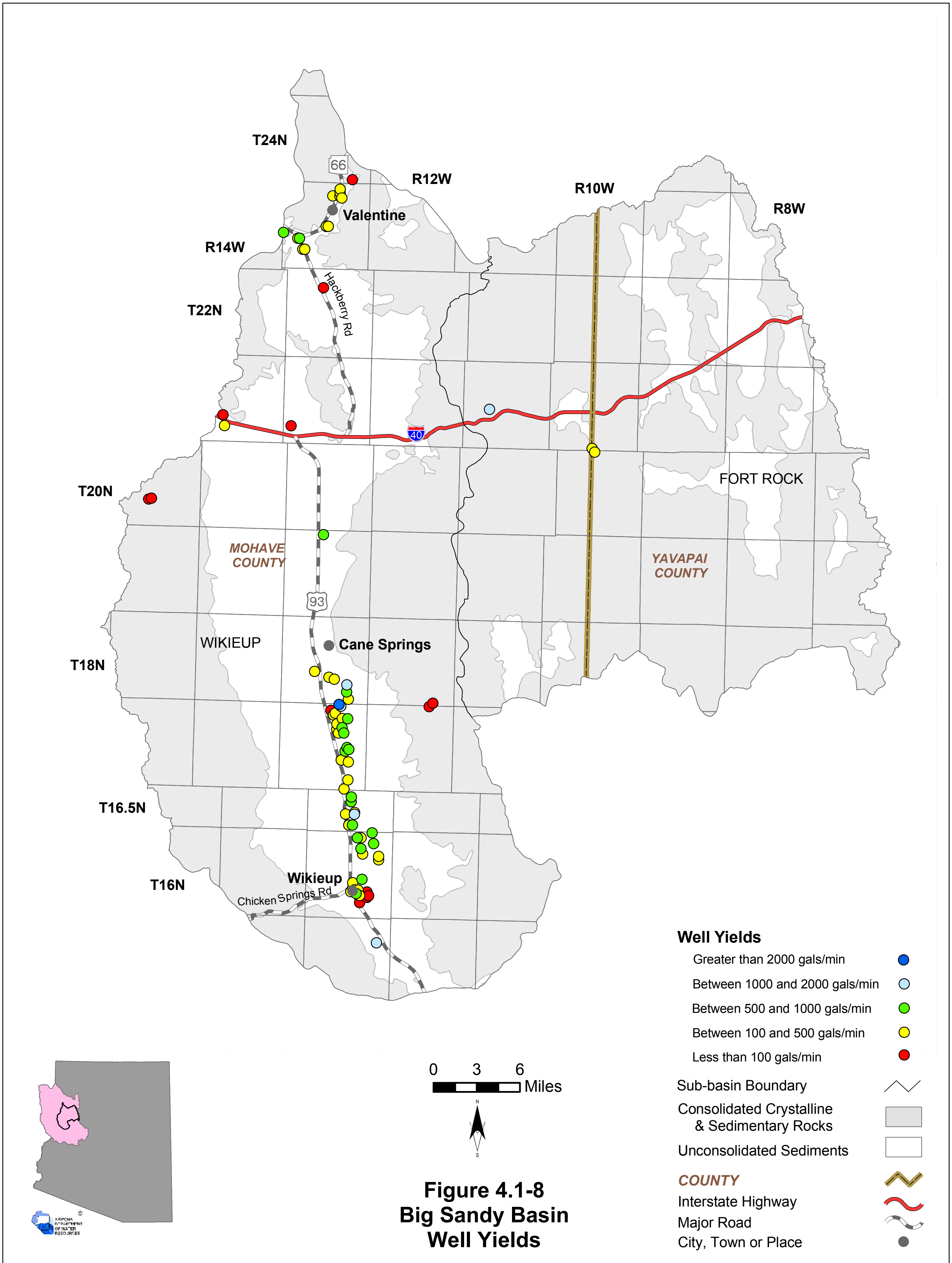


Figure 4.1-8
Big Sandy Basin
Well Yields

4.1.7 Water Quality of the Big Sandy Basin

Drinking water standard exceedences in wells, springs and mine sites including location and parameter(s) exceeded are shown in Table 4.1-7A. There are no impaired lakes or streams in this basin. Figure 4.1-9 shows the location of exceedences keyed to Table 4.1-7A. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mine Sites

- Refer to Table 4.1-7A.
- Drinking water standard exceedences in wells and springs have been reported for 64 sites in the basin.
- The drinking water standard for radionuclides, fluoride and lead were the most frequently exceeded standards at sites in this basin.
- The largest cluster of radionuclide exceedences is east of Highway 93 and south of Interstate 40.
- The largest cluster of lead exceedences is around Highway 93 north of Wikieup.
- Fluoride exceedences are scattered throughout the basin.
- Other drinking water standards exceeded in this basin include arsenic, antimony, beryllium and cadmium.

Table 4.1-7 Water Quality Exceedences in the Big Sandy Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Exceeding Drinking Water Standard[2]
		Township	Range	Section	
1	Spring	24 North	13 West	5	Rad
2	Spring	24 North	13 West	5	Rad
3	Well	23 North	13 West	19	As
4	Well	23 North	13 West	20	As, Pb
5	Well	23 North	13 West	29	As
6	Well	23 North	14 West	35	Pb
7	Well	22 North	13 West	34	As
8	Well	21 North	13 West	30	F
9	Well	21 North	14 West	15	F
10	Well	21 North	14 West	24	As, F
11	Well	21 North	14 West	29	F, Pb
12	Well	21 North	14 West	29	As, F
13	Well	21 North	14 West	29	As, F
14	Well	21 North	14 West	29	As
15	Spring	20 North	11 West	18	Rad
16	Well	20 North	12 West	13	Rad
17	Well	20 North	12 West	28	Rad
18	Spring	20 North	12 West	32	Rad
19	Well	20 North	12 West	34	Rad
20	Spring	20 North	12 West	35	Rad
21	Well	20 North	13 West	25	Rad
22	Well	20 North	14 West	1	Sb, As, F, Rad
23	Well	20 North	14 West	17	Rad
24	Well	20 North	14 West	19	Be, Cd, F
25	Spring	20 North	15 West	35	Rad
26	Spring	19 North	12 West	9	Rad
27	Well	19 North	13 West	8	Rad
28	Well	19 North	13 West	16	Rad
29	Well	19 North	14 West	10	F
30	Spring	19 North	15 West	14	Rad
31	Well	19 North	15 West	23	F
32	Well	18 North	9 West	9	Cd
33	Well	18 North	11 West	3	As
34	Well	18 North	11 West	27	As
35	Well	18 North	12 West	2	F
36	Well	18 North	12 West	25	Rad
37	Well	18 North	12 West	25	As
38	Spring	18 North	12 West	30	F
39	Well	18 North	14 West	11	F
40	Spring	18 North	14 West	25	As
41	Spring	18 North	14 West	31	As, Rad
42	Well	17 North	13 West	2	As, Pb
43	Well	17 North	13 West	14	As, Pb
44	Well	17 North	13 West	22	F
45	Well	17 North	13 West	23	Pb
46	Well	17 North	13 West	26	Pb
47	Well	17 North	13 West	31	As
48	Well	16.5 North	13 West	22	Pb
49	Well	16.5 North	13 West	22	Pb
50	Well	16.5 North	13 West	27	Pb
51	Well	16.5 North	13 West	27	Pb
52	Well	16.5 North	13 West	34	Pb
53	Spring	16.5 North	15 West	25	As
54	Well	16 North	13 West	3	Pb
55	Well	16 North	13 West	3	Pb
56	Well	16 North	13 West	9	Rad
57	Well	16 North	13 West	10	F
58	Well	16 North	13 West	10	Pb
59	Well	16 North	13 West	22	As
60	Spring	16 North	13 West	25	As, F
61	Well	16 North	13 West	27	As
62	Well	16 North	13 West	27	As
63	Well	16 North	13 West	36	F
64	Well	16 North	13 West	36	As, F

WATER QUALITY EXCEEDENCES IN THE BIG SANDY BASIN (cont'd)[1]

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard	Parameter(s) Exceeding Use Standard
None identified by ADWR at this time						

Notes:

[1] Most water quality samples collected between 1980 and 2004.

[2] Sb = Antimony
As = Arsenic
Be = Beryllium
Cd = Cadmium
F= Fluoride
Pb = Lead
Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium

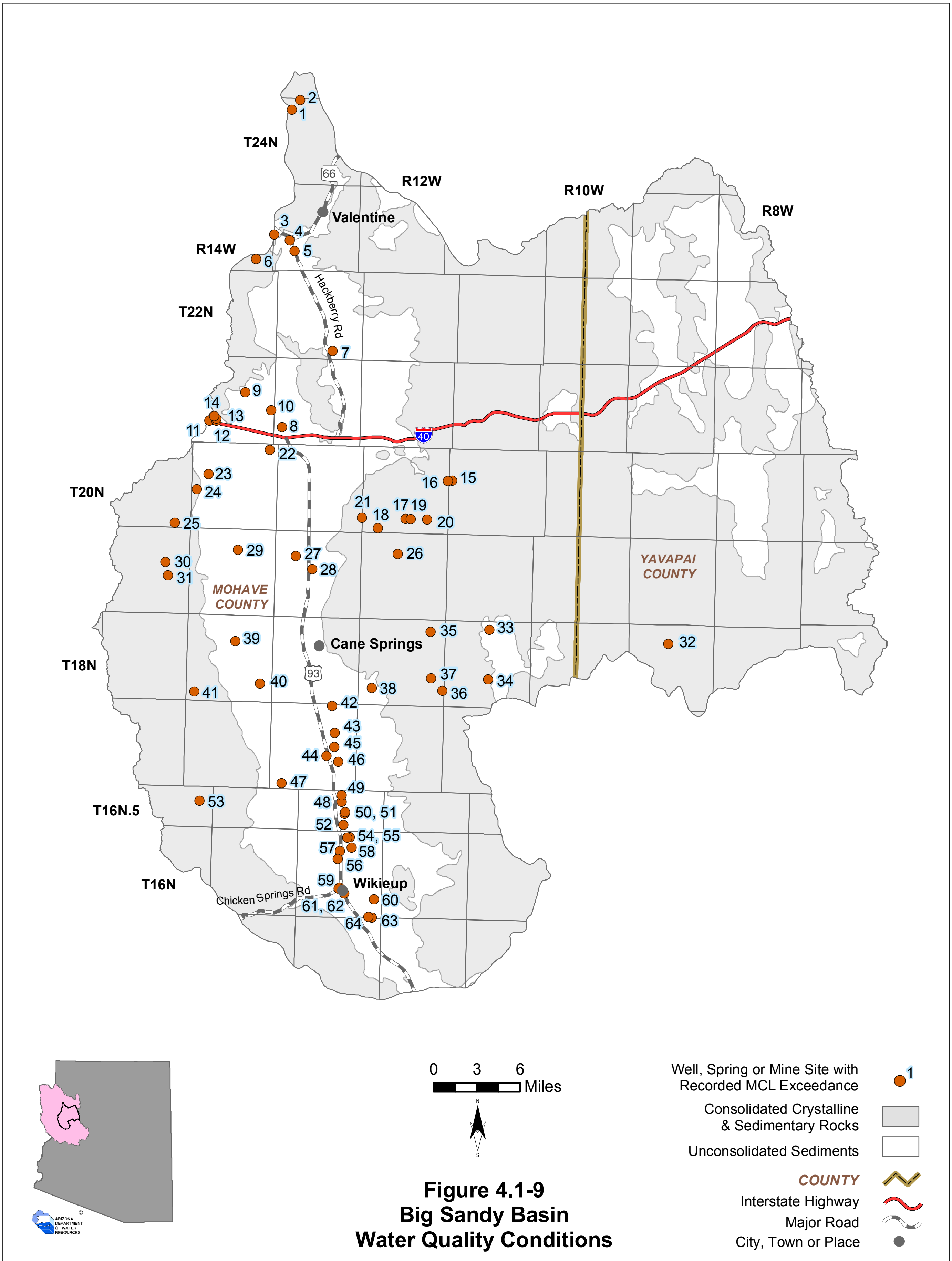


Figure 4.1-9
Big Sandy Basin
Water Quality Conditions

4.1.8 Cultural Water Demands in the Big Sandy Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 4.1-8. There are no wastewater treatment plants in this basin. Figure 4.1-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 4.0.7.

Cultural Water Demands

- Refer to Table 4.1-8 and Figure 4.1-10.
- Population in this basin is minimal but has almost tripled since 1980, increasing from 434 in 1980 to 1,178 in 2000. Projections suggest a similar rate of growth through 2050.
- Groundwater use has increased in this basin since 1971, with an average of 2,500 acre-feet pumped per year from 1971-1975 and an average of 15,600 acre-feet pumped per year from 2001-2003.
- There are no reported surface water diversions in this basin.
- There is minimal agricultural use in this basin, with less than 300 acre-feet per year from 1991-2003. Agricultural demand centers are located south of Cane Springs and south of Wikieup along Highway 93.
- Municipal groundwater demand is also minimal in this basin, with less than 300 acre-feet per year on average from 1991 to 2003. Municipal demand centers are located in the vicinity of Wikieup and north of Wikieup along Highway 93.
- There is significant industrial groundwater demand in this basin. 15,600 acre-feet per year on average from 2001-2003 was pumped and transported via pipeline to the Bagdad Mine in the Bill Williams Basin.
- As of 2003 there were 1,145 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 137 wells with a pumping capacity of more than 35 gallons per minute.

Table 4.1-8 Cultural Water Demands in the Big Sandy Basin[1]

Year	Recent (Census) and Projected (DES) Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)						Data Source
				Well Pumpage			Surface-Water Diversions			
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial[3]	Irrigation	Municipal	Industrial	Irrigation	
1971		464[2]	129[2]	2,500			NR			ADWR (1994) ADWR (2007)
1972										
1973										
1974										
1975										
1976				7,000			NR			
1977										
1978										
1979										
1980	434									
1981	445	93	3	10,000			NR			
1982	456									
1983	467									
1984	479									
1985	490									
1986	501	85	3	14,400			NR			
1987	512									
1988	523									
1989	534									
1990	546									
1991	609	100	2	<300	16,200	<300[4]	NR			USGS (2005) ADWR (2007)
1992	672									
1993	735									
1994	799									
1995	862									
1996	925	223	0	<300	16,800	<300	NR			
1997	988									
1998	1,052									
1999	1,115									
2000	1,178									
2001	1,315	116	0	<300	15,600	<300	NR			
2002	1,451									
2003	1,588									
2010	2,543									
2020	3,235									
2030	3,798									
2040	4,288									
2050	4,687									
ADDITIONAL WELLS: [5]		**64**								
WELL TOTALS:		**1,145**	**137**							

Notes:
NR = Not reported
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] Includes all wells through 1980.
[3] Groundwater withdrawn in the Big Sandy Basin is delivered to the Bill Williams Basin for industrial use at the Bagdad Mine.
[4] Agricultural water use in this basin is based on ADWR registered wells used for agricultural purposes.
[5] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 4.1-9 Effluent Generation in the Big Sandy Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf Irrigation	Wildlife Area	Discharged to Another Facility	Infiltration Basins			
No Wastewater Treatment Facilities Identified by ADWR in this Basin														

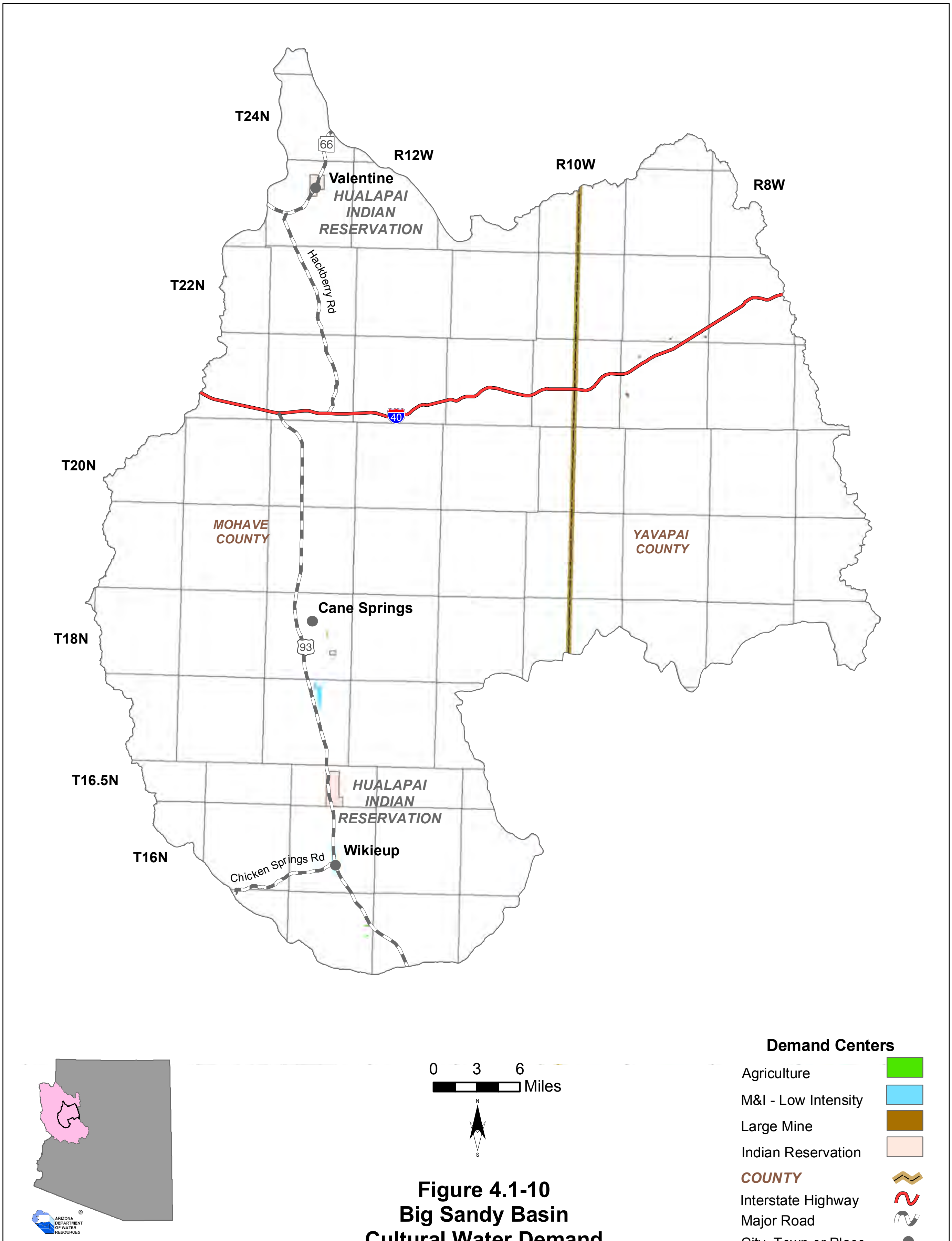


Figure 4.1-10
Big Sandy Basin
Cultural Water Demand

Primary Data Source: USGS National GAp Analysis Program, 2004

4.1.9 Water Adequacy Determinations in the Big Sandy Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 4.1-10. Figure 4.1-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

- A total of four water adequacy determinations have been made in this basin through December, 2006.
- Three determinations of inadequacy have been made; all of these determinations are in the northern portion of the basin.
- All inadequacy determinations were based on the applicant's decision not to submit necessary information and/or available hydrologic data was insufficient to make a determination.
- All lots receiving an adequacy determination are in Mohave County. 608 lots have received an inadequate determination; data on the number of lots with an adequate determination was not available to the Department.

Table 4.1-10 Adequacy Determinations in the Big Sandy Basin[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Greenwood Village # 1	Mohave	22 North	12 West	29, 30, 31, 32	214.0	22-300043	Inadequate	A1	08/23/95	Dry Lot Subdivision
2	Mountain Shadow Estates Tract 3806	Mohave	20 North	14 West	8	54.0	22-400466	Inadequate	A1	02/20/01	Subdivision wells
3	Orchards, The Tract 3800	Mohave	16 North	13 West	27	NA		Adequate		08/31/92	Dry Lot Subdivision
4	Silverado Acre Estates Unit 1, Tract 3805	Mohave	20 North	13 West	17	340.0	22-300264	Inadequate	A1	02/13/97	Dry Lot Subdivision

Notes:

[1]Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was ı
In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and p

[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.

[3] A. Physical/Continuous
1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
2) Insufficient Supply (existing water supply unreliable or physically unavaible; for groundwater, depth-to-water exceeds criteria)
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)
B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)
C. Water Quality
D. Unable to locate records
NA= Data not currently available to ADWR

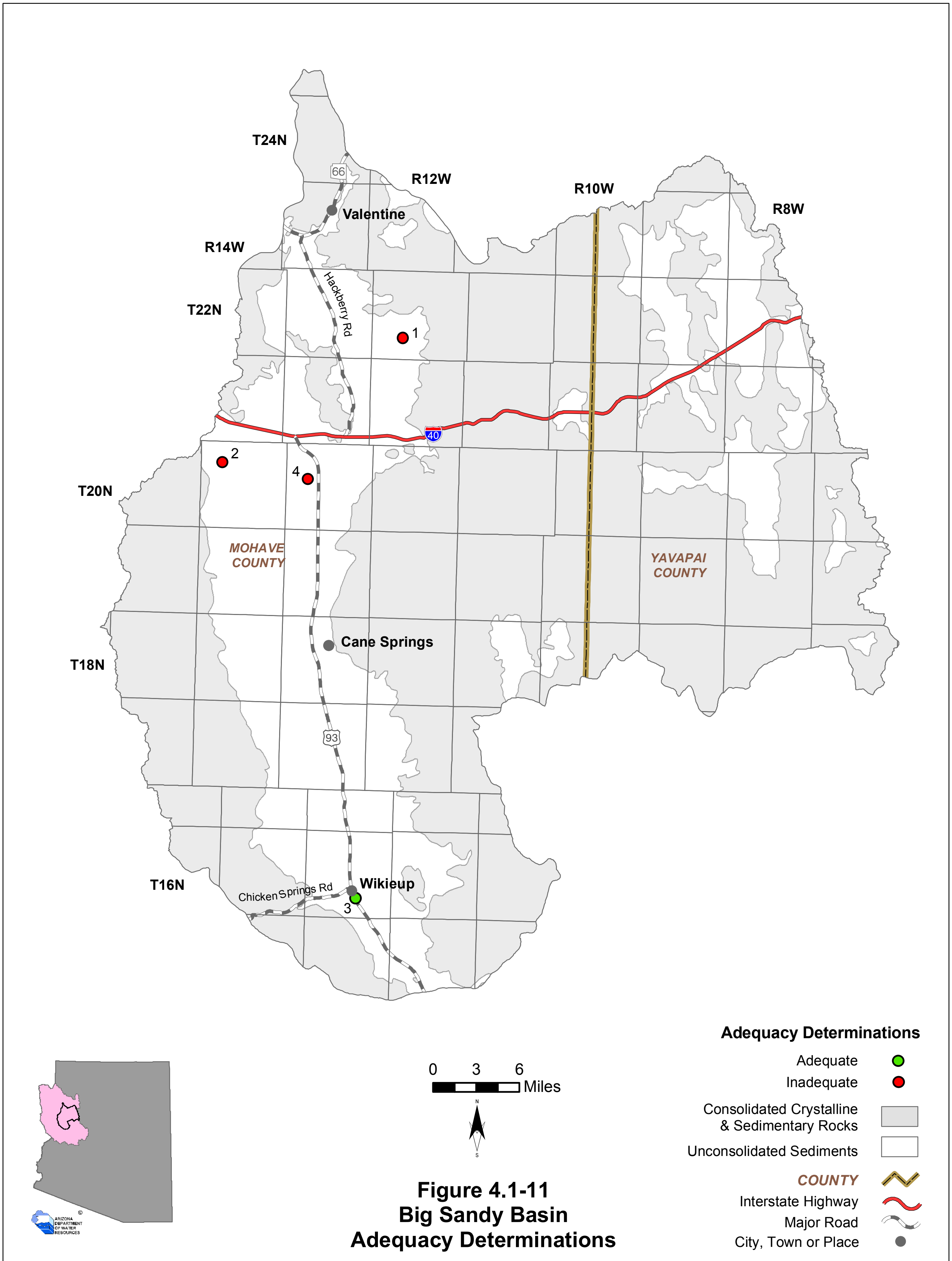


Figure 4.1-11
Big Sandy Basin
Adequacy Determinations

Big Sandy Basin

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Big Sandy Basin Index to Section 4.0

Section 4.2
Bill Williams Basin

4.2.1 Geography of the Bill Williams Basin

The Bill Williams Basin is the largest basin in the planning area at 3,350 square miles. It occupies the entire southern portion of the planning area. Geographic features and principal communities are shown on Figure 4.2-1. The basin is characterized by hilly terrain in much of the basin and by several major river drainages. There is a range of vegetation types including Sonoran and Mohave desertscrub, semi desert grassland and chaparral. Riparian vegetation is found along streams including cottonwood/willow, mesquite and tamarisk along the Bill Williams, Big Sandy and Santa Maria Rivers and mesquite, cottonwood/willow and mixed broadleaf along sections of Burro Creek

- Principal geographic features shown on Figure 4.2-1 are:
  - Principal communities of Bagdad, Kirkland, Peeples Valley and Skull Valley
  - Other communites of Yarnell, south of Peeples Valley and Wilhoit, east of Kirkland.
  - The ghost town of Swansea in La Paz County
  - Alamo Lake east of Swansea
  - A short segment of the Colorado River at the California border, with the lowest point in the basin, approximately 470 feet.
  - The Bill Williams River flowing from east to west along the La Paz County/Mohave County boundary and its major tributary, the Santa Maria River
  - Burro Creek in the north central part of the basin
  - Kirkland Creek in the southeastern part of the basin
  - Buckskin Mountains in La Paz County
  - Behm Mesa and Bozarth Mesa in the northern part of the basin
  - The Poachie Range in the middle of the Basin
  - The Black Mountains, including Tres Alamos Peak, west of highway 93 in Yavapai County
  - The Bill Williams Mountains on the western boundary of the basin
  - The highest point in the basin is Weaver Peak at 6,514 feet northwest of Peeples Valley

- Not well shown are the Mohon Mountains at the northern basin boundary

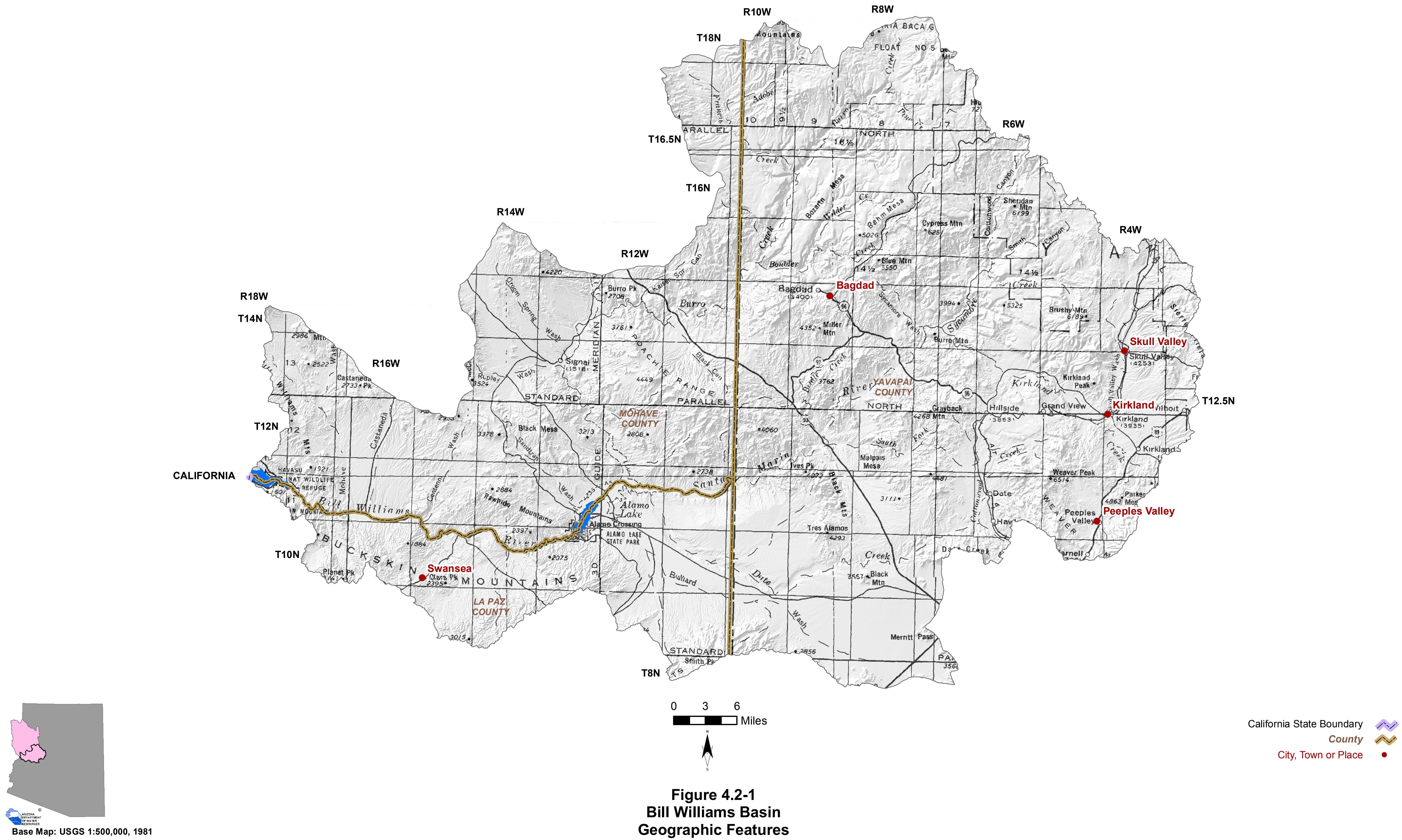


Figure 4.2-1
Bill Williams Basin
Geographic Features

4.2.2 Land Ownership in the Bill Williams Basin

Land ownership, including the percentage of ownership by category, for the Bill Williams Basin is shown in Figure 4.2-2. Principal features of land ownership in this basin are the large amounts of contiguous U.S. Bureau of Land Management and state trust lands. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

U.S. Bureau of Land Management (BLM)

- 46.1% of the land is federally owned and managed by the Lake Havasu Field Office and the Kingman Field Office of the Bureau of Land Management.
- The majority of the BLM lands are contiguous and located in the western portion of the basin.
- The basin contains six wilderness areas totaling 227,510 acres. The wilderness areas are: the 38,470-acre Rawhide Mountains Wilderness in T10N, R13W and R14W; the 16,400-acre Swansea Wilderness in T10N and T11N, R15W; the 129,800 acre Arrastra Mountain Wilderness located in Mohave, Yavapai, and La Paz counties north of Alamo Lake; the 8,300-acre Tres Alamos Wilderness in T10N and T11N, R9W; the 15,400-acre Aubrey Peak Wilderness in T12N, R15W; and the 27,440-acre Upper Burro Creek Wilderness in T15N and T16N, R10W.
- Primary land uses are recreation and grazing.

State Trust Land

- 30.5% of the land in this basin is held in trust for the public schools and five other beneficiaries under the State Trust Land system.
- The majority of the state land is contiguous and occurs in the eastern portion of the basin. Smaller portions of state land are also found interspersed with BLM land in the western portion of the basin.
- This basin contains the largest percentage of state land in the planning area.
- Primary land use is grazing.

Private

- 14.8% of the land is private.
- The majority of the private land is interspersed throughout state trust, national forest and BLM lands.
- There are a number of larger parcels of private land in the southeastern portion of the basin around the towns of Skull Valley, Kirkland Junction and Peeples Valley and along the northern basin boundary.
- Land uses include domestic, commercial, ranching and farming.

National Forest and Wilderness

- 7.6% of the land is federally owned and managed as National Forest and Wilderness.
- All forest lands in the basin are part of the Prescott National Forest.
- Most national forest land is contiguous and located along the northeastern basin boundary.

- Land uses include grazing, timber production and recreation.

U.S. Military
- 0.7% of the land is federally owned and managed by the Army Corps of Engineers for flood control. The land is also managed by the Arizona State Parks for recreation.
- All military lands are located around the boundary between La Paz County and Mohave County and include Alamo Lake.
- Primary land uses are flood control and recreation.

Wildlife Refuge
- 0.2% of the land is federally owned and managed by the U.S. Fish and Wildlife Service.
- All lands are within the Bill Williams National Wildlife Refuge located in T11N, R17W.
- Primary land uses are wildlife conservation and recreation.

Other (Game and Fish, County and Bureau of Reclamation Lands)
- 0.1% of the land is federally owned and managed by the Bureau of Reclamation.
- All lands are located in T11N, R17W adjacent to the Bill Williams National Wildlife Refuge.
- Primary land use is unknown.

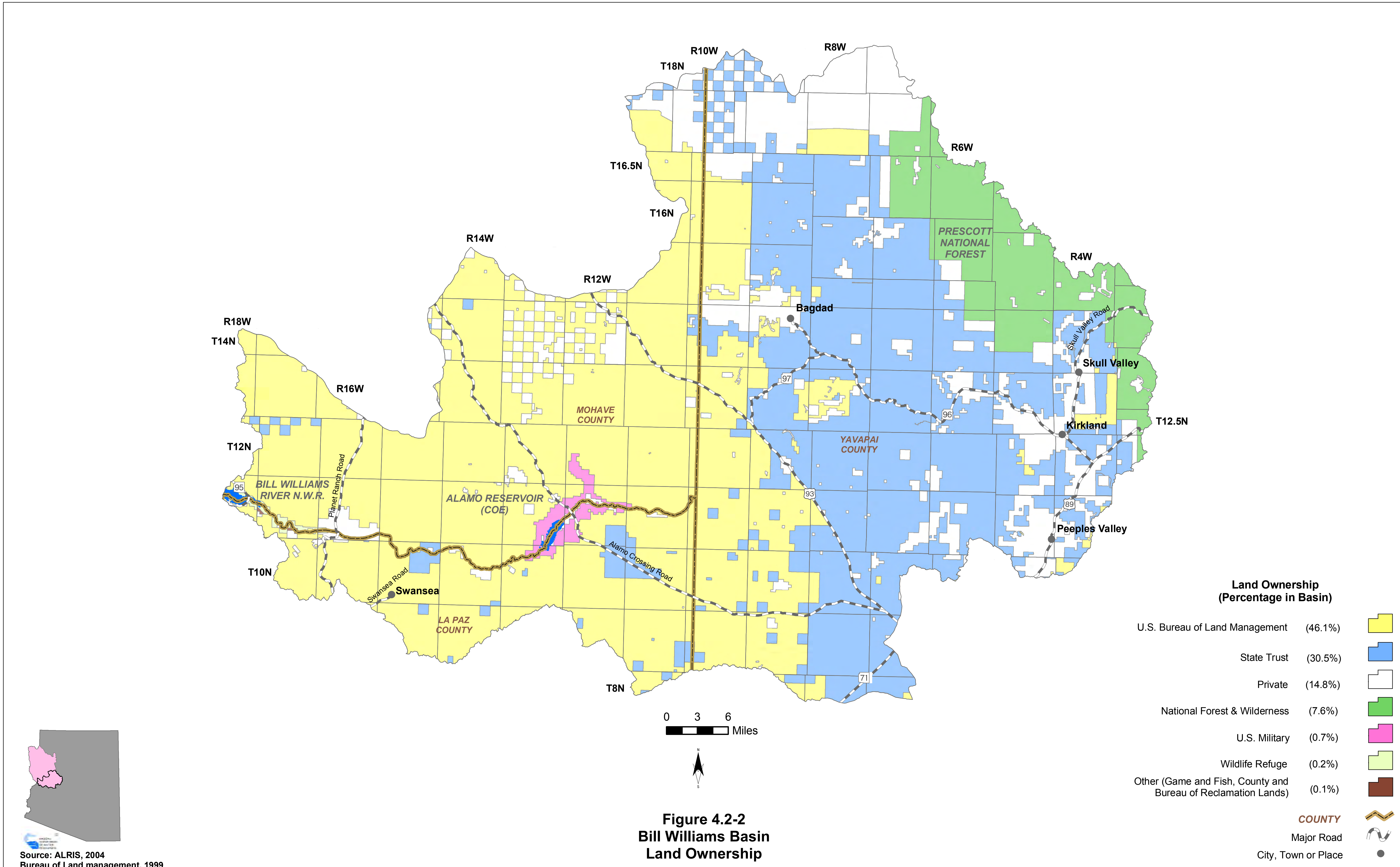


Figure 4.2-2
Bill Williams Basin
Land Ownership

4.2.3 Climate of the Bill Williams Basin

Climate data from NOAA/NWS Co-op Network stations are complied in Table 4.2-1 and the locations are shown on Figure 4.2-3. Figure 4.2-3 also shows precipitation data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Bill Williams Basin does not contain Evaporation Pan, AZMET and SNOTEL/Snowcourse stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 4.2-1A
- There are four NOAA/NWS Co-op network climate stations in the basin.
- Of the four stations, data from different periods of record may be used as shown. The variety of periods may be due to discontinued measurements, date of installation or other availability issues.
- Stations are dispersed throughout the basin.
- Station elevation ranges from 1,290 feet at Alamo Dam to 4,240 feet at Bagdad 8 NE.
- Maximum average temperatures range from 78.3°F at Hillside 4 NNE to 92.5°F at Alamo Dam.
- Minimum average temperatures range from 41.3°F at Bagdad 8 NE to 50.6°F at Alamo Dam.
- Average annual station precipitation is 8.59 inches per year at Alamo Dam and approximately 15-16 inches per year at the other three stations, with the highest precipitation at the Hillside 4 NNE station, 15.84 inches per year.
- Three of the stations report significant rainfall amounts in both the winter (January – March) and summer (July – September) seasons. One station, Bagdad 8 NE, reports the highest seasonal rainfall in the fall (October – December).
- The driest season for all stations is spring (April – June).

SCAS Precipitation Data

- See Figure 4.2-3
- Additional precipitation data shows rainfall as high as 24 inches northeast of Skull Valley approaching Granite Mountain, elevation 7,626. This is the highest average annual precipitation in the planning area. Precipitation is as low as four inches in the western portion of the basin along the Bill Williams River.
- This basin contains the largest range of average annual rainfall in the planning area with 20 inches separating areas of highest and lowest precipitation.

Table 4.2-1 Climate Data for the Bill Williams Basin

A.NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Alamo Dam	1,290	1971-2000	92.5/Jul	50.6/Dec	3.01	0.50	3.05	2.03	8.59
Bagdad	3,710	1971-2000	82.5/Jul	46.1/Jan	6.35	1.19	4.84	3.34	15.72
Bagdad 8 NE	4,240	1950-1975[1]	78.5/Jul	41.3/Jan	4.41	1.43	4.04	5.27	15.14
Hillside 4 NNE	3,320	1971-2000	78.3/Jul	42.4/Dec, Jan	5.92	1.35	5.04	3.53	15.84

Source: WRCC, 2003.

Notes:
[1]Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

Source: WRCC, 2003.

C. AZMET:

Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (*number of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content					
			Jan	Feb	March	April	May	June
None								

Source: Natural Resources Conservation Service, 2005

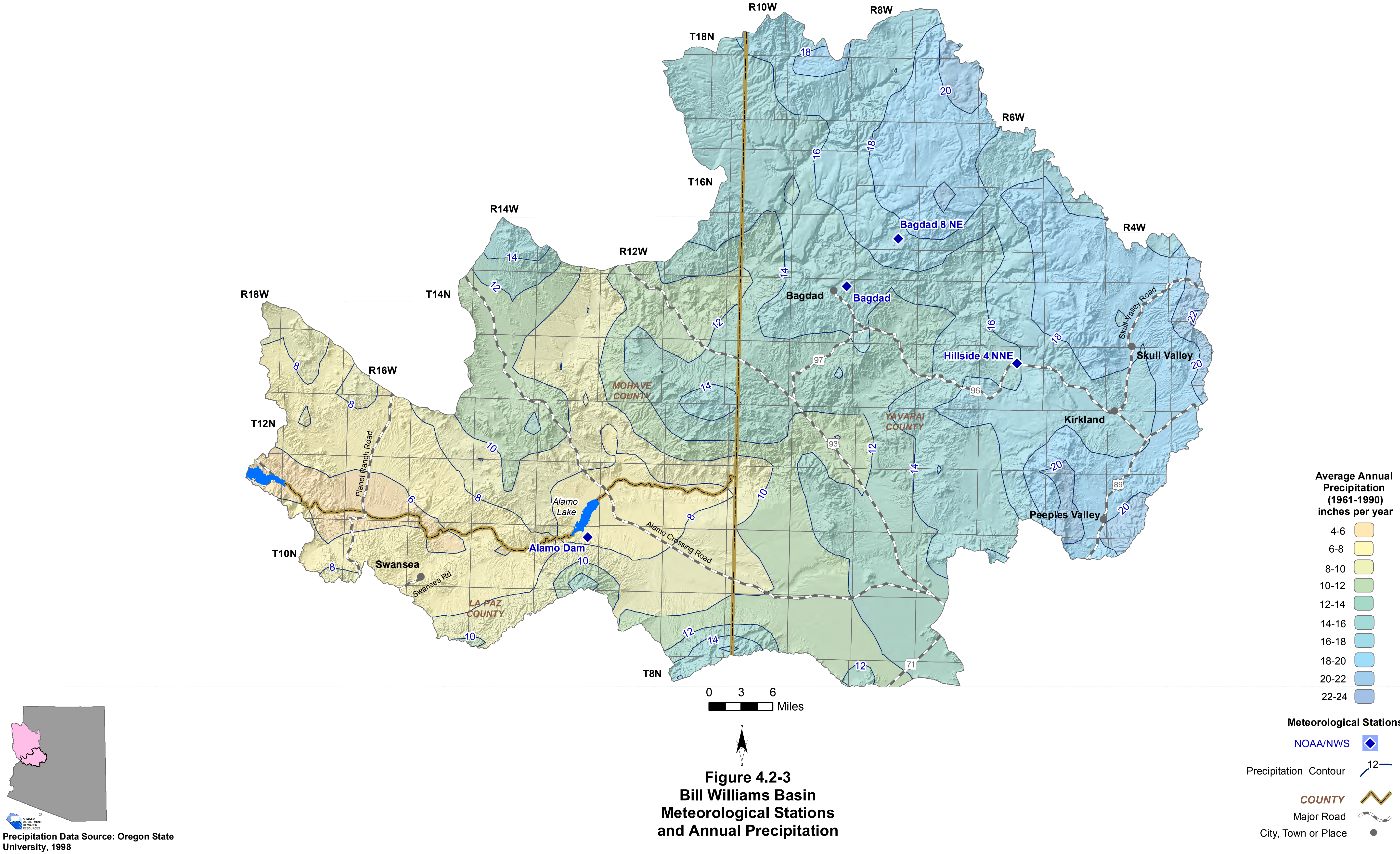


Figure 4.2-3
Bill Williams Basin
Meteorological Stations
and Annual Precipitation

4.2.4 Surface Water Conditions in the Bill Williams Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 4.2-2. Flood ALERT equipment in the basin is shown in Table 4.2-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.2-4. The location of streamflow gages, using the USGS number, is shown on Figure 4.2-4. The location of large reservoirs and flood ALERT equipment as well as USGS runoff contours are also shown on Figure 4.2-4. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Streamflow Data

- Refer to Table 4.2-2.
- Data from ten stations, including five discontinued stations, are shown in the table and on Figure 4.2-4.
- These stations are located on Francis Creek, Burro Creek, Big Sandy River, Kirkland Creek, Santa Maria River, Date Creek and Bill Williams River.
- The average seasonal flow for all stations is highest in the winter (January-March) when between 54% and 90% of the annual average seasonal flow occurs. The average seasonal flow is lowest for two stations in the spring (April-June), three stations in the summer (July-September) and five stations in the fall (October-December).
- Maximum annual flow in this basin was 701,711 acre-feet in 1993 at the Bill Williams station below Alamo Dam. Minimum annual flow was 0 acre-feet in 1942 at the Date Creek station.

Flood ALERT Equipment

- Refer to Table 4.2-3.
- As of October 2005 there were four stations in the basin, all but one station is in Yavapai County.
- Of the four stations three are precipitation only stations and one is a repeater/precipitation station.

Reservoirs and Stockponds

- Refer to Table 4.2-4.
- The basin contains one large reservoir, Alamo Lake, with a maximum capacity of 1,409,000 acre-feet although normal capacity is less than 500 acre-feet. Alamo Lake is operated by the U.S. Army Corps of Engineers for flood control and recreation.
- Surface water is stored or could be stored in 19 small reservoirs in the basin.
- Total maximum storage for the three small reservoirs with greater than 15 acre-feet and less than 500 acre-feet is 504 acre-feet. The remaining 16 reservoirs have a total surface area of 203 acres.
- There are an estimated 796 stockponds in this basin.

Runoff Contour

- Refer to Figure 4.2-4.
- Average annual runoff is one inch per year in the center of the basin around Bagdad and decreases to 0.1 inches in the southwestern portion of the basin.

Table 4.2-2 Streamflow Data for the Bill Williams Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9424432	Francis Creek near Bagdad	134.0	NA	12/1984-9/1993 (discontinued)	90	4	4	3	1,571 (1989)	6,918	7,145	13,176 (1992)	4
9424447	Burro Creek at Old US 93 Bridge near Bagdad	601.0	NA	7/1980-current	80	3	7	11	3,410 (1989)	47,638	49,750	155,655 (1983)	12
9424450	Big Sandy River near Wikieup	2,731.9	4,490	3/1966-current	80	5	4	10	2,448 (2002)	27,011	58,901	421,461 (1993)	36
9424470	Kirkland Creek near Kirkland	109.0	4,665	4/1973-3/1983 (discontinued)	68	8	9	15	1,614 (1975)	6,451	7,961	20,489 (1980)	9
9424900	Santa Maria River near Bagdad	1,129.0	4,010	4/1966-current	74	6	5	15	0 (1996, 2002)	15,063	40,551	168,005 (1980)	32
9425000	Date Creek near Congress	127.0	NA	10/1939-9/1943 (discontinued)	60	38	2	0	0 (1942)	2	2,559	7,674 (1941)	3
9425500	Santa Maria River near Alamo	1,439.0	3,650	12/1939-4/1966 (discontinued)	48	18	17	18	1,637 (1956)	10,211	24,878	184,661 (1941)	26
9426000	Bill Williams below Alamo Dam	4,623.0	4,120	10/1939-current	54	16	16	14	1,275 (1975)	33,963	82,317	701,711 (1993)	63
9426500	Bill Williams River at Planet	5,043.9	3,900	10/1914-9/1946 (discontinued)	64	9	21	6	11,876 (1933)	68,506	115,312	399,012 (1941)	17
9426620	Bill Williams River near Parker	5,327.0	NA	10/1988-current	78	14	5	3	645 (1990)	4,421	69,097	626,398 (1993)	14

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Notes:
Statistics based on Calendar Year
Annual Flow statistics based on monthly values
Summation of Average Annual Flows may not equal 100 due to rounding.
Period of record may not equal Year of Record used for annual Flow/Year statistics due to only using years with a 12 month record

Table 4.2-3 Flood ALERT Equipment in the Bill Williams Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
5365	Wilhoit	Precipitation	7/24/1981	Maricopa County FCD
7145	Wood Tank	Precipitation	11/20/2002	Maricopa County FCD
7150	Joshua Tree	Precipitation	3/5/2002	Maricopa County FCD
7460	Aubrey Peak Repeater	Repeater/Precipitation	NA	Mohave County FCD

Notes:
FCD = Flood Control District
NA = Information is not available to ADWR at this time

Table 4.2-4 Reservoirs and Stockponds in the Bill Williams Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE[1]	JURISDICTION
1	Alamo	Army Corps of Engineers	1,409,000[2]	C, R	Federal

Source: US Army Corps of Engineers, 2005

B. Other Large Reservoirs (50 acre surface area or greater)[3]

MAP KEY	RESERVOIR/LAKE NAME (Name of dam if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE	JURISDICTION
None identified by ADWR at this time					

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 3
Total maximum storage: 504 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)[3]

Total number: 16
Total surface area: 203 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 796 (from water right filings)

Notes:
[1]C=flood control; R=recreation
[2]Normal capacity < 500 acre-feet
[3]Capacity data not available to ADWR

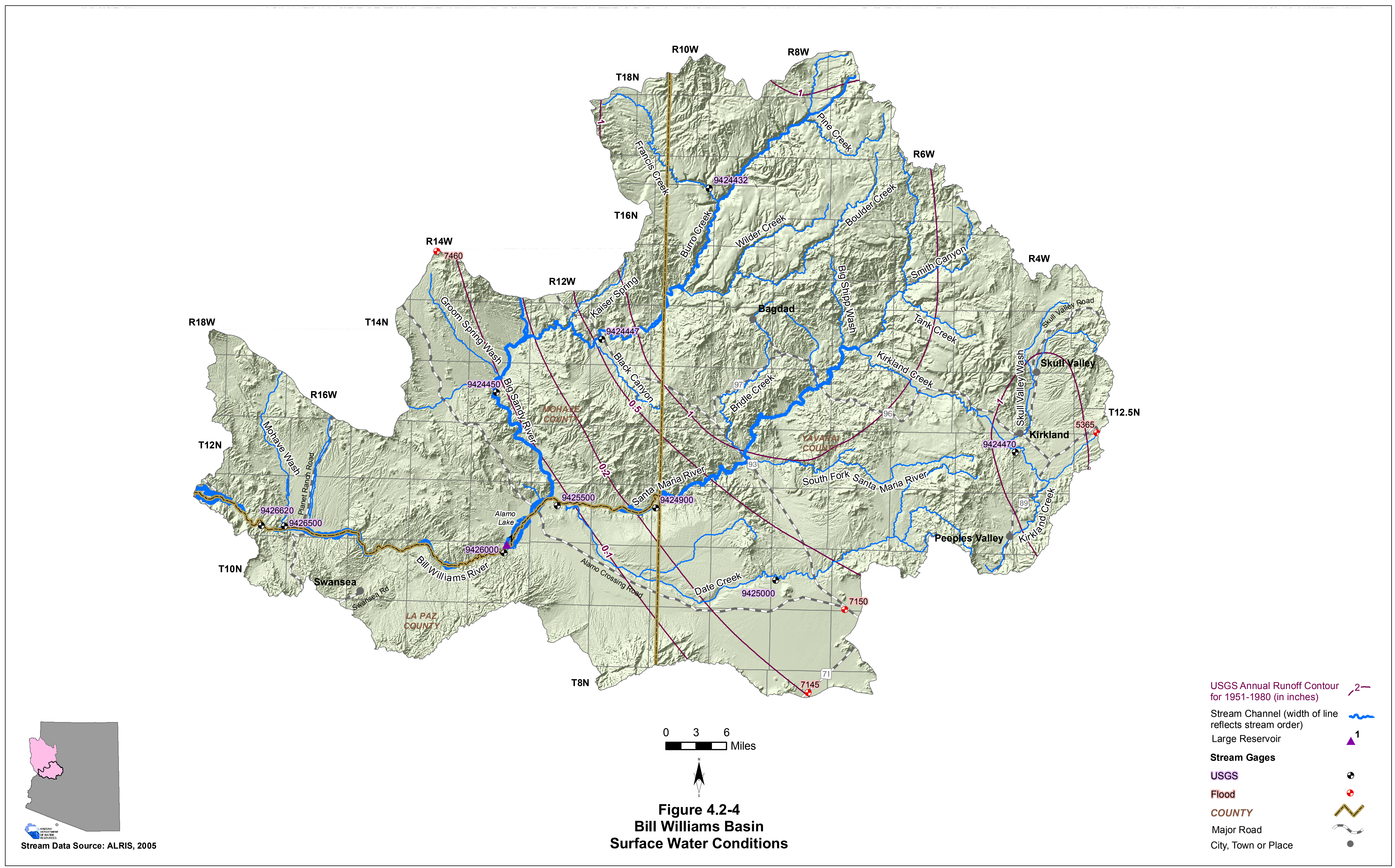


Figure 4.2-4
Bill Williams Basin
Surface Water Conditions

4.2.5 Perennial/Intermittent Streams and Major Springs in the Bill Williams Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 4.2-5. The locations of major springs as well as perennial and intermittent streams are shown on Figure 4.2-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- There are numerous perennial streams located throughout the basin.
- Numerous intermittent streams are also located throughout the basin with the largest concentration of intermittent streams in the northeastern portion of the basin.
- Significant perennial reaches include sections of the Bill Williams River, Santa Maria River, Big Sandy River and Burro Creek. All of these waterways also have reaches that are intermittent.
- There are six major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time.
- Listed discharge rates may not be indicative of current conditions. All of the measurements were taken on or before 1980.
- Major springs are found in the eastern and north central areas of the basin. The greatest discharge rate was measured near Peeples Valley (Genung, 228 gpm).
- All but one of the major springs discharge 200 gpm or less.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 4.2-5B. There are 13 minor springs identified in this basin.
- The total number of springs identified by the USGS varies from 249 to 303, depending on the database reference.

Table 4.2-5 Springs in the Bill Williams Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Genung	341631	1124245	228	6/18/1946
2	Copper Basin	342545	1124017	200	11/6/1974
3	Kaiser Hot	343348	1132946	40	8/20/1980
4	Buckman Flat	343616	1123631	36	8/9/1979
5	Unnamed	343615	1123630	27	8/9/1979
6	Unnamed[2]	343725	1134226	18	5/9/1979

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Wood	343650	1124658	9	9/19/1979
Unnamed	343440	1124232	8	3/4/1982
Iron	343504	1123425	6	8/9/1979
Signal	342817	1133807	4	12/13/1979
Quail	341714	1130007	4	9/7/1979
Unnamed	341720	1132313	3	6/8/1979
Unnamed	342641	1124017	3	3/16/1979
Unnamed	341429	1125300	2	3/16/1979
Unnamed	342647	1124133	2	3/10/1981
Lawler	342405	1125758	1	10/18/1979
Bonita	343437	1134158	1	5/9/1979
Little Santa Cruez	343448	1134230	1	5/9/1979
Unnamed	342653	1124132	1	4/17/1973

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and USGS, 2006): 249 to 303

Notes:
[1]Most recent measurement identified by ADWR
[2]Spring is not displayed on current USGS topo maps

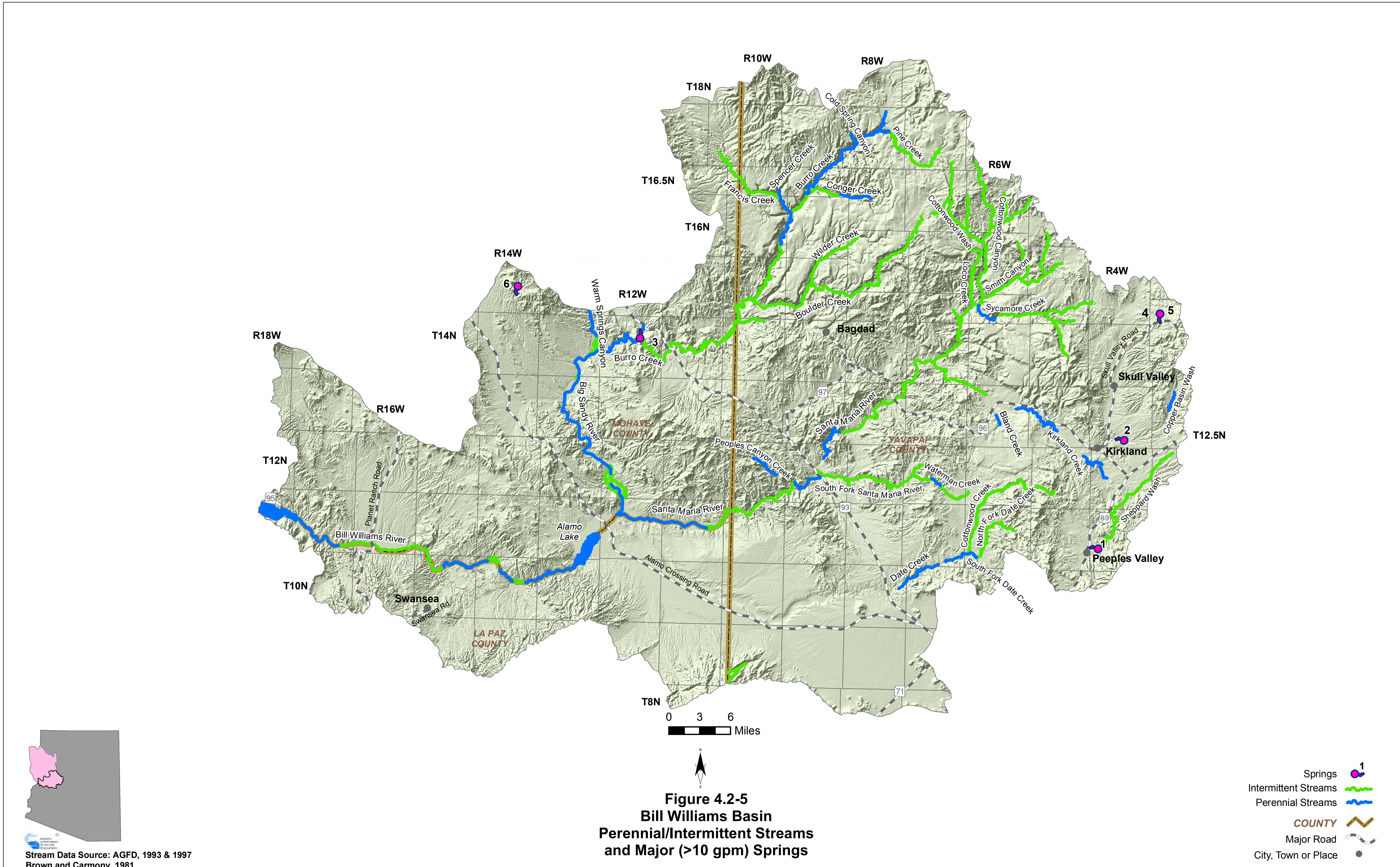


Figure 4.2-5
Bill Williams Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

4.2.6 Groundwater Conditions of the Bill Williams Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 4.2-6. Figure 4.2-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 4.2-7 contains hydrographs for selected wells shown on Figure 4.2-6. Figure 4.2-8 shows well yields in five yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields, is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 4.2-6 and Figure 4.2-6.
- Major aquifers in the basin include recent stream alluvium, basin fill and volcanic rock.
- This basin contains five sub-basins, Clara Peak in the west, Alamo Reservoir in the center of the basin, Burro Creek in the northeast, Santa Maria in the central east and Skull Valley in the east.
- In general the principal water-bearing aquifer is the basin fill, however, the recent stream alluvium is the main water-bearing aquifer in the Peeples Valley area, Skull Valley sub-basin.
- Flow direction is generally from east to west.

Well Yields

- Refer to Table 4.2-6 and Figure 4.2-8.
- As shown on Figure 4.2-8 well yields in this basin range from less than 100 gallons per minute (gpm) to greater than 2,000 gpm.
- One source of well yield information, based on 195 reported wells, indicates that the median well yield in this basin is 280 gpm.
- Well yields vary throughout the basin with the majority of the highest well yields, greater than 2,000 gpm, occurring in the western portion of the basin along the Bill Williams River.

Natural Recharge

- Refer to Table 4.2-6.
- The estimate of natural recharge for this basin is 32,000 acre-feet per year.

Water in Storage

- Refer to Table 4.2-6.
- There are three storage estimates for this basin, ranging from 10 million acre-feet to 23 million acre-feet. The most recent estimate, from a 1990 ADWR study, indicates the basin has 23 million acre-feet in storage to a depth of 1,200 feet.
- The predevelopment storage estimate is 10 million acre-feet to a depth of 1,200 feet.

Water Level

- Refer to Figure 4.2-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures 21 index wells in this basin.
- In 1979, the year of the last water level sweep, 117 wells were measured.
- The deepest recorded water level in the basin is 641 feet in La Paz County east of the Yavapai County line and the shallowest is five feet north of Peeples Valley. This is the shallowest recorded water level in the planning area.
- Hydrographs corresponding to selected wells shown on Figure 4.2-6 but covering a longer time period are shown in Figure 4.2-7.

Table 4.2-6 Groundwater Data for the Bill Williams Basin

Basin Area, in square miles:	3,350	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Recent Stream Alluvium	
	Basin Fill	
	Volcanic Rock	
Well Yields, in gal/min:	Range 1.3-440 Median 2 (3 wells measured)	Measured by ADWR and/or USGS
	Range 5-5,000 Median 280 (195 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 10-4,000	ADWR (1990 and 1994)
	Range 0-500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	32,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	23,000,000 (to 1,200 ft)	ADWR (1990)
	10,000,000[1] (to 1,200 ft)	Freethey and Anderson (1986)
	20,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
Current Number of Index Wells:	21	
Date of Last Water-level Sweep:	1979 (117 wells measured)	

Notes:
[1]Predevelopment Estimate

Figure 4.2-6
Bill Williams Basin
Groundwater Conditions

Figure 4.2-7
Bill Williams Basin
Hydrographs Showing Depth to Water in Selected Wells

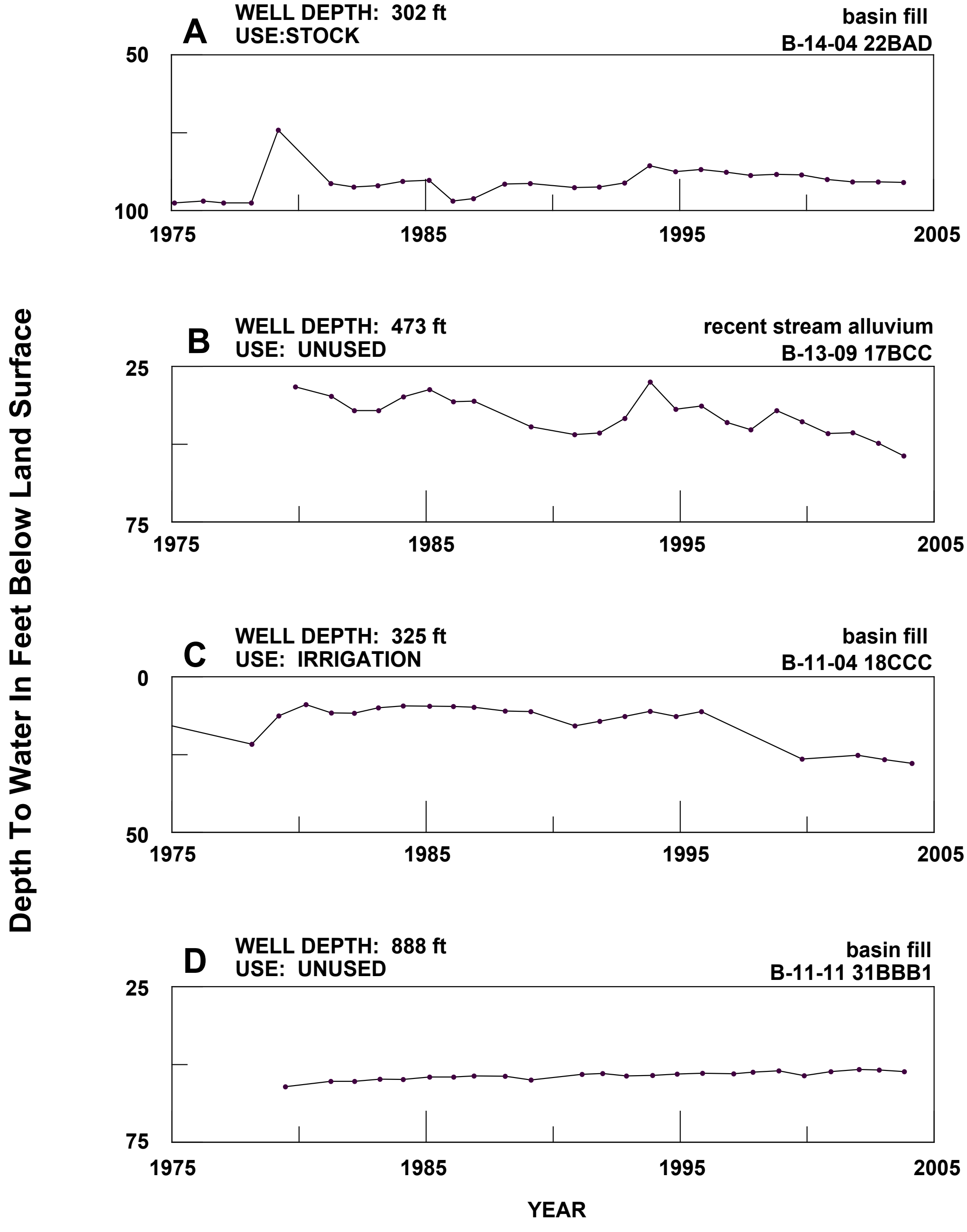
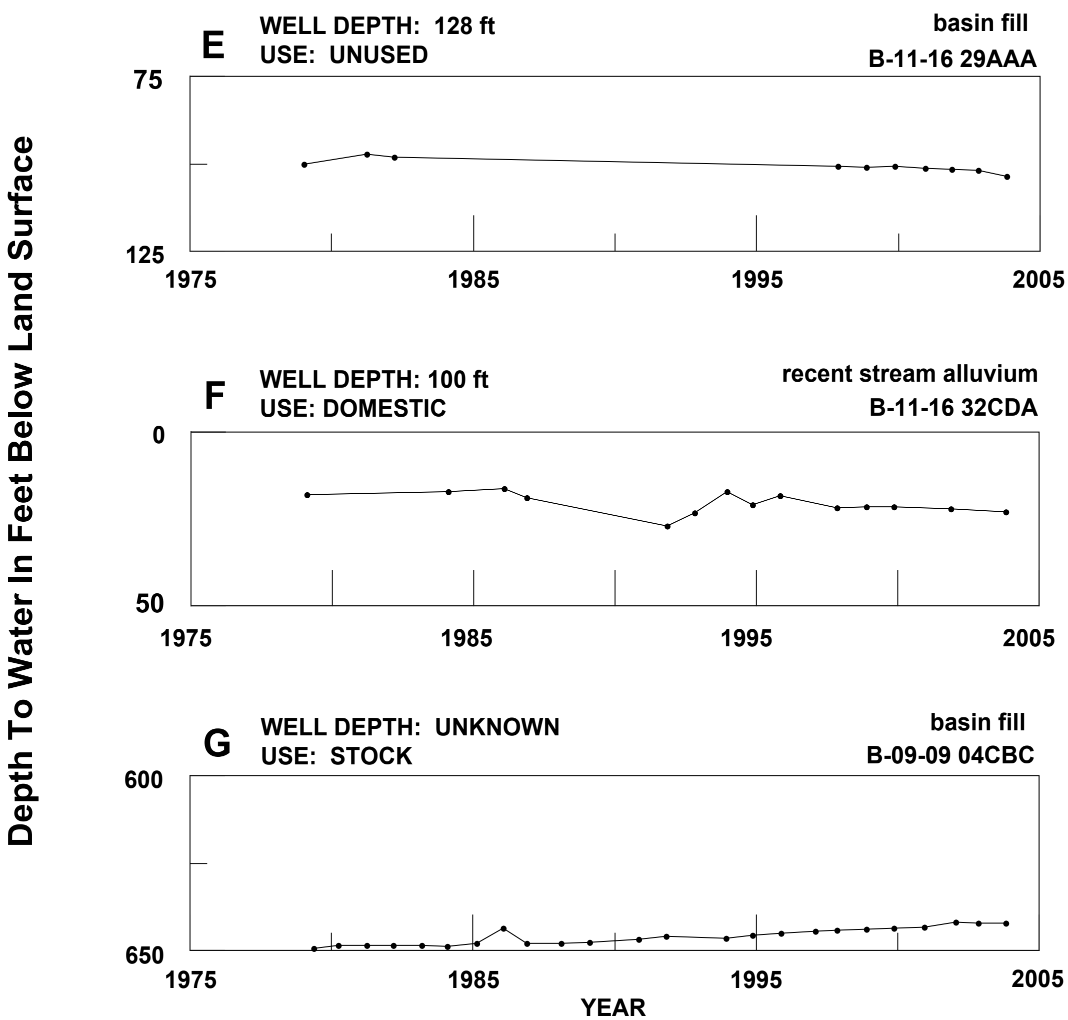


Figure 4.2-7 (Con't.)
Bill Williams Basin
Hydrographs Showing Depth to Water in Selected Wells



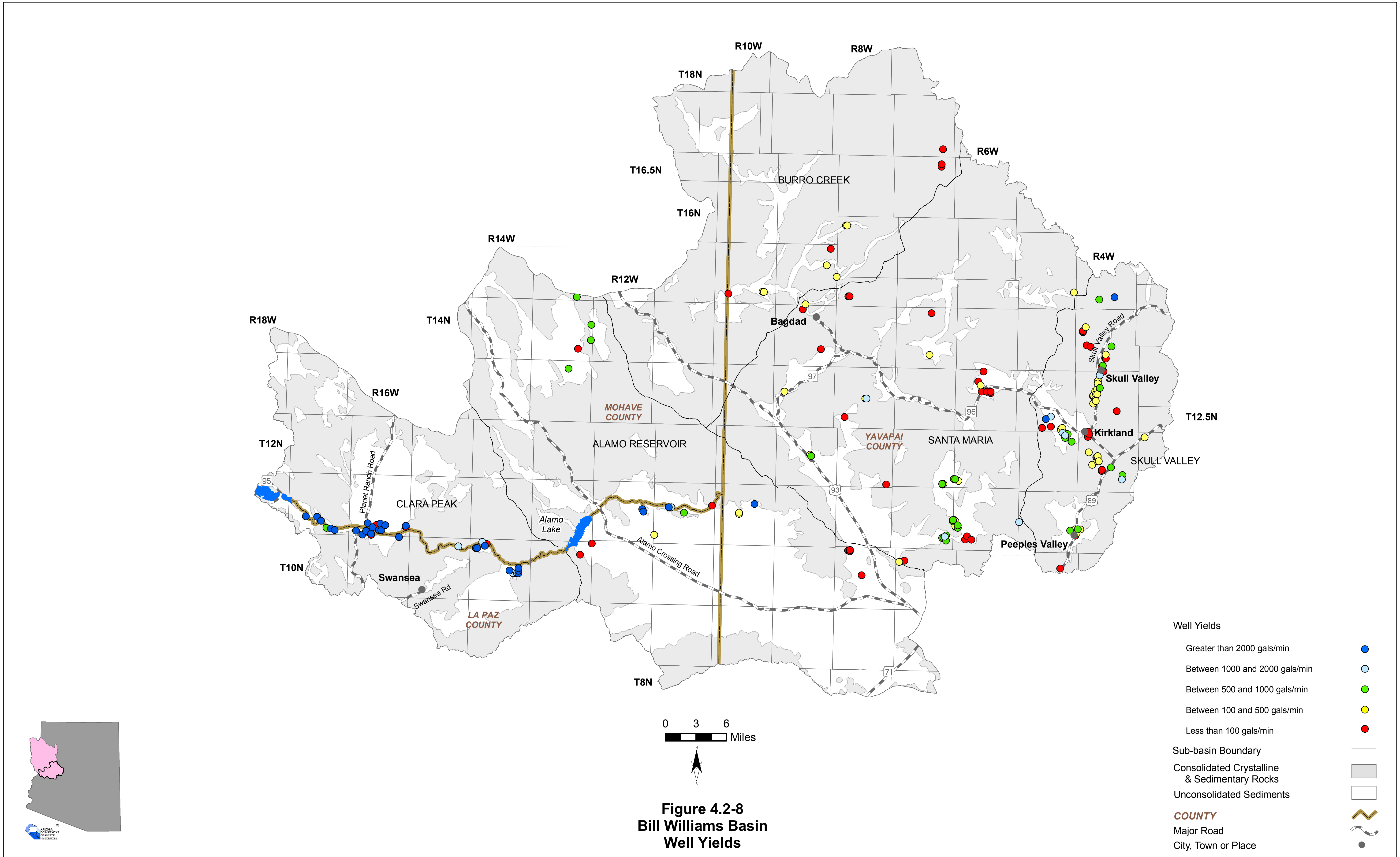


Figure 4.2-8
Bill Williams Basin
Well Yields

4.2.7 Water Quality of the Bill Williams Basin

Drinking water standard exceedences in wells, springs and mine sites including location and parameter(s) exceeded are shown in Table 4.2-7A. Impaired lakes and streams with site type, name, length of impaired stream reach, area of impaired lake, designated use standard and parameter(s) exceeded is shown in Table 4.2-7B. Figure 4.2-9 shows the location of exceedences and impairment keyed to Table 4.2-7. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mine Sites

- Refer to Table 4.2-7A.
- Drinking water standard exceedences in wells and springs have been reported for 60 sites in the basin.
- The drinking water standards for fluoride and arsenic were the most frequently exceeded standards at sites in this basin.
- The largest cluster of fluoride exceedences is north of Highway 96.
- Arsenic exceedences are scattered throughout the basin.
- Other drinking water standards exceeded in this basin include cadmium, copper, lead, nitrate/nitrite, total dissolved solids and radionuclides.

Lakes and Streams

- Refer to Table 4.2-7B.
- Water quality standards were exceeded in two reaches of Boulder Creek, one reach of Burro Creek, Alamo Lake and Coors Lake.
- The mercury drinking water standard was exceeded in every impaired stream or lake. Other parameters exceeded in Alamo Lake include ammonia and pH levels. Arsenic, copper and zinc were exceeded in Boulder Creek
- The longest impaired reach was 17 miles of Boulder Creek.
- Boulder Creek and Alamo Lake are part of the ADEQ water quality improvement effort called the Total Maximum Daily Load (TMDL) program. The final TMDL report has been completed for Boulder Creek and an implementation plan is underway. Modeling is complete for Alamo Lake and ADEQ is drafting the TMDL document.
- Burro Creek and Coors Lake are not part of the TMDL program at this time.

Table 4.2-7 Water Quality Exceedences in the Bill Williams Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Exceeding Drinking Water Standard[2]
		Township	Range	Section	
1	Well	17 North	11 West	13	As
2	Well	17 North	11 West	25	As
3	Spring	16 North	5 West	32	As, Cd
4	Spring	15 North	6 West	25	As, Cd
5	Well	15 North	8 West	27	NO3, Rad
6	Well	15 North	10 West	26	As
7	Well	15 North	11 West	21	As
8	Well	15 North	14 West	20	As, Rad
9	Well	14.5 North	8 West	29	As
10	Well	14.5 North	8 West	29	As
11	Spring	14 North	4 West	30	As
12	Well	14 North	6 West	8	F
13	Well	14 North	6 West	16	F
14	Well	14 North	6 West	31	F
15	Spring	14 North	7 West	25	F
16	Well	14 North	7 West	25	F
17	Spring	14 North	7 West	25	F
18	Well	14 North	7 West	27	F
19	Spring	14 North	8 West	23	As
20	Spring	14 North	8 West	23	As, F, Rad
21	Well	14 North	8 West	34	F
22	Well	14 North	9 West	13	As
23	Well	14 North	9 West	16	NO3, Rad
24	Well	14 North	10 West	32	Rad
25	Well	14 North	12 West	30	As
26	Well	14 North	13 West	13	Pb, Rad
27	Well	14 North	15 West	13	F
28	Well	13 North	3 West	18	As, Cd
29	Well	13 North	4 West	9	Rad
30	Well	13 North	5 West	22	F
31	Well	13 North	5 West	25	Rad
32	Spring	13 North	6 West	2	As, Cd
33	Well	13 North	6 West	16	As
34	Well	13 North	6 West	16	F
35	Well	13 North	7 West	18	Rad
36	Well	13 North	7 West	21	F
37	Well	13 North	7 West	21	F
38	Spring	13 North	8 West	35	Rad
39	Well	13 North	10 West	16	As, Rad
40	Spring	13 North	11 West	14	As
41	Well	13 North	13 West	3	F
42	Well	13 North	13 West	3	F
43	Spring	13 North	13 West	17	F
44	Well	12.5 North	3 West	32	As
45	Well	12.5 North	3 West	33	NO3
46	Well	12 North	3 West	18	As
47	Well	12 North	4 West	6	Rad
48	Well	12 North	6 West	33	As
49	Spring	12 North	9 West	5	As
50	Well	12 North	9 West	22	F
51	Spring	12 North	9 West	26	As
52	Well	12 North	13 West	8	As
53	Well	11 North	4 West	7	As
54	Well	11 North	4 West	15	NO3

Table 4.2-7 Water Quality Exceedences in the Bill Williams Basin (cont'd)[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Exceeding Drinking Water Standard[2]
		Township	Range	Section	
55	Well	11 North	18 West	14	As
56	Well	11 North	18 West	15	Cd, F, Pb, NO3, TDS
57	Well	11 North	18 West	15	Cd, F, Pb, NO3, TDS
58	Well	11 North	18 West	15	Cd, F, Hg
59	Well	10 North	13 West	11	F
60	Well	10 North	14 West	14	F

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard[3]	Parameter(s) Exceeding Use Standard[2]
a	Lake	Alamo Lake	NA	1,414	A&W, FC, FBC, AgL	NH3, pH, Hg
b	Stream	Boulder Creek (unnamed wash latitude 344114, longitude 1130304 to Wilder Creek)	14	NA	A&W	Hg
c	Stream	Boulder Creek (Wilder Creek to Copper Creek)	3	NA	A&W, FBC, AgL	As, Cu, Hg, Zn
d	Stream	Burro Creek (Boulder Creek to Black Canyon)	17	NA	A&W	Hg
e	Lake	Coors Lake	NA	229	FC	Hg

Notes:

[1] Most water quality samples collected between 1979 and 2003.

[2] NH3 = Ammonia
As = Arsenic
Cd = Cadmium
Cu = Copper
F= Fluoride
Pb = Lead
pH = Measurement of acidity or alkalinity
Hg = Mercury
NO3 = Nitrate/Nitrite
TDS = Total Dissolved Solids
Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium
Zn = Zinc

[3] A&W = Aquatic and Wildlife
AgL = Agricultural Livestock Watering
FBC = Full Body Contact
FC = Fish Consumption

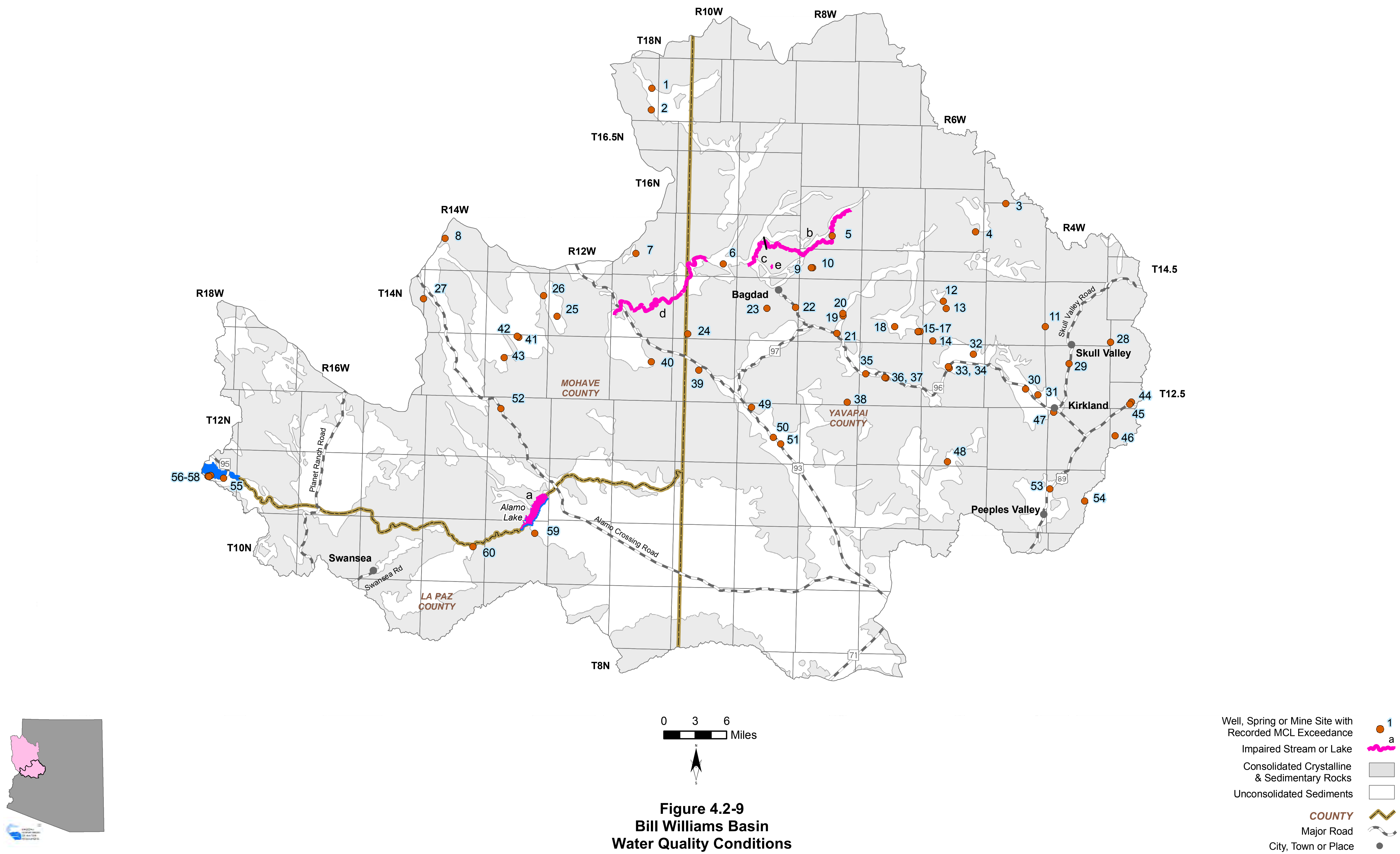


Figure 4.2-9
Bill Williams Basin
Water Quality Conditions

4.2.8 Cultural Water Demands in the Bill Williams Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 4.2-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown on Table 4.2-9. Figure 4.2-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 4.0.7.

Cultural Water Demands

- Refer to Table 4.2-8 and Figure 4.2-10.
- Population in this basin has decreased slightly since 1980, from 5,532 in 1980 to 4,691 in 2000. Projections suggest a small increase in growth through 2050.
- Groundwater use has decreased in this basin since 1971, with an average of 18,000 acre-feet per year from 1971-1975 and an average of 3,880 acre-feet pumped per year from 2001-2003.
- There is a small amount of surface water diverted for municipal use in the Town of Bagdad, 500 acre-feet per year on average from 1991 to 2003. Some of this water demand may include industrial demand at the Bagdad Mine.
- Municipal groundwater demand is minimal, between 500 and 600 acre-feet per year on average from 1991 to 2003.
- Principal municipal demand centers are located in the vicinity of Peeples Valley, Kirkland and Bagdad.
- Although there is one large mine, the Bagdad Mine, and a number of small mines or quarries in the basin, industrial demand is minimal because the Bagdad Mine receives water from the Big Sandy Basin via pipeline.
- The primary water demand in this basin is agricultural. This demand has declined substantially from approximately 18,000 acre-feet per year on average in 1971 to 3,000 acre-feet per year on average in 2003. The majority of the agricultural demand is located in the eastern portion of the basin around Skull Valley, Kirkland and Peeples Valley.
- As of 2003 there were 1,565 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 243 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 4.2-9.
- There is one treatment facility in this basin, the Bagdad Sewer System, which serves the Town of Bagdad.
- The population served by the Bagdad facility is 1,500. Information on effluent generation was not available.
- Treated effluent is used for industrial purposes.

Table 4.2-8: Cultural Water Demands in the Bill Williams Basin[1]

Year	Recent (Census) and Projected (DES) Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)						Data Source
				Well Pumpage			Surface-Water Diversions[2]			
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial[3]	Irrigation	Municipal	Industrial	Irrigation	
1971										
1972										
1973				18,000			700			
1974										
1975										
1976		1,041[4]	206[4]							
1977										
1978				18,000			800			
1979										
1980	5,532									ADWR (1994) ADWR (2007)
1981	5,393									
1982	5,253									
1983	5,114	115	12	18,000			600			
1984	4,974									
1985	4,835									
1986	4,695									
1987	4,556									
1988	4,416	86	9	22,000			500			
1989	4,277									
1990	4,138									
1991	4,193									
1992	4,248									
1993	4,304	111	13	500	<300	15,600	500	NR	NR	
1994	4,359									
1995	4,414									
1996	4,470									USGS (2005) ADWR (2007) Malcom Pirnie (2006)
1997	4,525									
1998	4,580	135	3	500	<300	4,200	500	NR	NR	
1999	4,636									
2000	4,691									
2001	4,692									
2002	4,694	36	0	600	<300	3,200	500	NR	NR	
2003	4,695									
2010	4,705									
2020	4,714									
2030	4,724									
2040	4,733									
2050	4,738									
ADDITIONAL WELLS:[5]		**41**								
WELL TOTALS:		**1,565**	**243**							

Notes:
NR = Not reported
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] The 1994 ADWR Arizona Water Resources Assessment included surface water diversions for this basin for the Bill Williams National Wildlife Refuge. Surface water diversions in this basin are for the Town of Bagdad and based on available data from Phelps Dodge. Municipal water demand listed here may also be for industrial use at the mine.
[3] Groundwater withdrawn in the Big Sandy Basin is delivered to the Bill Williams Basin for industrial use at the Bagdad Mine. These withdrawals are not included in this table.
[4] Includes all wells through 1980.
[5] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 4.2-9 Effluent Generation in the Bill Williams Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf Irrigation	Wildlife Area	Discharged to Another Facility	Infiltration Basins			
Bagdad Sewer System	PDBI	Bagdad	1500	NA	Used for Industrial purposes							NA		

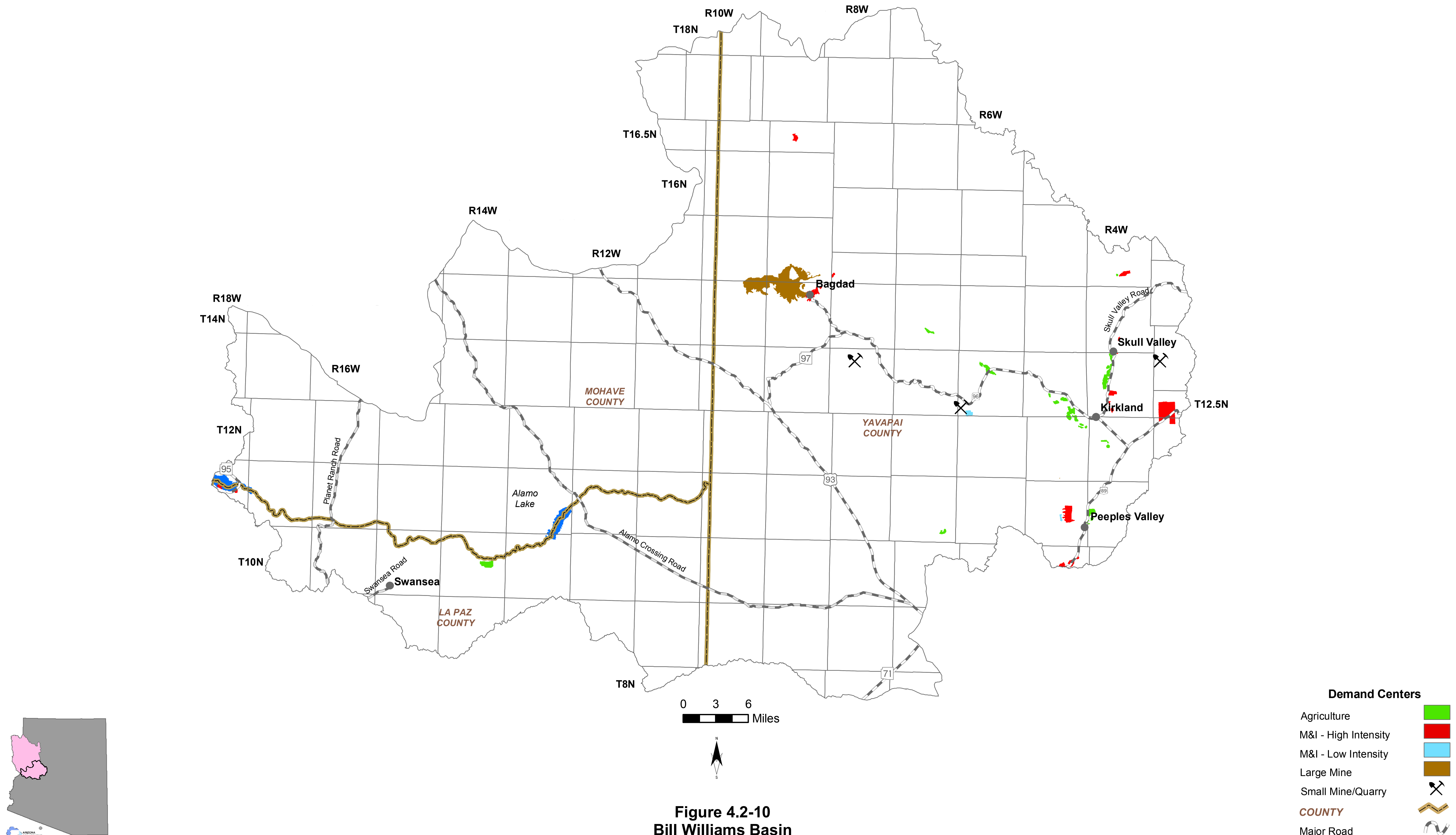


Figure 4.2-10
Bill Williams Basin
Cultural Water Demand

4.2.9 Water Adequacy Determinations in the Bill Williams Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 4.2-10. Figure 4.2-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

- A total of seven water adequacy determinations have been made in this basin through December, 2006. All lots received an adequate determination.
- All lots receiving an adequacy determination are in Yavapai County.

Table 4.2-10 Adequacy Determinations in the Bill Williams Basin[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Highland Pines	Yavapai	14 North	3 West	17, 34	27.0		Adequate		09/06/73	Subdivision wells
2	Highland Pines # 2	Yavapai	14 North	3 West	28, 33	14.0		Adequate		12/16/74	Subdivision wells
3	Peeples Valley # 2	Yavapai	11 North	5 West	22, 23	NA		Adequate		12/03/87	Peeples Valley Water Company
4	Pinon Estates # 1	Yavapai	11 North	5 West	14, 15	NA		Adequate		03/21/86	Peeples Valley Water Company
5	Pinon Estates # 2	Yavapai	11 North	5 West	14, 15	NA		Adequate		03/10/86	Peeples Valley Water Company
6	Rolling Hills	Yavapai	13 North	5 West	25, 26, 35, 36	41.0	22-300123	Adequate		03/20/96	Dry Lot Subdivision
7	Shawnee Hills	Yavapai	11 North	5 West	23	17.0	22-300210	Adequate		10/24/96	Peeples Valley Water Company

Notes:

[1]Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made In some cases. ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies

[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.

[3] A. Physical/Continuous
1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
2) Insufficient Supply (existing water supply unreliable or physically unavaible; for groundwater, depth-to-water exceeds criteria)
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)
B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)
C. Water Quality
D. Unable to locate records

NA = Data not currently available to ADWR

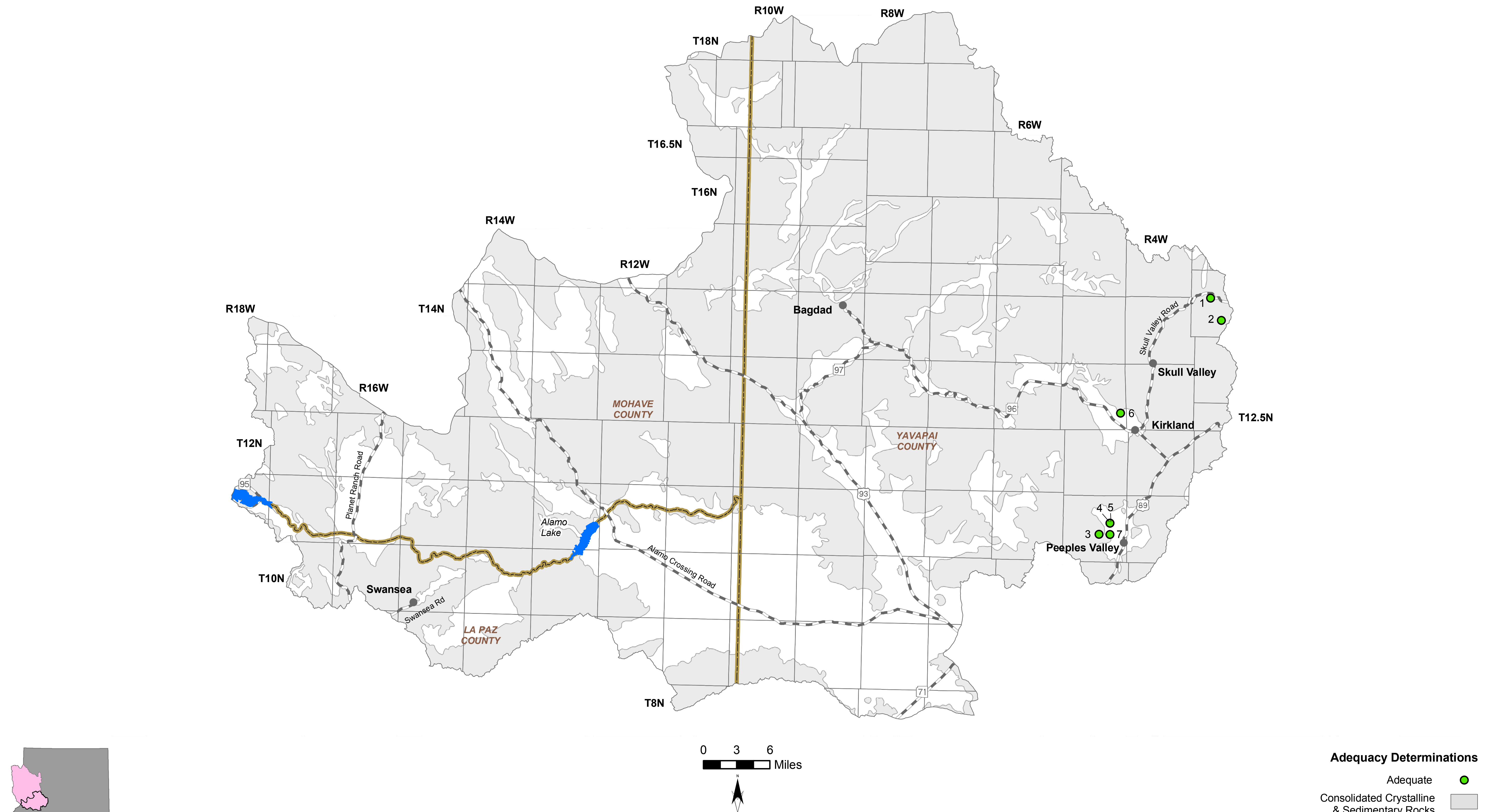


Figure 4.2-11
Bill Williams Basin
Adequacy Determinations

Bill Williams Basin

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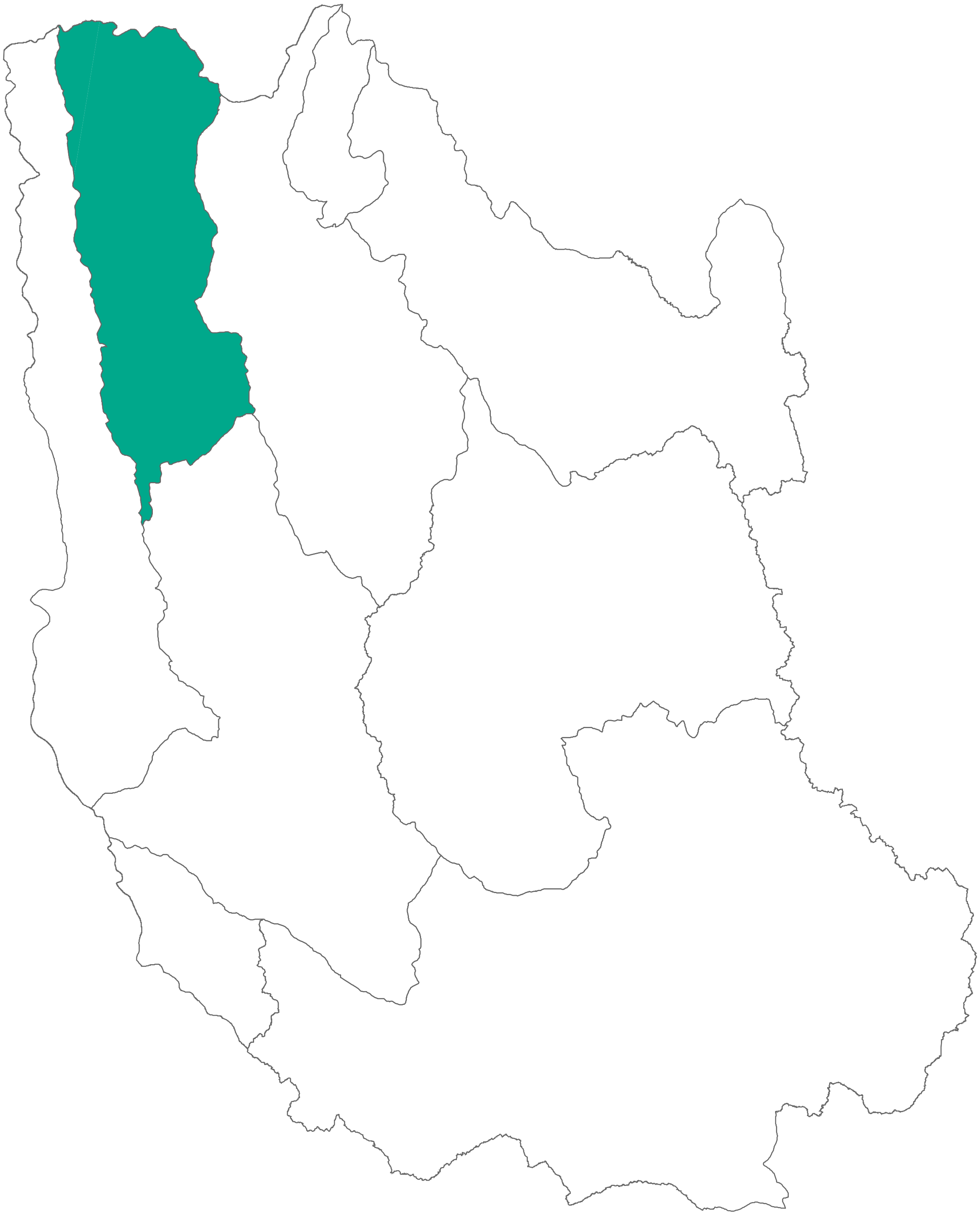
Bill Williams Basin Index to Section 4.0

Section 4.3
Detrital Valley Basin

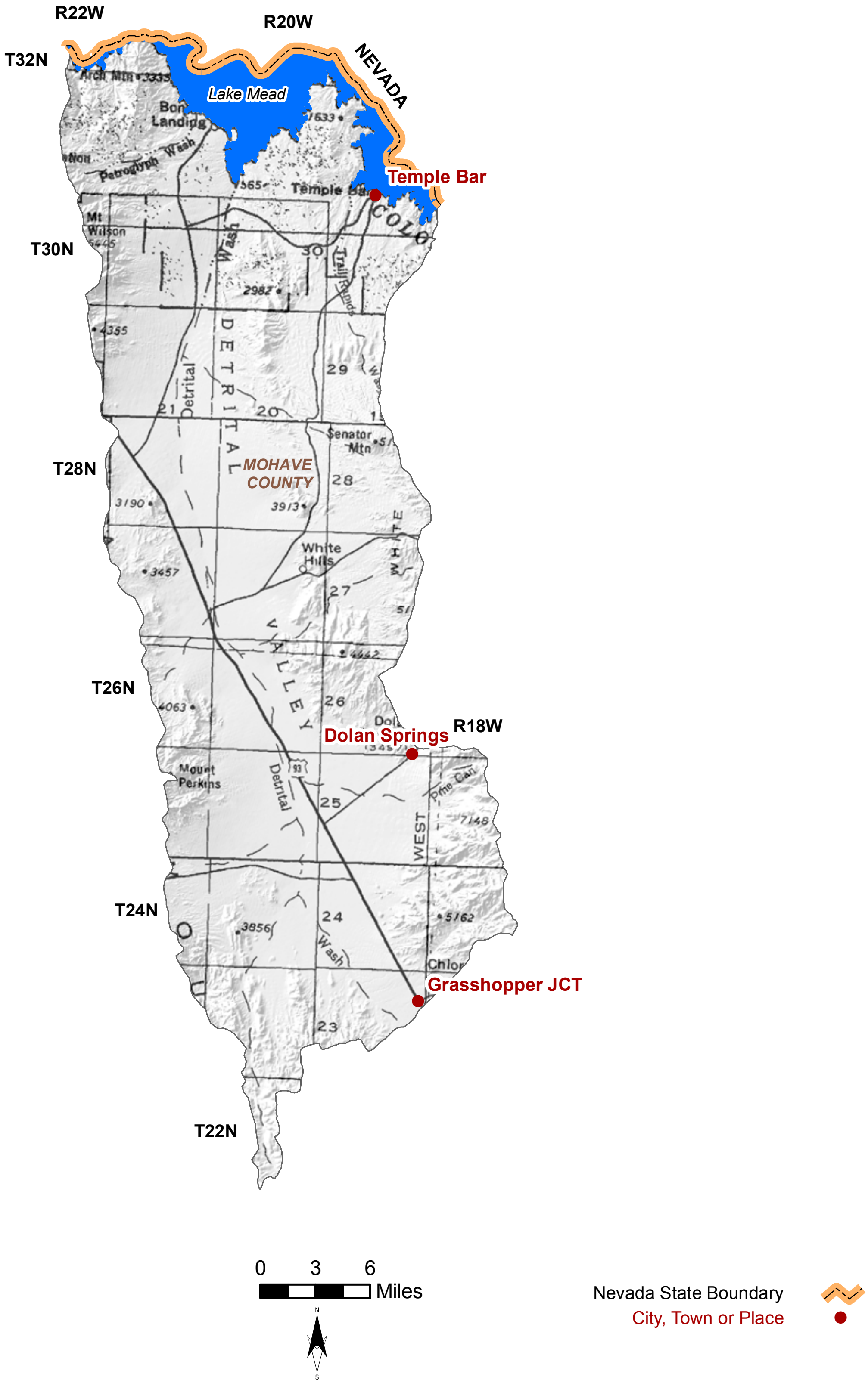


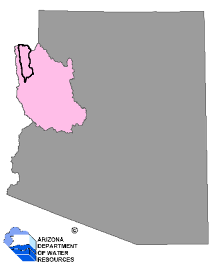
4.3.1 Geography of the Detrital Valley Basin

The Detrital Valley Basin is small-size basin in the northwestern part of the planning area at 892 square miles. Geographic features and principal communities are shown on Figure 4.3-1. The basin is characterized by a wide north-south trending valley and mountains on the east and west basin margins. Lake Mead forms the northern boundary of the basin. Vegetation types include Mohave desert scrub and conifer woodland.

- Principal geographic features shown on Figure 4.3-1 are:
    - Principal communities of Dolan Springs and Temple Bar
    - Other communities/sites of Grasshopper Junction and Bonelli Landing at Lake Mead
    - Detrital Wash running south to north through the basin and the lowest point in the basin, about 1,100 feet where the Wash drains into Lake Mead
    - The White Hills on the east central basin boundary
    - Mt. Wilson, the highest point in the basin at 5,445 in the northwest part of the basin

- Not well shown north of Grasshopper Junction is a section of the Cerbat Mountains, including part of the Mount Tipton Wilderness





Base Map: USGS 1:500,000, 1981

Figure 4.3-1
Detrital Valley Basin
Geographic Features

4.3.2 Land Ownership in the Detrital Valley Basin

Land ownership, including the percentage of ownership by category, for the Detrital Valley Basin is shown in Figure 4.3-2. Principal features of land ownership in this basin are the large amount of U.S. Bureau of Land Management and National Park Service lands. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

U.S. Bureau of Land Management (BLM)

- 49.1% of the land is federally owned and managed by the Kingman Field Office of the Bureau of Land Management.
- BLM lands in this basin are partially contiguous and partially found in a checkerboard pattern with private land and some state trust lands.
- The basin contains two wilderness areas, a portion of the 30,760-acre Mt. Tipton Wilderness in T25N, R18W and most of the 23,900-acre Mt. Wilson Wilderness in T30N, R21W and R22W.
- Primary land uses are recreation and grazing.

National Parks, Monuments and Recreation Areas

- 24.8% of the land is federally owned and managed by the National Park Service (NPS) as the Lake Mead National Recreation Area.
- Most NPS lands are located along the northern basin boundary.
- Primary land use is recreation.

Private

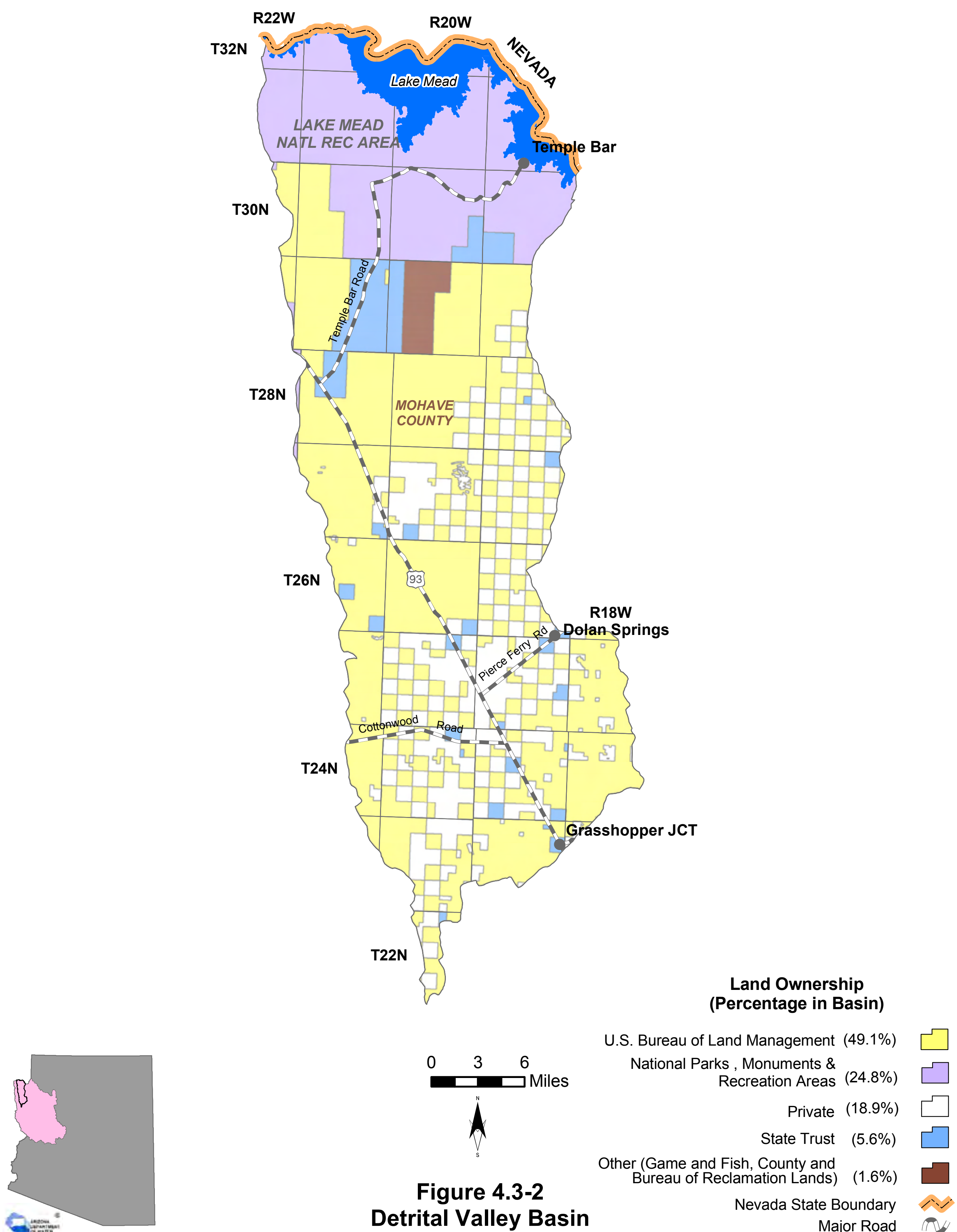
- 18.9% of the land is private.
- Most private land is interspersed in a checkerboard pattern throughout BLM and state trust lands.
- Primary land uses are domestic and grazing.

State Trust Land

- 5.6% of the land in this basin is held in trust for the public schools under the State Trust Land system.
- There are two larger contiguous parcels of state land adjacent to the Lake Mead National Recreation Area and a number of small areas of land interspersed with BLM and private lands throughout the basin.
- Primary land use is grazing.

Other (Game and Fish, County and Bureau of Reclamation Lands)

- 1.6% of the land is federally owned and managed by the Bureau of Reclamation
- Primary land use is unknown.



Source: ALRIS, 2004
Bureau of Land Management, 1999

Figure 4.3-2
Detrital Valley Basin
Land Ownership

4.3.3 Climate of the Detrital Valley Basin

Climate data from a NOAA/NWS Co-op Network station are complied in Table 4.3-1 and the location is shown on Figure 4.3-3. Figure 4.3-3 also shows precipitation data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Detrital Valley Basin does not contain Evaporation Pan, AZMET and SNOTEL/Snowcourse stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 4.3-1A
- There is one NOAA/NWS Co-op network climate station in the basin at Temple Bar.
- The station is located at 1,280 feet.
- Average maximum temperature at the station is 94.2°F and average minimum temperature is 47.2°F.
- Annual average precipitation is 4.15 inches.
- Most precipitation, 2.01 inches on average, occurs in the winter season (January – March).
- The driest season is the spring (April-June) when an average of 0.32 inches is recorded.

SCAS Precipitation Data

- See Figure 4.3-3
- Other precipitation data shows rainfall as high as 12 inches in the southern portion of the basin in the Cerbat Mountains near Grasshopper Junction and as low as four inches in the northern portion of the basin.
- In general, precipitation increases as altitude increases in this basin. This basin is one of three basins in the planning area with a range of eight inches between areas of highest and lowest average annual precipitation, the lowest in the planning area.

Table 4.3-1 Climate Data for the Detrital Valley Basin

A.NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Temple Bar	1,280	1971-2000	94.2/Jul	47.2/Jan	2.01	0.32	1.12	0.70	4.15

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

Source: WRCC, 2003.

C. AZMET:

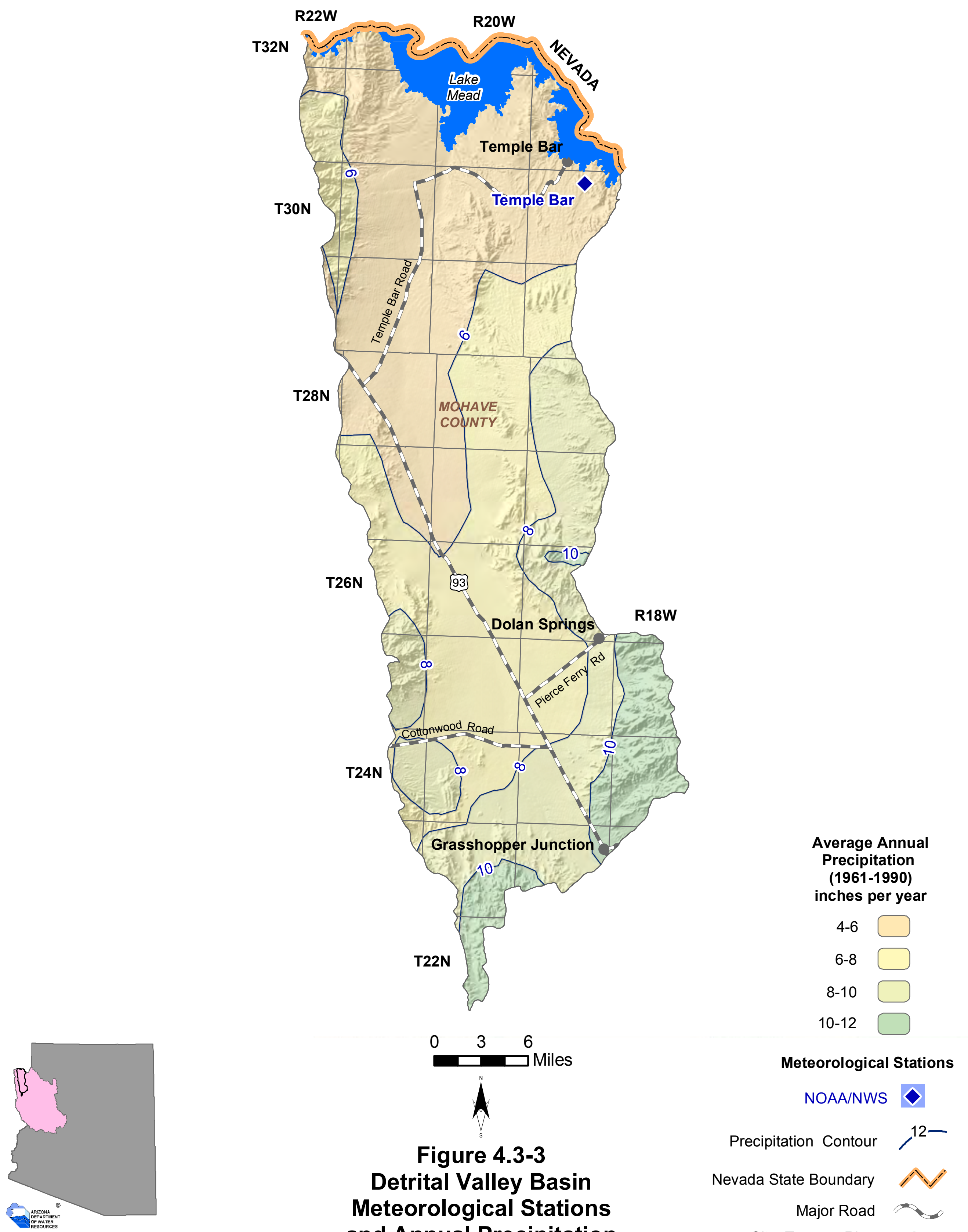
Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (*number of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content					
			Jan	Feb	March	April	May	June
None								

Source: Natural Resources Conservation Service, 2005



Precipitation Data Source: Oregon State University, 1998

Figure 4.3-3
Detrital Valley Basin
Meteorological Stations
and Annual Precipitation

4.3.4 Surface Water Conditions in the Detrital Valley Basin

There are no streamflow data for this basin. Flood ALERT equipment in the basin is shown in Table 4.3-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.3-4. The location of large reservoirs and flood ALERT equipment as well as USGS runoff contours are shown on Figure 4.3-4. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Flood ALERT Equipment

- Refer to Table 4.3-3.
- As of October 2005 there were three stations in the basin.
- Of the three stations one is a repeater/precipitation station, one is a precipitation/stage station and one is a weather station.

Reservoirs and Stockponds

- Refer to Table 4.3-4.
- The basin borders one large reservoir, Mead, with a maximum capacity of 29,755,000 acre-feet. The dam that creates Lake Mead, Hoover Dam, is in the Lake Mohave Basin. The reservoir is operated for hydroelectric power generation, recreation and water supply.
- There are no small reservoirs in the basin.
- There are an estimated 43 stockponds in this basin.

Runoff Contour

- Refer to Figure 4.3-4.
- Average annual runoff is 0.5 inches per year in the center of the basin around Dolan Springs and decreases to 0.1 inches on the edges of the basin.

Table 4.3-2 Streamflow Data for the Detrital Valley Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
None													

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Table 4.3-3 Flood ALERT Equipment in the Detrital Valley Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
1630	Detrital Wash	Precipitation/Stage	12/3/2001	Mohave County FCD
7430	Mt.Tipton	Repeater/Precipitation	NA	Mohave County FCD
7470	Dolan Springs	Weather Station	NA	Mohave County FCD

Notes:
FCD = Flood Control District
NA = Not available

Table 4.3-4 Reservoirs and Stockponds in the Detrital Valley Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE[1]	JURISDICTION
None	Mead (Hoover Dam)[2]	Bureau of Reclamation	29,755,000[3]	C,H,I,RR,S	Federal

Sources: US Army Corps of Engineers 2005, BOR 2006

B. Other Large Reservoirs (50 acre surface area or greater)[4]

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE	JURISDICTION
None identified by ADWR at this time					

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 0
Total maximum storage: 0 acre-feet

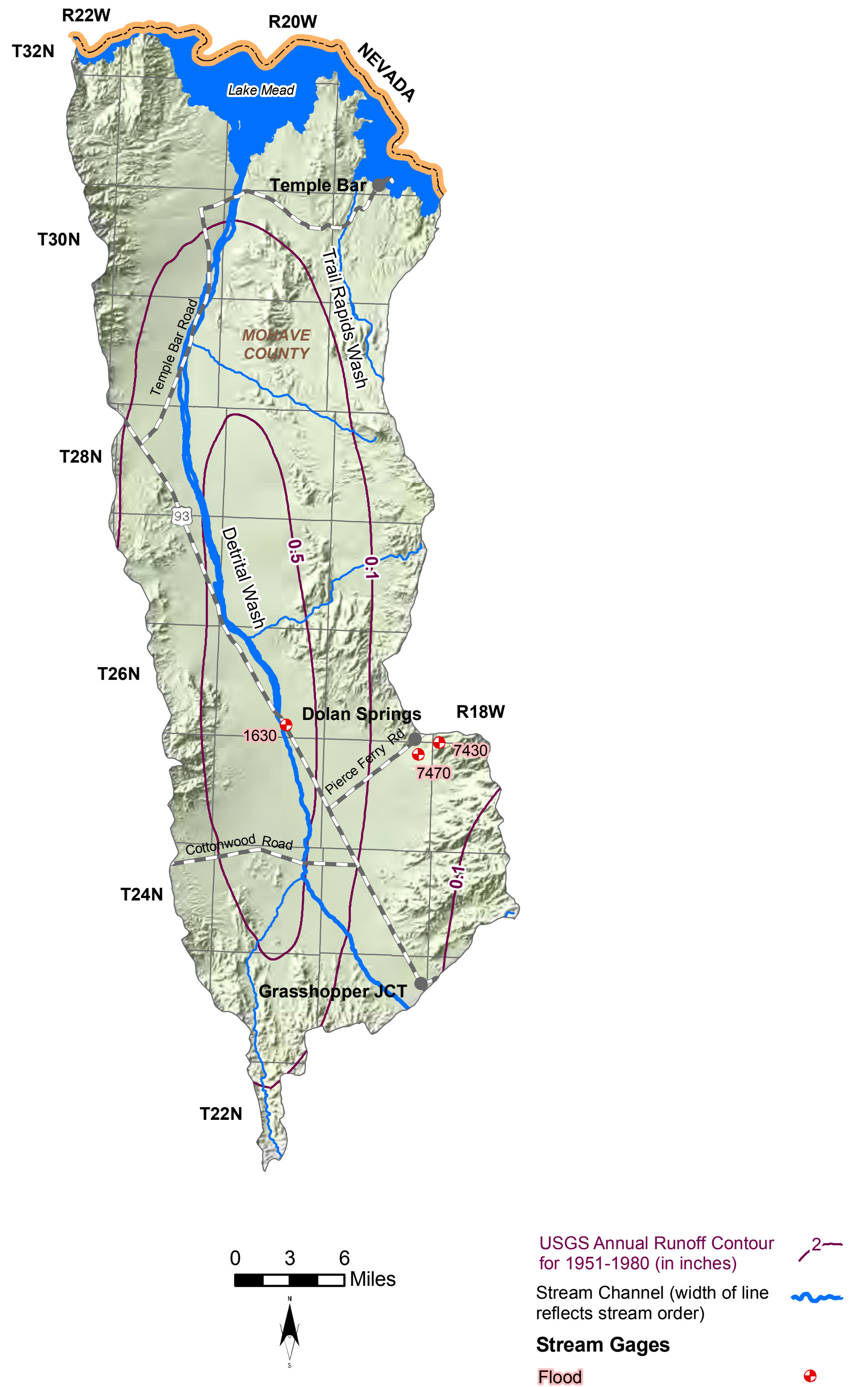
D. Other Small Reservoirs (between 5 and 50 acres surface area)[3]

Total number: 0
Total surface area: 0 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 43 (from water right filings)

Notes:
[1]C=flood control; F=fish & wildlife pond; H=hydroelectric; I=irrigation; R=recreation; RR=river regulation; S=water supply
[2] Dam is located in Lake Mohave Basin and lake storage is located in Lake Mohave, Detrital Valley, Hualapai Valley and Meadview Basins.
[3] Includes 2,378,000 acre-feet of dead storage.
[4] Capacity data not available to ADWR



Stream Data Source: ALRIS, 2005

Figure 4.3-4
Detrital Valley Basin
Surface Water Conditions

4.3.5 Perennial/Intermittent Streams and Major Springs in the Detrital Valley Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 4.3-5. The locations of major springs are shown on Figure 4.3-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- There are no perennial or intermittent streams in this basin.
- There is one major spring, Monkey Cove, with a measured discharge 1,200 gallons per minute (gpm).
- Listed discharge rates may not be indicative of current conditions. The most recent measurement of the Monkey Cove spring was taken in 1964. This spring is no longer listed on the current U.S. Geological Survey topographical maps because it is normally submerged by Lake Mead.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 4.3-5B. There are four minor springs identified in this basin.
- The total number of springs identified by the USGS varies from 24 to 27, depending on the database reference.

Table 4.3-5 Springs in the Detrital Valley Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Monkey Cove[2]	360223	1141949	1,200	11/23/1964

B. Minor Springs (1 to 10 gpm):

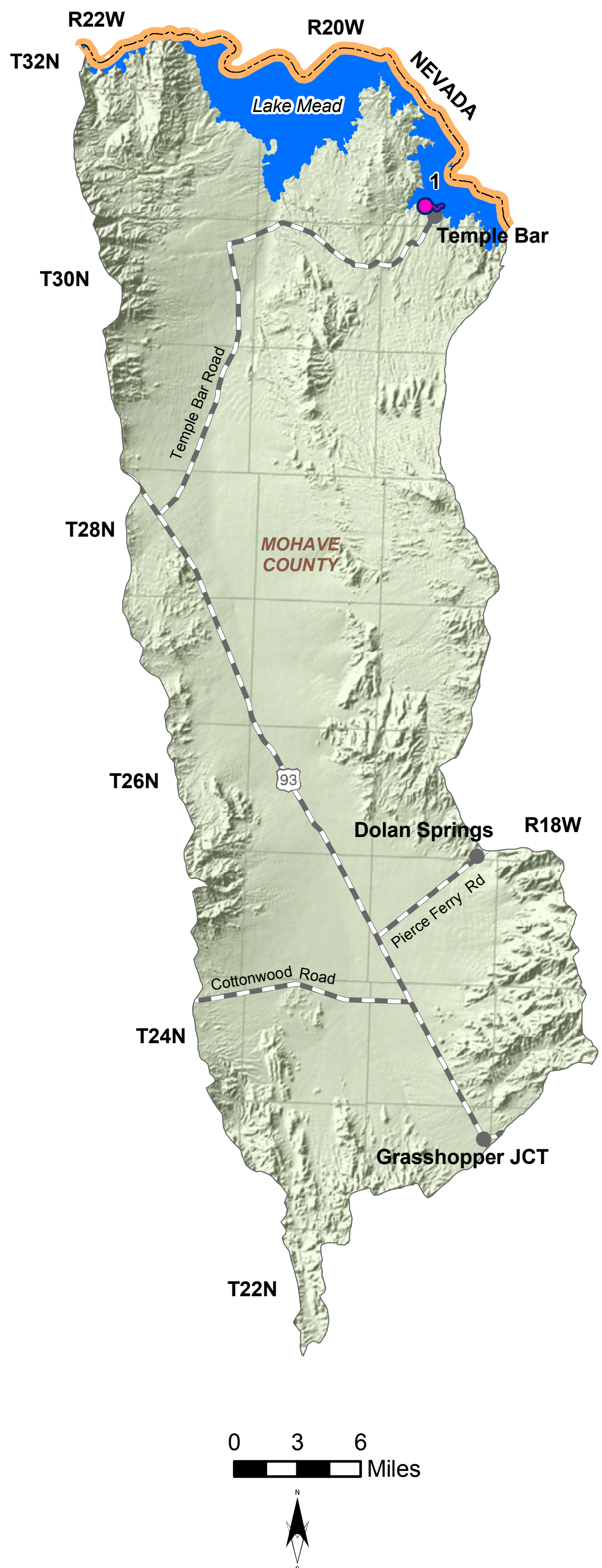
Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Unnamed	353405	1141240	6	During or prior to 1965
Antelope	353601	1141144	6	During or prior to 1965
Unnamed	353310	1141405	3	During or prior to 1965
Unnamed	353200	1141430	3	During or prior to 1965

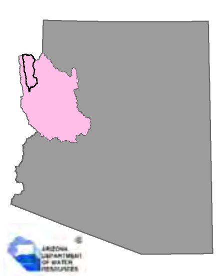
C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and USGS, 2006): 24 to 27

Notes:

[1]Most recent measurement identified by ADWR

[2]Spring is not displayed on current USGS topo maps because it normally submerged by Lake Mead





Springs
Perennial Streams
Nevada State Boundary
Major Road
City, Town or Place

Stream Data Source: AGFD, 1993 & 1997

Figure 4.3-5
Detrital Valley Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

4.3.6 Groundwater Conditions of the Detrital Valley Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 4.3-6. Figure 4.3-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 4.3-7 contains hydrographs for selected wells shown on Figure 4.3-6. Figure 4.3-8 shows well yields in two yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields, is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 4.3-6 and Figure 4.3-6.
- Major aquifers in the basin include recent stream alluvium and basin fill.
- The principal water-bearing aquifer is the basin fill.
- Flow direction is generally from the south to the north.

Well Yields

- Refer to Table 4.3-6 and Figure 4.3-8.
- As shown on Figure 4.3-8 well yields in this basin range from less than 100 gallons per minute (gpm) to 500 gpm.
- One source of well yield information, based on six reported wells, indicates that the median well yield in this basin is 31.5 gpm.
- Well yields are similar throughout the basin with the highest well yield, between 100 gpm and 500 gpm, occurring near Temple Bar.

Natural Recharge

- Refer to Table 4.3-6.
- The estimate of natural recharge for this basin is 1,000 acre-feet per year.

Water in Storage

- Refer to Table 4.3-6.
- There are four storage estimates for this basin, ranging from one million acre-feet to seven million acre-feet. The most recent estimate, from a 2006 preliminary ADWR study, indicates the basin has between 1.38 and 3.68 million acre-feet in storage to a depth of 1,200 feet.
- The predevelopment storage estimate is one million acre-feet to a depth of 1,200 feet.

Water Level

- Refer to Figure 4.3-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures four index wells in this basin.
- The Department measures water levels four times daily at one automated groundwater monitoring site in the west-central portion of the basin.
- In 1995, the year of the last water level sweep, 26 wells were measured.
- The deepest recorded water level in the basin is 597 feet west of Dolan Springs and the shallowest is 68 feet west of Temple Bar.

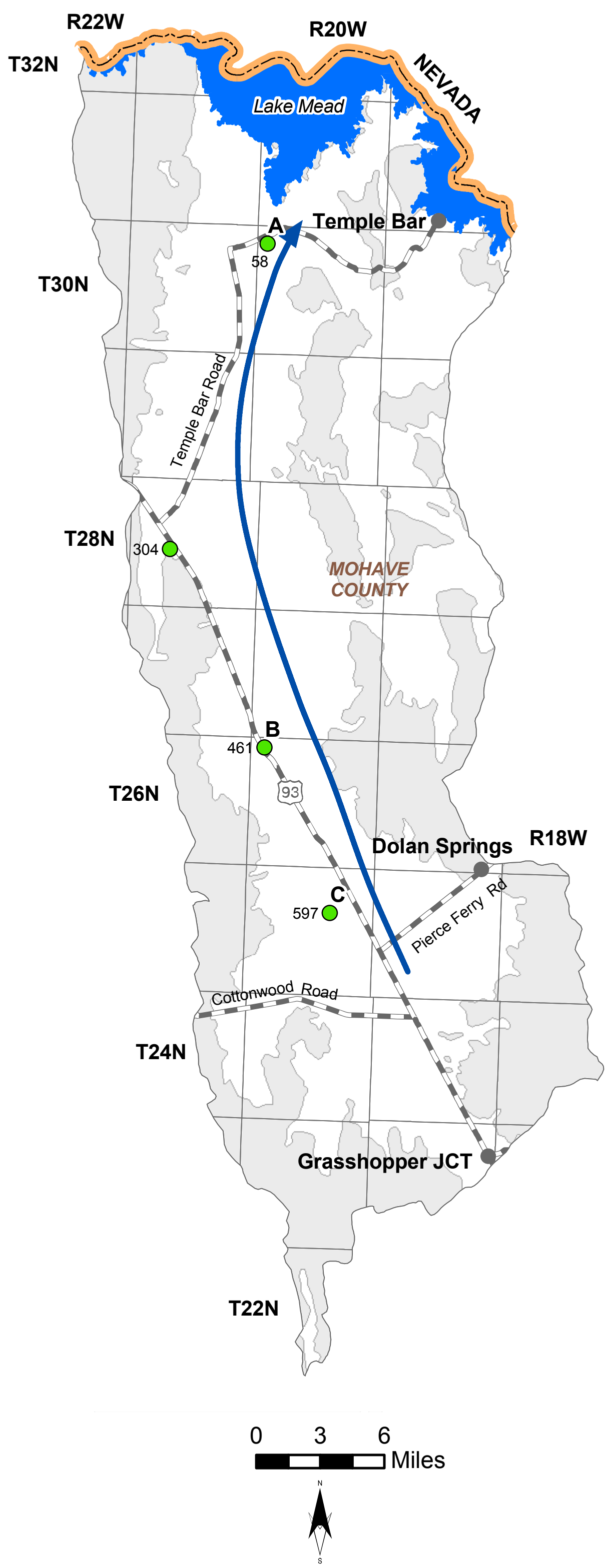
Table 4.3-6 Groundwater Data for the Detrital Valley Basin

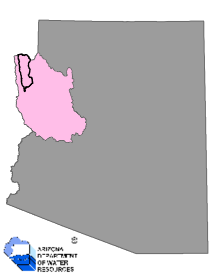
Basin Area, in square miles:	892	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Recent Stream Alluvium	
	Basin Fill	
	Sedimentary Rock (Muddy Creek and Chemehueve Formations)	
Well Yields, in gpm:	Range 10-44 Median 31.5 (6 wells measured)	Measured by ADWR and/or USGS
	Range 35-240 Median 35 (3 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 30-100	ADWR (1990)
	Range 0-500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	1,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	1,380,000 to 3,680,000[1] (to 1200 ft)	ADWR (2006)
	1,000,000	ADWR (1994)
	1,000,000[2] (to 1200 ft)	Freethey and Anderson (1986)
	7,000,000 (to 1200 ft)	Arizona Water Commission (1975)
Current Number of Index Wells:	4	
Date of Last Well Sweep:	1995 (26 wells measured)	

Notes:

[1] Draft estimate, subject to revision. Range based on assumed values for specific yield.

[2] Predevelopment estimate





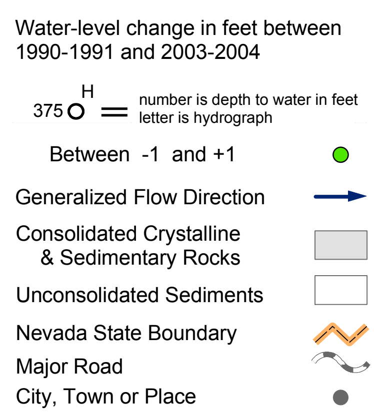
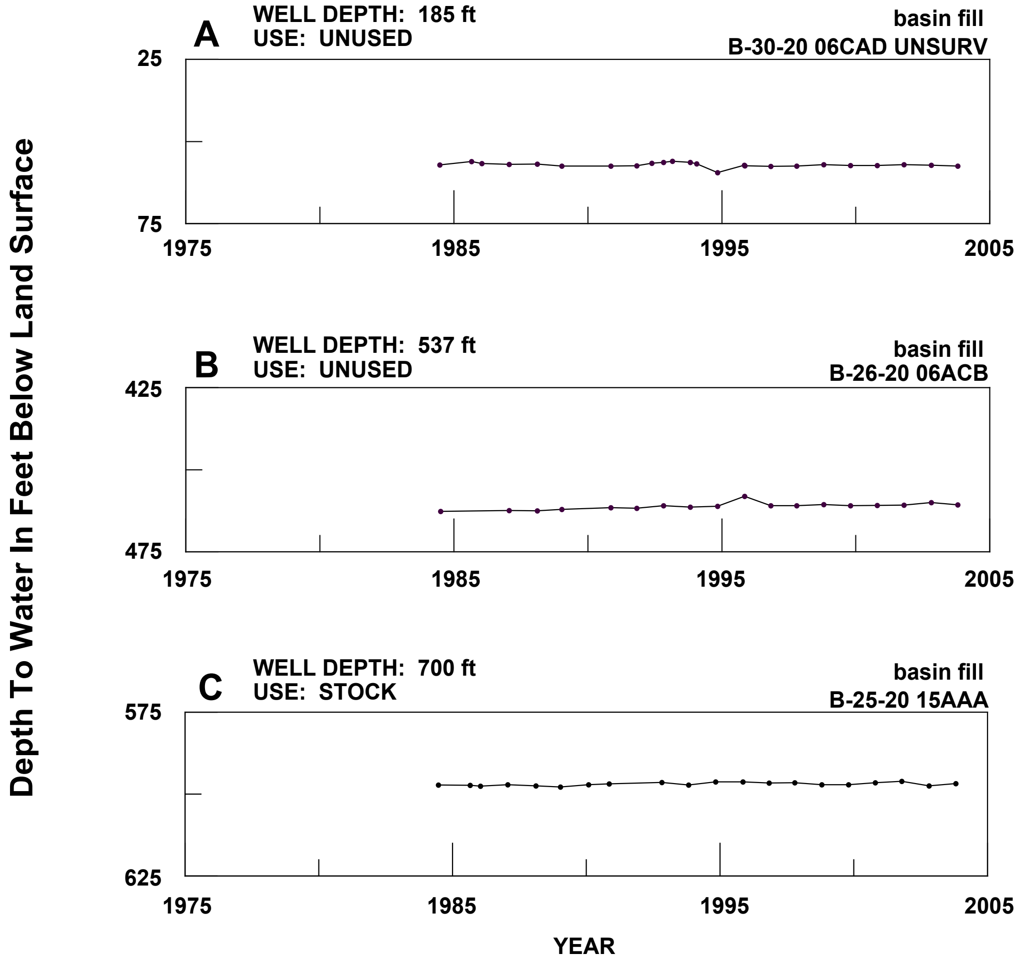


Figure 4.3-6
Detrital Valley Basin
Groundwater Conditions

Figure 4.3-7
Detrital Valley Basin
Hydrographs Showing Depth to Water in Selected Wells



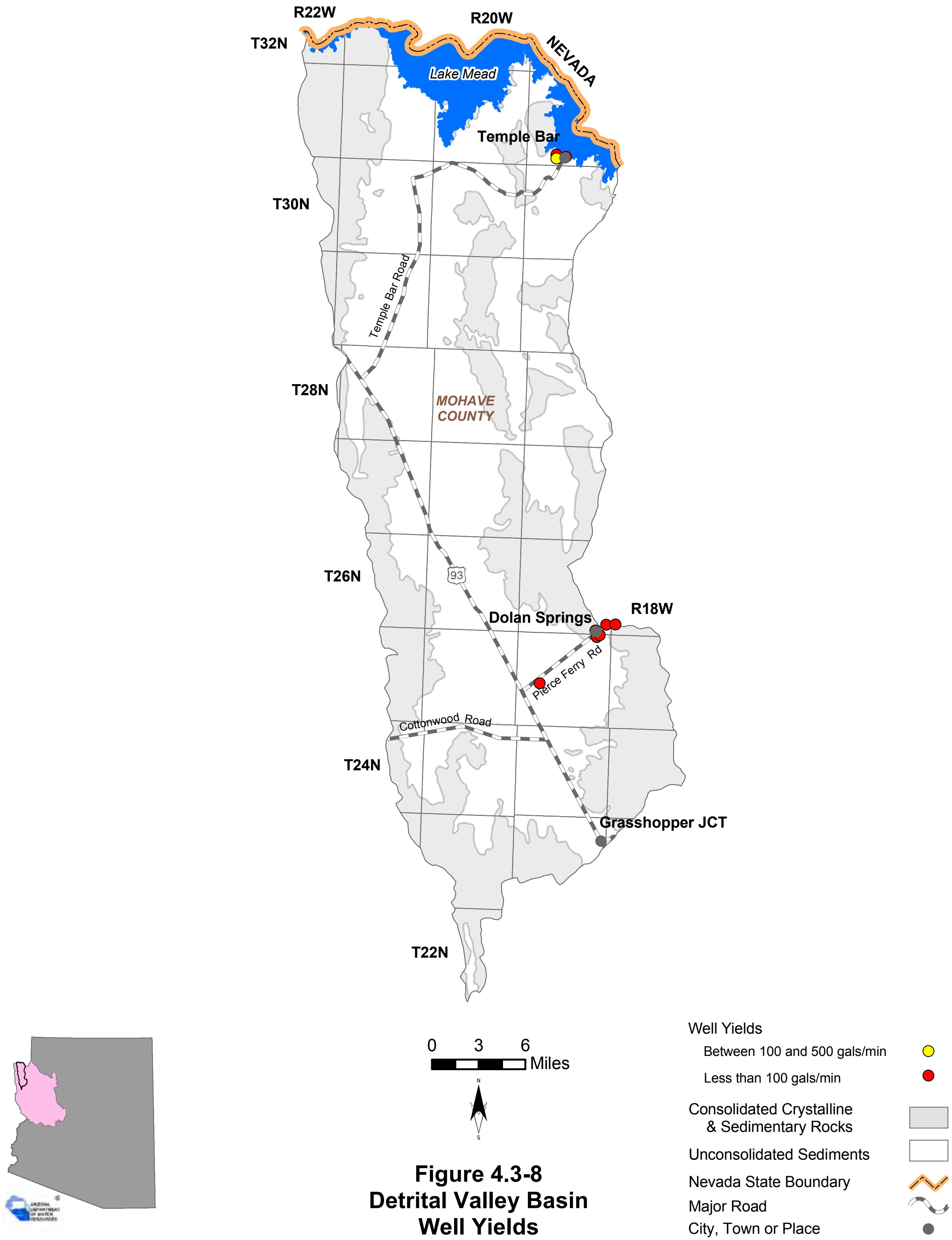


Figure 4.3-8
Detrital Valley Basin
Well Yields

4.3.7 Water Quality of the Detrital Valley Basin

Drinking water standard exceedences in wells, springs and mine sites including location and parameter(s) exceeded are shown in Table 4.3-7A. There are no impaired lakes or streams in this basin. Figure 4.3-9 shows the location of exceedences keyed to Table 4.3-7. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mine Sites

- Refer to Table 4.3-7A.
- Drinking water standard exceedences in wells and springs have been reported for 23 sites in the basin.
- The drinking water standard for arsenic was the most frequently exceeded standard at sites in this basin.
- Arsenic exceedences are scattered throughout the basin.
- Other drinking water standards exceeded in this basin include radionuclides, nitrate/nitrite, lead and total dissolved solids.

Table 4.3-7 Water Quality Exceedences in the Detrital Valley Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Exceeding Drinking Water Standard[2]
		Township	Range	Section	
1	Well	31 North	19 West	32	As
2	Well	31 North	19 West	32	As, Rad
3	Well	30 North	20 West	6	As, NO3
4	Well	30 North	22 West	13	Rad
5	Spring	30 North	22 West	13	Rad
6	Well	28 North	21 West	20	As
7	Well	28 North	21 West	23	As, NO3
8	Well	28 North	21 West	26	NO3
9	Spring	27 North	19 West	12	As
10	Well	27 North	21 West	13	As
11	Well	27 North	21 West	24	As
12	Well	27 North	21 West	25	As
13	Spring	25 North	18 West	16	As, Rad
14	Spring	25 North	18 West	17	As
15	Well	25 North	21 West	35	NO3
16	Well	24 North	18 West	20	Rad
17	Well	24 North	18 West	30	Pb
18	Well	24 North	18 West	30	Pb
19	Well	24 North	18 West	30	Rad
20	Well	24 North	18 West	31	As
21	Well	24 North	18 West	32	Pb
22	Well	23 North	18 West	6	TDS
23	Well	23 North	20 West	11	As

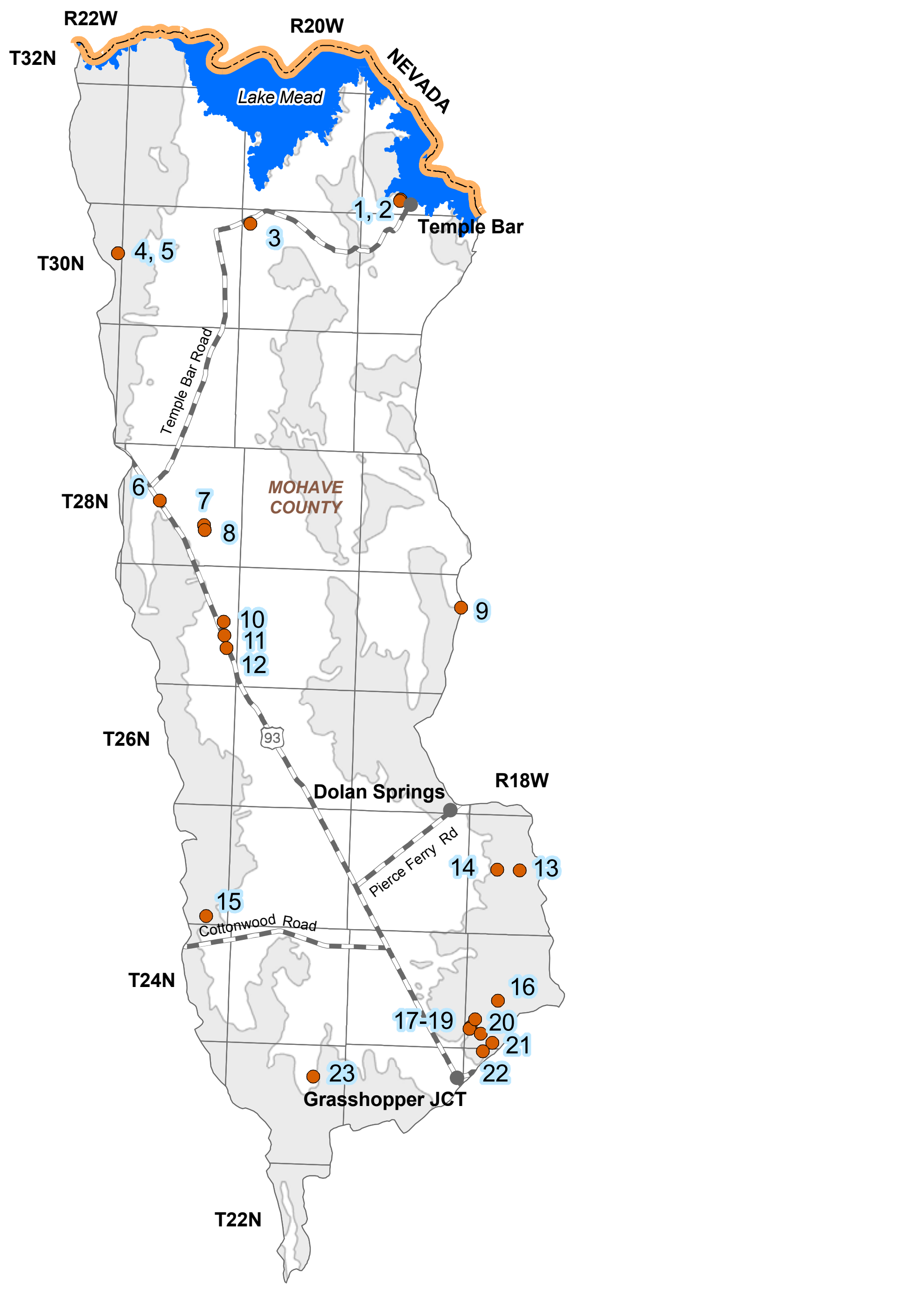
B. Lakes and Streams

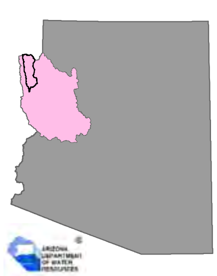
Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard	Parameter(s) Exceeding Use Standard
None identified by ADWR at this time						

Notes:

[1] Water quality samples collected between 1975 and 2002.

[2] As = Arsenic
Pb = Lead
NO3 = Nitrate/Nitrite
Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium
TDS = Total Dissolved Solids





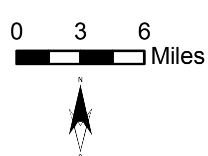


Figure 4.3-9
Detrital Valley Basin
Water Quality Conditions

4.3.8 Cultural Water Demands in the Detrital Valley Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 4.3-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 4.3-9. Figure 4.3-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 4.0.7.

Cultural Water Demands

- Refer to Table 4.3-8 and Figure 4.3-10.
- Population in this basin is small but has almost doubled since 1980, increasing from 757 in 1980 to 1,347 in 2000. Projections suggest a similar rate of growth through 2050.
- Groundwater pumping is minimal in this basin. Current pumping is comparable to historic pumping with an annual average of less than 300 acre-feet per year from 2001-2003.
- Surface water diversions are minimal in this basin, less than 300 acre-feet per year from 1991-2000.
- All of the surface water diversions are for municipal use at Temple Bar within the Lake Mead National Recreation Area.
- Most municipal and industrial demand is around Dolan Springs at this time. There are, however, a number of proposed residential developments in this basin east of Highway 93 and north of Pierce Ferry Road.
- Municipal groundwater demand has remained consistently less than 300 acre-feet per year since 1991.
- There are no recorded industrial or agricultural water demands in this basin. There is, however, a small mine or quarry north of Grasshopper Junction.
- As of 2003 there were 142 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 12 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 4.3-9.
- There is one wastewater treatment facility, the Temple Bar Wastewater Treatment Facility, located within the Lake Mead National Recreation Area.
- No other information on this facility was available.

Table 4.3-8 Cultural Water Demands in the Detrital Valley Basin[1]

Year	Recent (Census) and Projected (DES) Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)						
				Well Pumpage			Surface-Water Diversions			Data Source
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial	Irrigation	Municipal	Industrial	Irrigation	
1971										
1972										
1973					<500			NR		
1974										
1975										
1976		86[2]	8[2]							
1977										
1978					<500			NR		
1979										
1980	757									ADWR
1981	776									(1994)
1982	795									
1983	815	0	0		<500			NR		
1984	834									
1985	853									
1986	872									
1987	891									
1988	911	0	0		<500			NR		
1989	930									
1990	949									
1991	991									
1992	1,034									
1993	1,076	10	3	<300	NR	NR	<300	NR	NR	
1994	1,119									
1995	1,161									
1996	1,204									USGS
1997	1,246									(2005)
1998	1,289	22	0	<300	NR	NR	<300	NR	NR	ADWR
1999	1,331									(2006)
2000	1,374									
2001	1,397									
2002	1,419	16	0	<300	NR	NR	<300	NR	NR	
2003	1,442									
2010	1,599									
2020	1,831									
2030	2,003									
2040	2,114									
2050	2,200									
	ADDITIONAL WELLS:[3]	**8**	**1**							
	WELL TOTALS:	**142**	**12**							

Notes:
NR = Not reported
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] Includes all wells through 1980.
[3] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 4.3-9 Effluent Generation in the Detrital Valley Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf Irrigation	Wildlife Area	Discharge to Another Facility	Infiltration Basins			
Temple Bar WWTF	National Park Service	Park	NA											

Notes:
NA: Data not currently available to ADWR
WWTF: Waste Water Treatment Facility

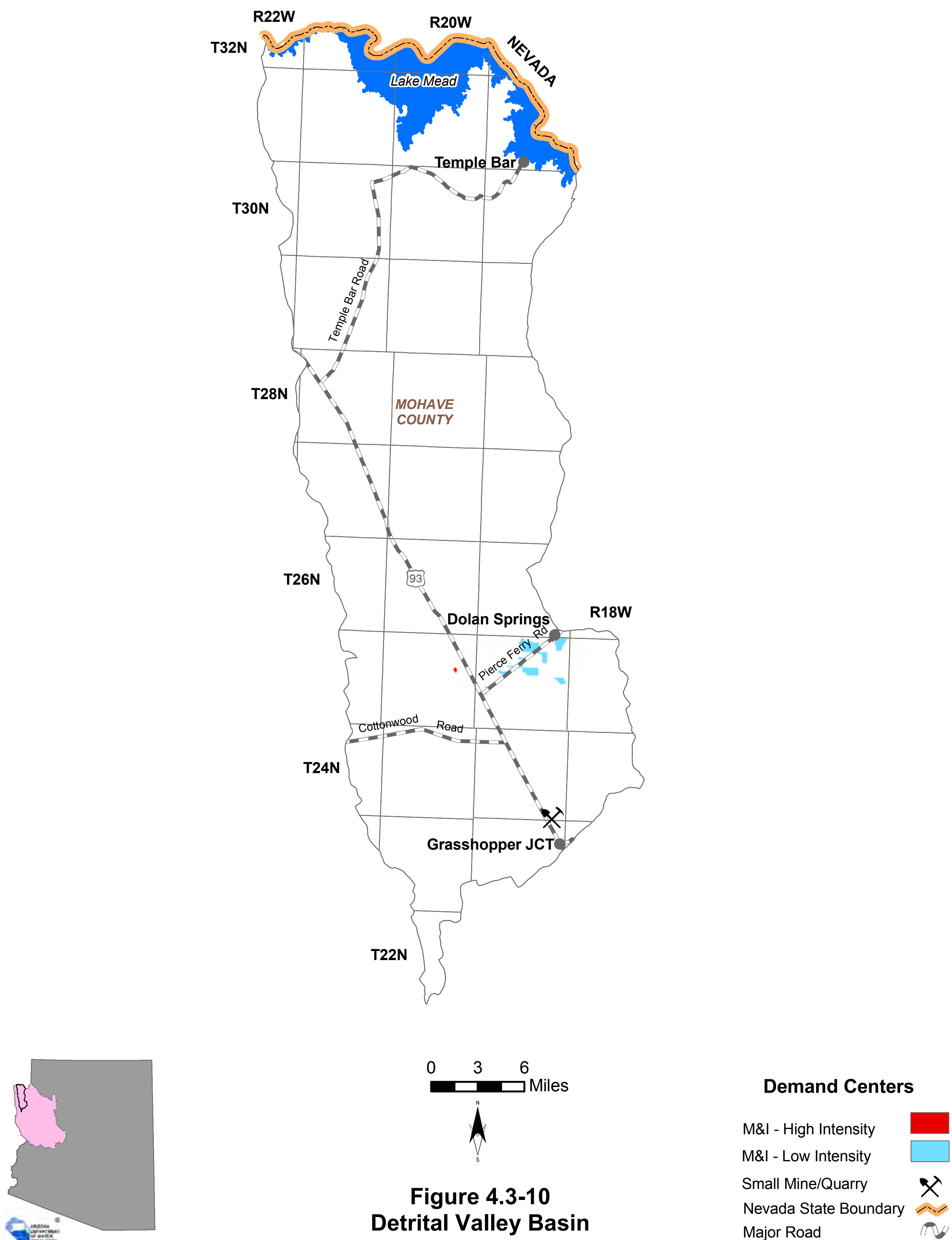


Figure 4.3-10
Detrital Valley Basin
Cultural Water Demand

Primary Data Source: USGS National Gap Analysis Program, 2004

4.3.9 Water Adequacy Determinations in the Detrital Valley Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 4.3-10. Figure 4.3-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

Water Adequacy Reports

- See Table 4.3-10A
- A total of 27 water adequacy determinations have been made in this basin through December, 2006.
- 27 determinations of inadequacy have been made; these determinations are found in the southern and central portions of the basin.
- The most common reason for an inadequacy determination was because the existing water supply is unreliable or physically unavailable.
- Other reasons for an inadequacy determination included insufficient data, insufficient infrastructure, failure to demonstrate a legal right to use the water and water quality.
- All lots receiving an adequacy determination are in Mohave County. No lots received an adequate water supply designation in this basin.

Analysis of Adequate Water Supply

- See Table 4.3-10B
- One analysis of adequate water supply for a master planned community has been issued for this basin. The analysis was for 25,000 lots and is located across a broad disconnected area . For more information on analysis of adequate water supply see Section 4.0.9.

Table 4.3-10 Adequacy Determinations in the Detrital Valley Basin[1]

A. Water Adequacy Reports

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Flannery & Allen	Mohave	27 North	20 West	31	55	22-400912	Inadequate	A1,A2	04/10/03	Individual Wells
2	Gateway Acres, Tracts, 1, 2, 7	Mohave	25 North	20 West	3, 5, 7	352	22-401105	Inadequate	A1,A2	05/07/04	None
3	Gateway Acres 3	Mohave	25 North	19 West	19, 29	19		Inadequate	A2,A3	08/29/85	Dry Lot Subdivision
4	Gateway Acres 4	Mohave	24 North	19 West	5, 7, 17	186		Inadequate	A2,A3	08/29/85	Dry Lot Subdivision
5	Gateway Acres Tract 5	Mohave	24 North	20 West	23, 25	170		Inadequate	A2,A3	08/27/84	Dry Lot Subdivision
6	Gateway Acres Tract 6	Mohave	24 North	20 West	11	49		Inadequate	A1,A2,A3	08/13/82	Dry Lot Subdivision
7	Gateway Acres Tract 6 A	Mohave	24 North	20 West	13, 15	NA		Inadequate	A2,A3	03/14/84	Dry Lot Subdivision
8	Gateway Acres 8	Mohave	25 North	20 West	1, 13	642		Inadequate	A2,A3	11/23/77	Dry Lot Subdivision
9	Gateway Acres 9	Mohave	25 North	19 West	5, 7, 9, 17, 19, 21, 29	NA		Inadequate	A2,A3	11/23/77	Dry Lot Subdivision
10	Gateway Acres Tract 11	Mohave	24 North	19 West	7	183		Inadequate	A2,A3	03/14/84	Dry Lot Subdivision
11	Gateway Acres Tract 11 A	Mohave	24 North	19 West	9	NA		Inadequate	A1,A2,A3	06/30/92	Dry Lot Subdivision
12	Gateway Acres Tract 12	Mohave	24 North	19 West	19,31	170		Inadequate	A2,A3	08/27/84	Dry Lot Subdivision
13	Gateway Acres 13	Mohave	25 North	19 West	31	NA		Inadequate	D	07/29/93	Dry Lot Subdivision
14	Golden Horseshoe Ranchos # 1	Mohave	27 North	20 West	9	98		Inadequate	A1	12/31/92	Dry Lot Subdivision
15	Golden Horseshoe Ranchos # 2	Mohave	27 North	19 West	7	540	22-300222	Inadequate	A1,A2	11/07/96	Dry Lot Subdivision
16	Golden Horseshoe Ranchos Units 3 & 4	Mohave	27 North	19 West	9, 17	192	22-300196	Inadequate	A2	09/26/96	Dry Lot Subdivision
17	Golden Horseshoe Ranchos Unit # 5	Mohave	27 North	19 West	19	375	22-400274	Inadequate	A1,B,C	04/07/00	White Hills Water Company
18	Golden Horseshoe Ranchos Unit # 5	Mohave	27 North	19 West	19	283	22-401884	Inadequate	A1	10/06/05	Dry Lot Subdivision
19	Lake Mohave Ranchos	Mohave	25 North	19 West	1, 11, 12, 15, 23, 25, 27	NA		Inadequate	A2,A3	11/23/77	Dry Lot Subdivision
20	Lake Mohave Ranchos A	Mohave	25 North	18 West	7	NA		Inadequate	A2,A3	11/23/77	Dry Lot Subdivision
21	Lake Mohave Ranchos B	Mohave	26 North	20 West	35	NA		Inadequate	A2,A3	11/23/77	Dry Lot Subdivision
22	Lake Mohave Ranchos C	Mohave	26 North	19 West	21, 25, 27, 29, 31, 33	NA		Inadequate	A2,A3	11/23/77	Dry Lot Subdivision
23	Lake Mohave Ranchos Unit 16	Mohave	25 North	18 West	7	9	22-401802	Inadequate	A1	07/14/05	Dry Lot Subdivision
24	Sunny Lakes Ranchos Unit 1	Mohave	28 North	20 West	13	546	22-402260	Inadequate	A2	08/25/06	Dry Lot Subdivision

Table 4.3-10 Adequacy Determinations in the Detrital Valley Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
25	Sunset Vista	Mohave	25 North	19 West	4	10	22-401293	Inadequate	A1,A2	05/07/04	NA
26	Triangle Air Park	Mohave	27 North	21 West	24	35		Inadequate	A1,A2,A3	01/24/84	Dry Lot Subdivision
27	Western Horizon Estates # 2	Mohave	24 North	19 West	27	80		Inadequate	A1,A2,A3	07/13/92	Dry Lot Subdivision

B. Analysis of Adequate Water Supply

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section				
a	The Ranch at White Hills	Mohave	27-29 North	19-20 West	multiple	25,000	23-401774	04/11/06	Double Diamond Utilities

[1]Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made. In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies.

[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.

[3] A. Physical/Continuous
1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
2) Insufficient Supply (existing water supply unreliable or physically unavailable; for groundwater, depth-to-water exceeds criteria)
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)
B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)
C. Water Quality
D. Unable to locate records

NA = Data not currently available to ADWR

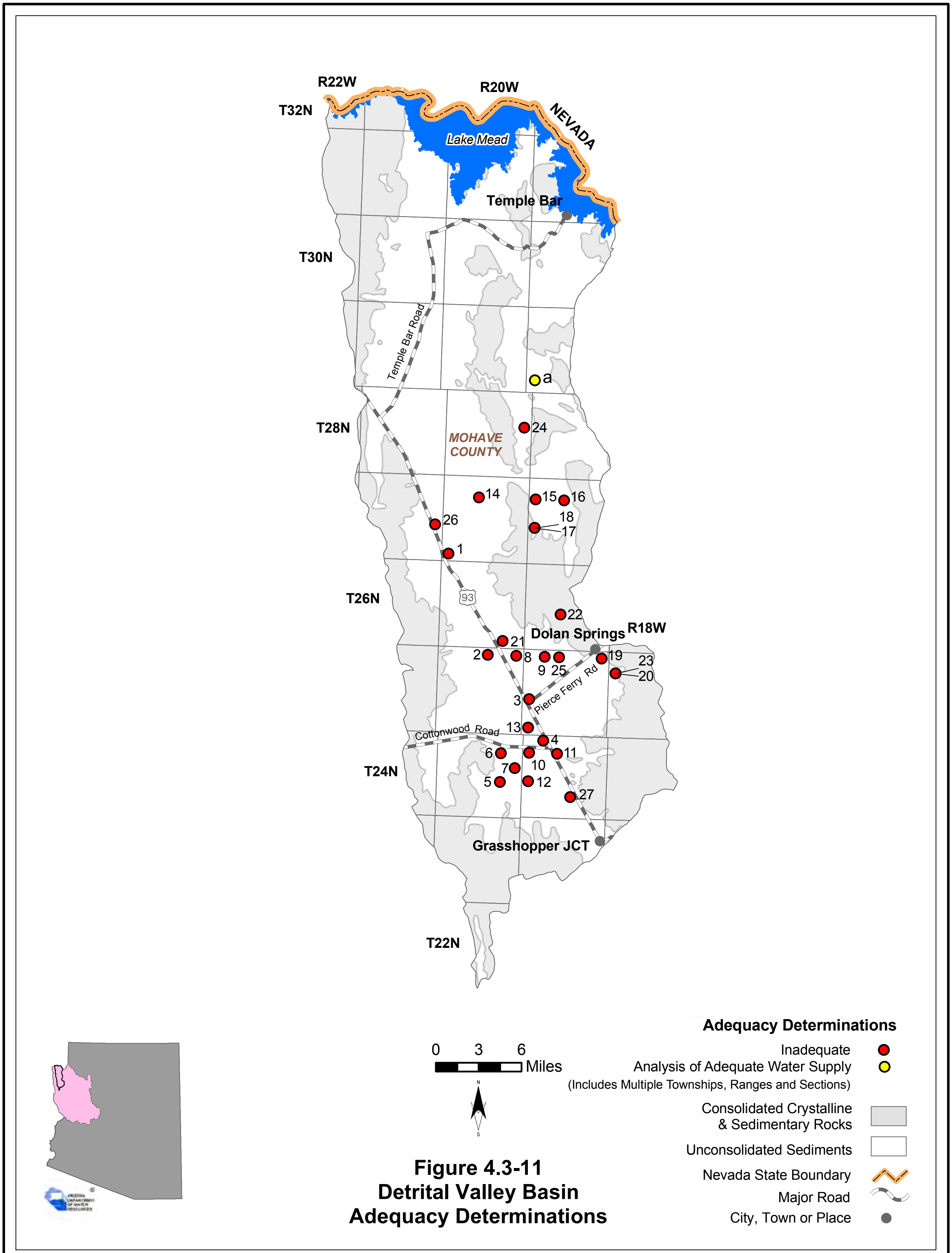


Figure 4.3-11
Detrital Valley Basin
Adequacy Determinations

Detrital Valley Basin

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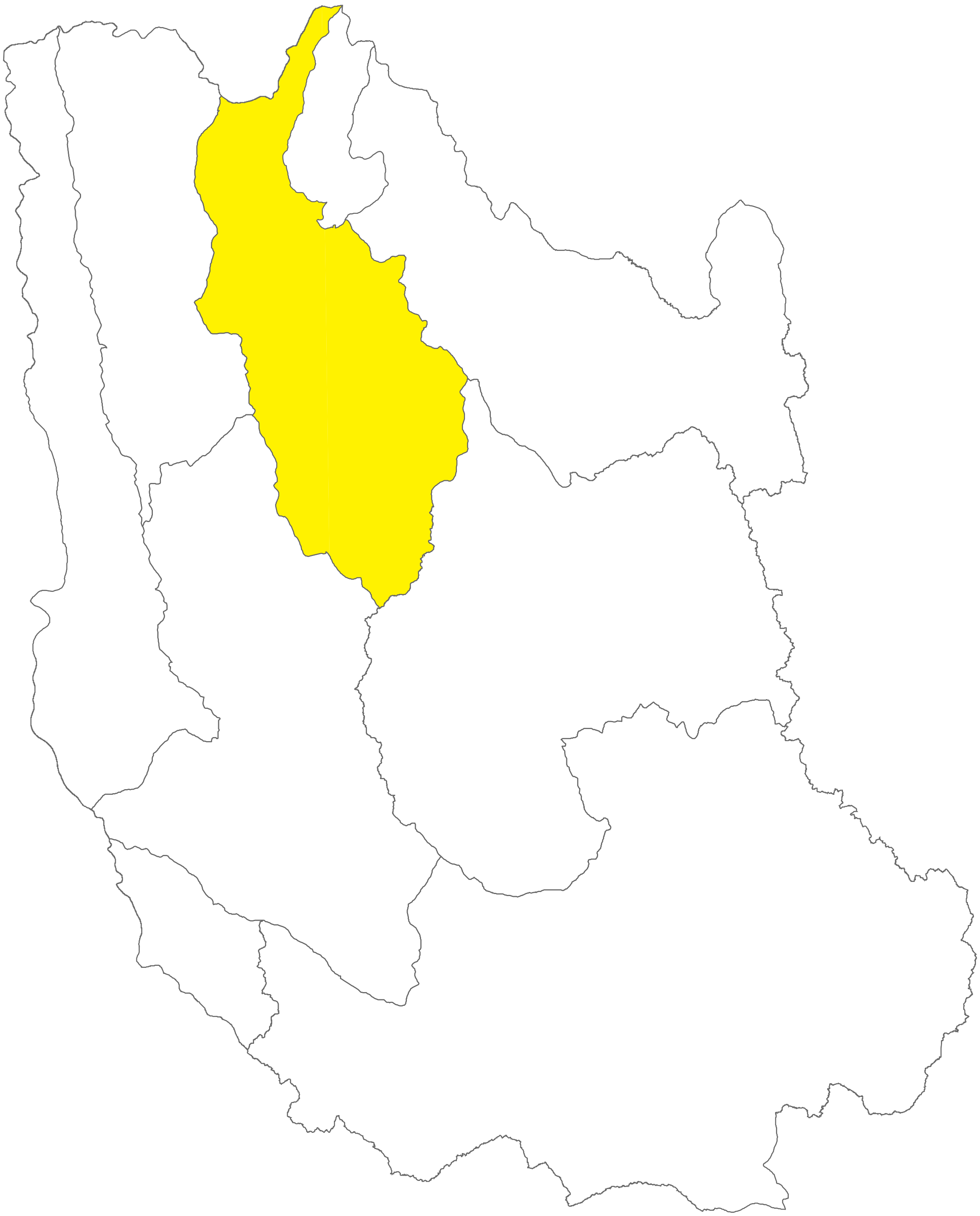
Detrital Valley Basin Index to Section 4.0

Section 4.4
Hualapai Valley Basin



4.4.1 Geography of the Hualapai Valley Basin

The Hualapai Valley Basin is a medium-size basin in the north central part of the planning area at 1,212 square miles. Geographic features and principal communities are shown on Figure 4.4-1. The basin is characterized by a wide north-south trending valley, mountains along the west basin margins and cliffs and plateau on the eastern basin boundary. Vegetation types include Mohave desertscrub, semidesert grassland, chaparral, conifer woodlands and conifer forest.

- Principal geographic features shown on Figure 4.4-1 are:
  - Principal community of New Kingman-Butler, the small community of Hackberry and the national park service facilities at South Cove.
  - Hualapai Valley running through the center of the basin
  - Red Lake, a dry lake in the center of the basin
  - Truxton Wash running from the southeast near Hackberry to Red Lake
  - The Cerbat Mountains on the southwestern basin boundary with the highest point in the basin, Cherum Peak at 6,978 feet, located south of Mt. Tipton and the Mount Tipton Wilderness area
  - The lowest point in the basin is at Lake Mead at approximately 1,100 feet
  - The Grand Wash Cliffs located along the eastern basin boundary
  - The White Hills located along the northwest basin boundary

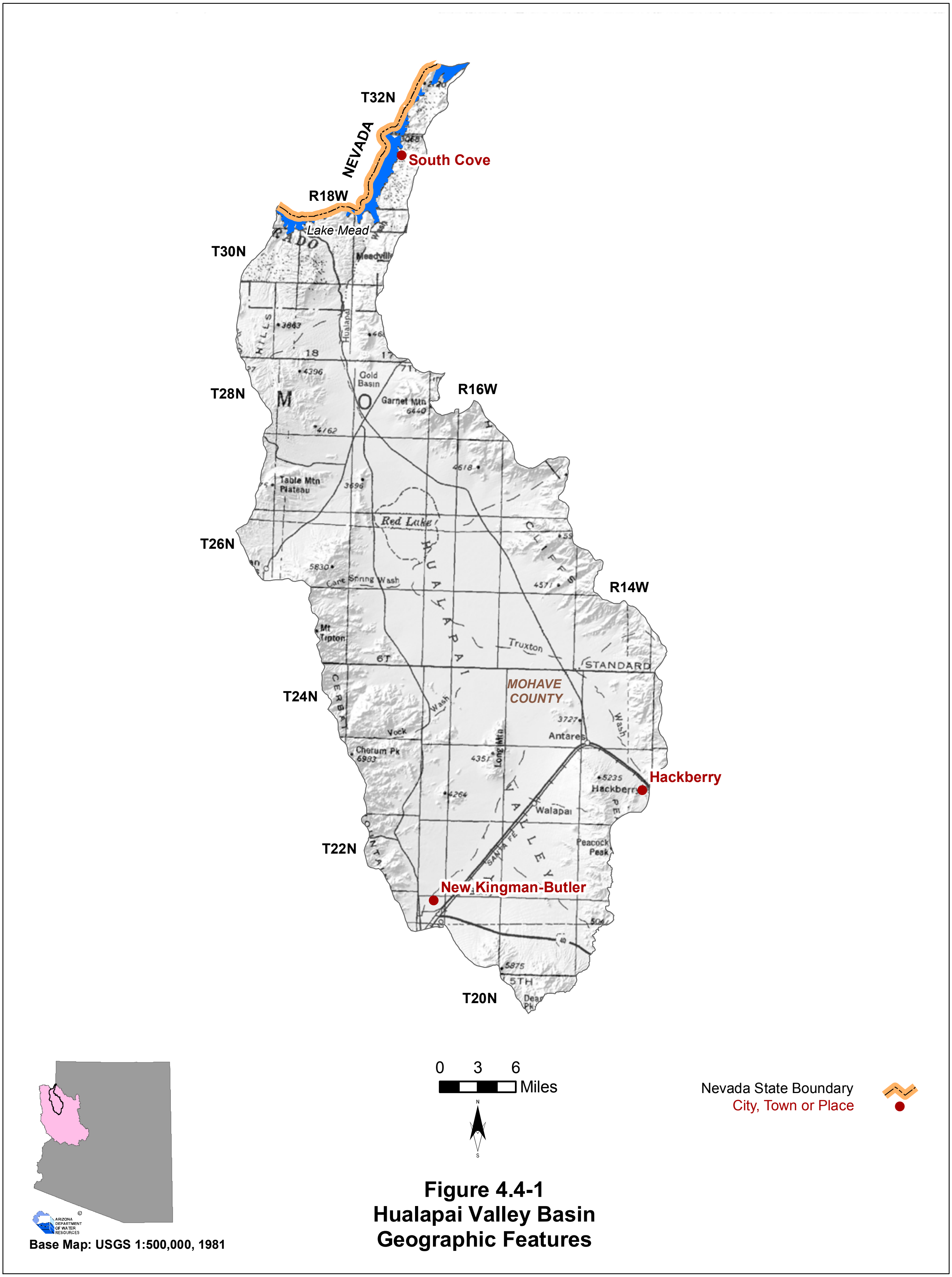


Figure 4.4-1
Hualapai Valley Basin
Geographic Features

4.4.2 Land Ownership in the Hualapai Valley Basin

Land ownership, including the percentage of ownership by category, for the Hualapai Valley Basin is shown in Figure 4.4-2. The principal feature of land ownership in this basin is the checkerboard land ownership pattern. For a discussion of how this land pattern was created see section 4.0.9. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

Private

- 43.4% of the land is private.
- Many of the private lands in the basin are interspersed in a checkerboard pattern with BLM and state trust lands. There are also a number of larger parcels of contiguous private lands around New Kingman-Butler and north of Highway 66.
- This basin contains the largest percentage of private land in the planning area.
- Land uses include domestic, commercial and ranching.

U.S. Bureau of Land Management (BLM)

- 39.1% of the land is federally owned and managed by the Kingman Field Office of the Bureau of Land Management.
- BLM lands in this basin are partially contiguous and partially found in a checkerboard pattern with private land and some state and tribal lands.
- Primary land uses are recreation and grazing.

National Parks, Monuments and Recreation Areas

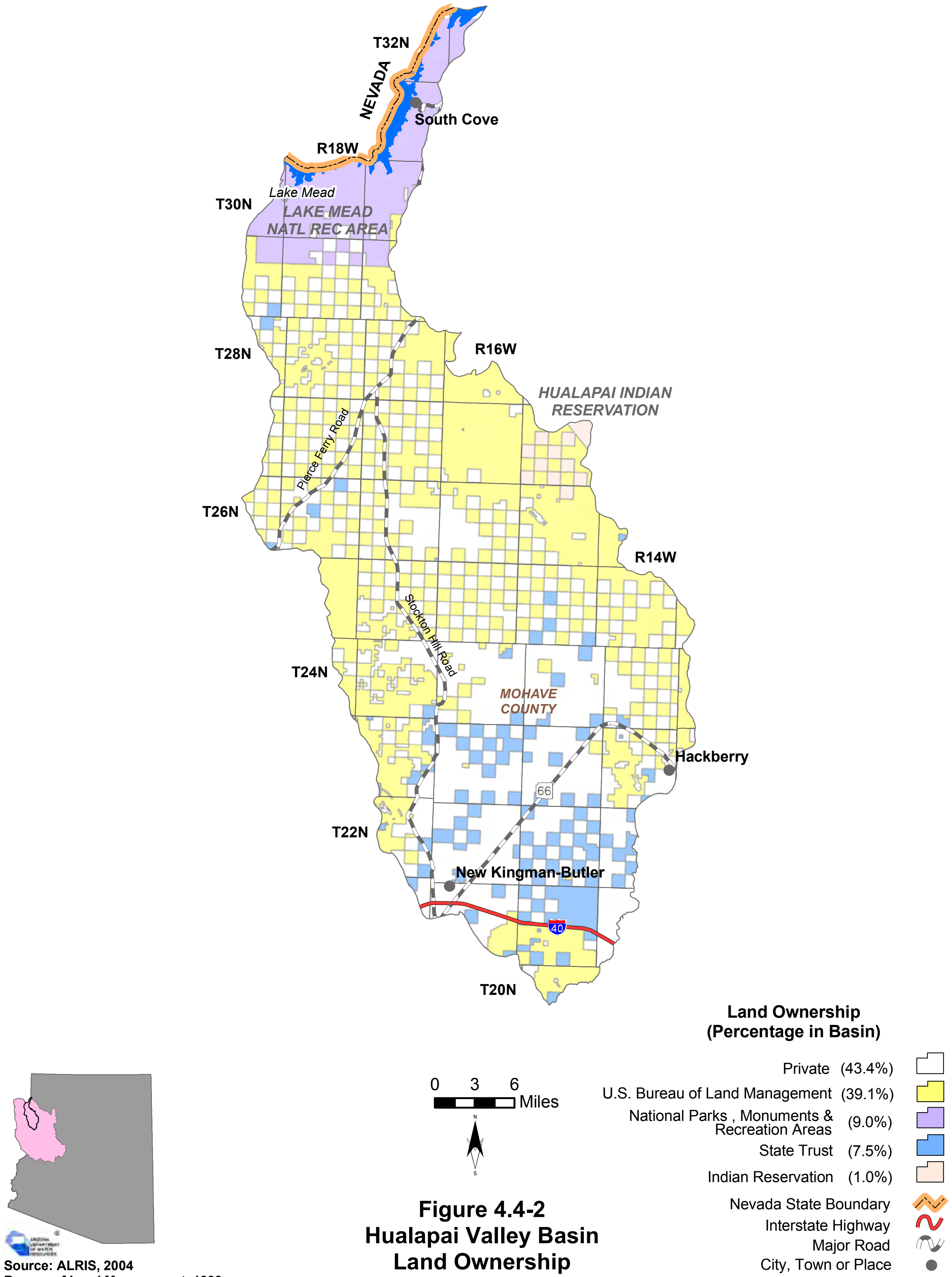
- 9.0% of the land is federally owned and managed by the National Park Service (NPS) as the Lake Mead National Recreation Area.
- All NPS lands are located along the northern basin boundary.
- Primary land use is recreation.

State Trust Land

- 7.5% of the land in this basin is held in trust for the public schools under the State Trust Land system.
- Most state lands are in the southern portion of the basin and are interspersed with private lands.
- Primary land use is grazing.

Indian Reservation

- 1.0% of the land is under ownership of the Hualapai Tribe
- Most of the Indian land is in T27N, R17W and is interspersed with BLM lands.
- Primary land use is grazing.



Source: ALRIS, 2004
Bureau of Land Management, 1999

Figure 4.4-2
Hualapai Valley Basin
Land Ownership

4.4.3 Climate of the Hualapai Valley Basin

The Hualapai Valley Basin does not contain any NOAA/NWS Co-op Network, Evaporation Pan, AZMET or SNOTEL/Snowcourse stations. The precipitation figures shown in Figure 4.4-3 are from the Spatial Climatic Analysis Service (SCAS) at Oregon State University. A description of this and other climate data sources and methods is found in Volume 1, Section 1.3.3.

SCAS Precipitation Data

- Average annual precipitation is as high as 14 inches at the southernmost tip of the basin in the Hualapai Mountains.
- Average annual precipitation is as low as four inches in the northern portion of the basin along the boundary with Nevada.
- In general, precipitation increases as the elevation increases in this basin. The range of 10 inches between areas of highest and lowest average annual precipitation is low for the planning area.

Table 4.4-1 Climate Data for the Hualapai Valley Basin

A. NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
None									

Source: WRCC, 2003.

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

Source: WRCC, 2003.

C. AZMET:

Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (*number of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content *(Number of measurements to calculate average)*					
			Jan	Feb	March	April	May	June
None								

Source: Natural Resources Conservation Service, 2005

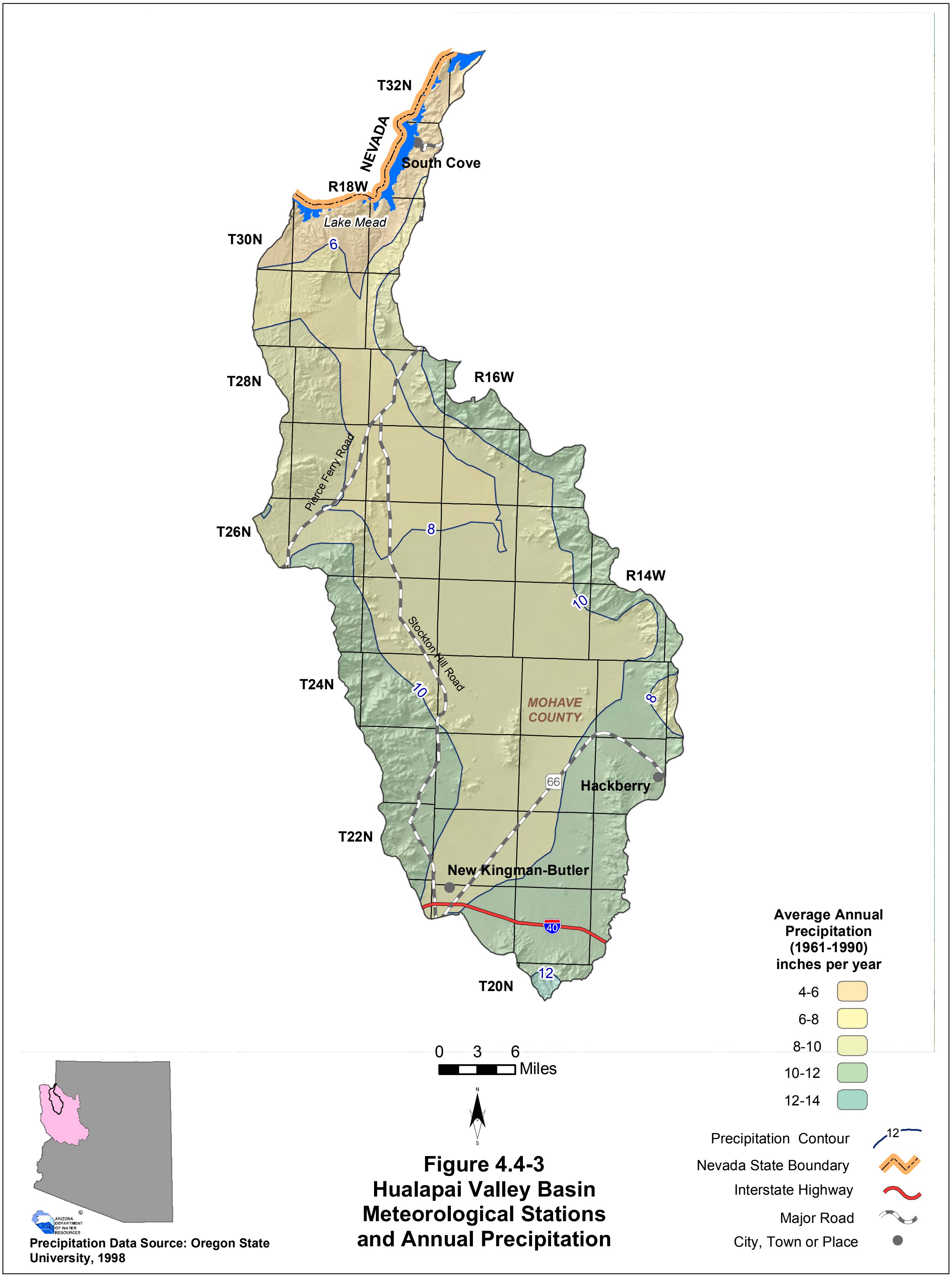


Figure 4.4-3
Hualapai Valley Basin
Meteorological Stations
and Annual Precipitation

4.4.4 Surface Water Conditions in the Hualapai Valley Basin

Streamflow was not measured in this basin. Flood ALERT equipment in the basin is shown in Table 4.4-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.4-4. The location of large reservoirs and flood ALERT equipment as well as USGS runoff contours are shown on Figure 4.4-4. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Flood ALERT Equipment

- Refer to Table 4.4-3.
- As of October 2005 there were six stations in the basin.
- Of the six stations one is precipitation only, one is a weather station and four are precipitation/stage stations.

Reservoirs and Stockponds

- Refer to Table 4.4-4.
- The basin borders one large reservoir, Mead, with a maximum capacity of 29,755,000 acre-feet. The dam that creates Lake Mead, Hoover Dam, is in the Lake Mohave Basin. The reservoir is operated for hydroelectric power generation, recreation and water supply purposes.
- Other large reservoirs in the basin include Red Lake with a maximum surface area of 13,412 acres. Red Lake is a dry lake and its use is unknown.
- Surface water is stored or could be stored in two small reservoirs in the basin.
- Total maximum storage for the one small reservoir with greater than 15 acre-feet and less than 500 acre-feet capacity is 145 acre-feet. The remaining reservoir has a surface area of 12 acres.
- There are an estimated 72 stockponds in this basin.

Runoff Contour

- Refer to Figure 4.4-4.
- Average annual runoff is 0.5 inches per year in the southwest corner of the basin around New Kingman-Butler and decreases to 0.1 inches in the northern and eastern portions of the basin.

Table 4.4-2 Streamflow Data for the Hualapai Valley Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
None													

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Table 4.4-3 Flood ALERT Equipment in the Hualapai Valley Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
1600	Mohave Wash	Precipitation/Stage	12/4/2001	Mohave County FCD
1670	Kingman ADOT	Weather Station	12/3/2001	Mohave County FCD
7400	Devlin Wash	Precipitation/Stage	NA	Mohave County FCD
7440	Archibald Wash	Precipitation/Stage	NA	Mohave County FCD
7510	Diagonal Wash	Precipitation/Stage	NA	Mohave County FCD
7660	Bull Mountain	Precipitation	NA	Mohave County FCD

Notes:
FCD = Flood Control District
NA = Not available

Table 4.4-4 Reservoirs and Stockponds in the Hualapai Valley Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE[1]	JURISDICTION
None	Mead (Hoover Dam)[2]	Bureau of Reclamation	29,755,000[3]	C,H,I,RR,S	Federal

Sources: US Army Corps of Engineers 2005, BOR 2006

B. Other Large Reservoirs (50 acre surface area or greater)[4]

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE[1]	JURISDICTION
1	Red[5]	Private	13,412	U	Landowner

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 1
Total maximum storage: 145 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)[3]

Total number: 1
Total surface area: 12 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 72 (from water right filings)

Notes:
[1] C=flood control; H=hydroelectric; I=irrigation; R=recreation; RR=river regulation; S=water supply; U=Unknown
[2] Dam is located in Lake Mohave Basin and lake storage is located in Lake Mohave, Detrital Valley, Hualapai Valley and Meadview Basins.
[3] Includes 2,378,000 acre-feet of dead storage.
[4] Capacity data not available to ADWR
[5] Dry lake

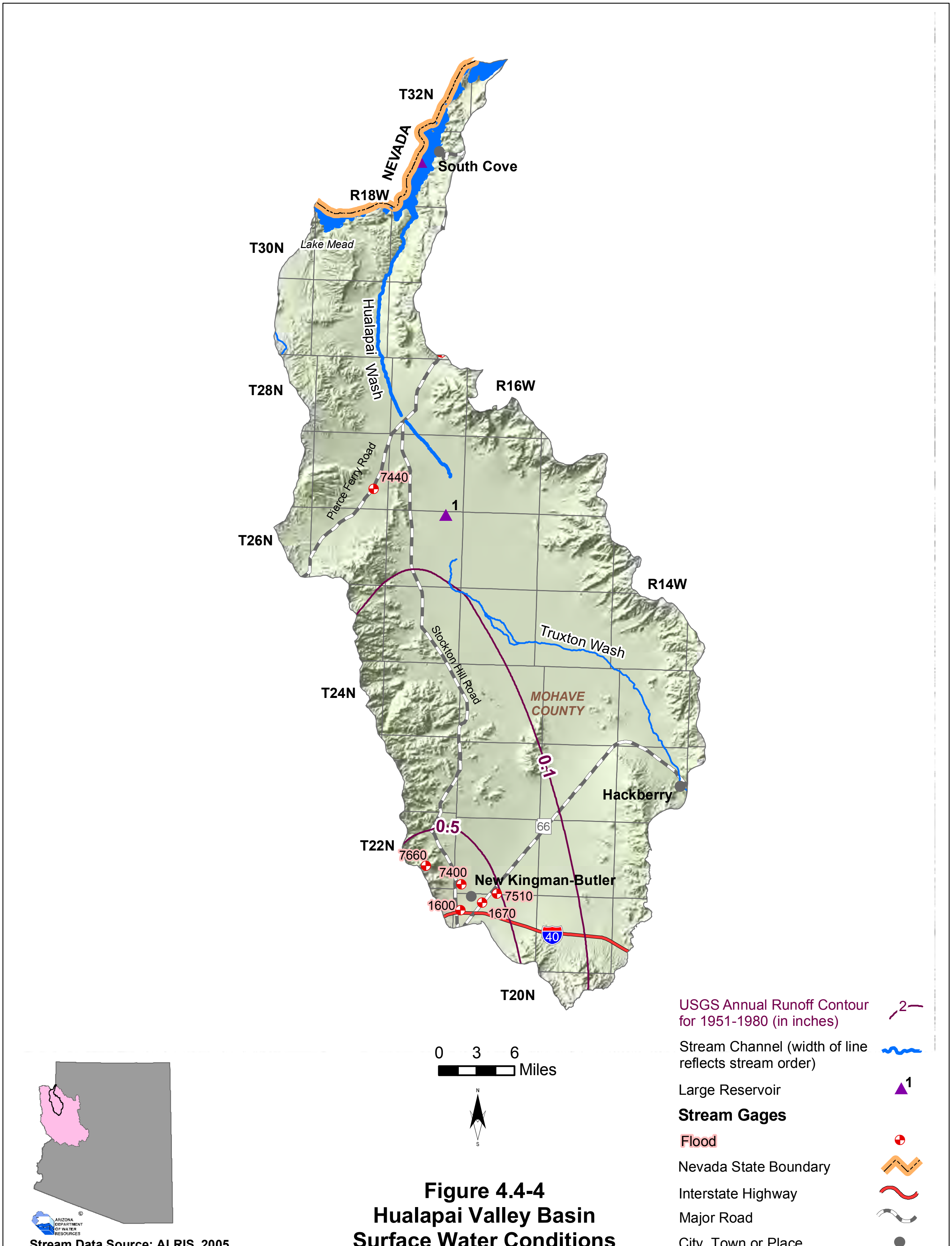


Figure 4.4-4
Hualapai Valley Basin
Surface Water Conditions

4.4.5 Perennial/Intermittent Streams and Major Springs in the Hualapai Valley Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 4.4-5. The locations of major springs as well as perennial and intermittent streams are shown on Figure 4.4-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- There is one perennial stream, the Colorado River, located along the northern basin boundary.
- There are three major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time.
- Listed discharge rates may not be indicative of current conditions. Two of the major springs in this basin were measured before 1997.
- Major springs are found on the edges of the basin. The greatest discharge rate was measured near the Nevada boundary (Westwater, 49 gpm).
- All major springs discharge less than 50 gpm.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 4.4-5B. There are 19 minor springs identified in this basin.
- The total number of springs identified by the USGS varies from 70 to 72, depending on the database reference.

Table 4.4-5 Springs in the Hualapai Valley Basin

A. Major Springs (10 gpm or greater):

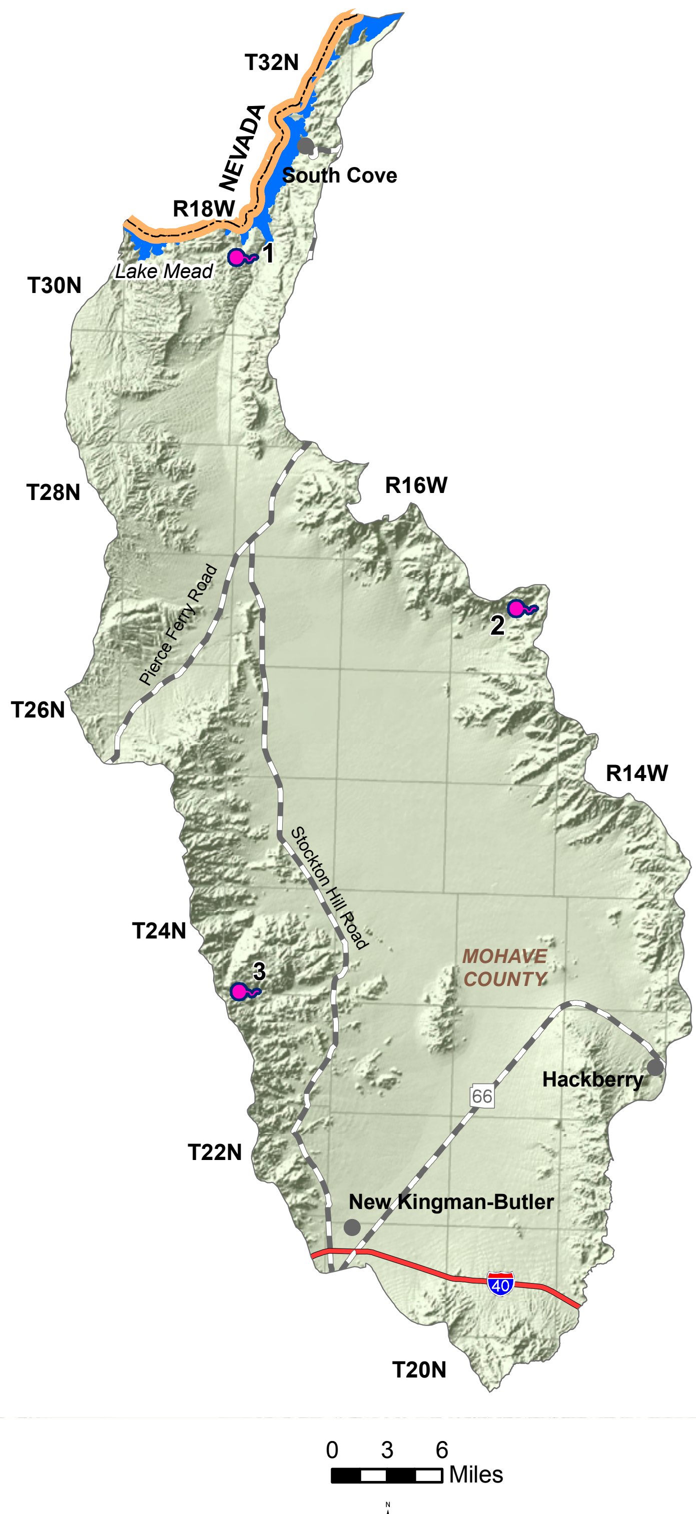
Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Unnamed	360031	1140902	25	2/9/1976
2	Clay (middle)	354346	1135202	18	6/10/1993
3	Unnamed	352512	1140726	10	During or prior to 1964

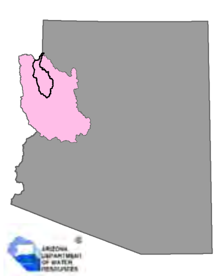
B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Unnamed	351100	1135120	7	1/1940
Unnamed	352429	1134301	6	During or prior to 1950
Unnamed	360042	1140949	5	6/1973
Unnamed	352058	1134348	3	1/1965
Clay #1	354352	1135203	3	9/23/1980
Upper Stone Corral	352728	1134253	3	9/23/1980
Unnamed	350756	1135151	3	2/1965
Unnamed	351534	1140412	3	2/1965
Unnamed	352744	1134239	3[2]	During or prior to 1965
Unnamed	355920	1141525	2	1/5/1975
Unnamed	352225	1134940	2	5/1965
Unnamed	352133	1140357	2	During or prior to 1965
Unnamed	350743	1135318	2	2/1965
Unnamed	350838	1135359	1	2/1965
Unnamed	352255	1140823	1	1/1965
Unnamed	352121	1140626	1	During or prior to 1965
Unnamed	353044	1134321	1	During or prior to 1965
Unnamed	353152	1140826	1	During or prior to 1964
Cedar	354638	1135808	1	9/23/1980

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and USGS, 2006): 70 to 72

Notes:
[1]Most recent measurement identified by ADWR
[2]Most recent measurement <1gpm





Stream Data Source: AGFD, 1993 & 1997

Figure 4.4-5
Hualapai Valley Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

4.4.6 Groundwater Conditions of the Hualapai Valley Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 4.4-6. Figure 4.4-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 4.4-7 contains hydrographs for selected wells shown on Figure 4.4-6. Figure 4.4-8 shows well yields in five yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields, is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 4.4-6 and Figure 4.4-6.
- The major aquifer and principal water-bearing unit in this basin is basin fill.
- Flow direction is from the south to the north in most of the basin and east to west near New Kingman-Butler.

Well Yields

- Refer to Table 4.4-6 and Figure 4.4-8.
- As shown on Figure 4.4-8 well yields in this basin range from less than 100 gallons per minute (gpm) to greater than 2,000 gpm.
- One source of well yield information, based on 33 reported wells, indicates that the median well yield in this basin is 900 gpm.

Natural Recharge

- Refer to Table 4.4-6.
- There are two estimates of natural recharge for this basin ranging from 2,000 acre-feet per year to 3,000 acre-feet per year.
- Recharge to the aquifers comes principally from streambed infiltration.

Water in Storage

- Refer to Table 4.4-6.
- There are four storage estimates for this basin, ranging from three million acre-feet to 5.3 million acre-feet to a depth of 1,200 acre-feet. The most recent estimate, from a 1994 ADWR study, indicates the basin has between five and 5.3 million acre-feet in storage to a depth of 1,200 feet.
- The USGS (1971) estimates that the basin has between 10.5 and 21 million acre-feet in storage to a depth of 1,500 feet.
- The predevelopment storage estimate is five million acre-feet to a depth of 1,200 feet.

Water Level

- Refer to Figure 4.4-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures seven index wells in this basin.

- The Department measures water levels four times daily at one automated groundwater monitoring site in the southern portion of the basin.
- In 1995, the year of the last water level sweep, 79 wells were measured.
- The deepest recorded water level in the basin is 924 feet east of New Kingman-Butler and the shallowest is 257 feet east of Stockton Hill Road in the center of the basin.
- Hydrographs corresponding to selected wells shown on Figure 4.4-6 but covering a longer time period are shown in Figure 4.4-7.

Table 4.4-6 Groundwater Data for the Hualapai Valley Basin

Basin Area, in square miles:	1,212	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Basin Fill	
	Sedimentary Rock (Muddy Creek and Chemehueve Formations)	
Well Yields, in gal/min:	Range 20-2,128 Median 966.5 (10 wells measured)	Measured by ADWR and/or USGS
	Range 5-6,000 Median 900 (33 reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 30-1,500	ADWR (1990 and 1994)
	Range 0-2,500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	3,000	Freethey and Anderson (1986)
	2,000 - 2,500	ADWR (1981) (HMS 4)
Estimated Water Currently in Storage, in acre-feet:	5,000,000 - 5,300,000 (to 1,200 ft)	ADWR (1990 and 1994)
	5,000,000[1] (to 1,200 ft)	Freethey and Anderson (1986)
	3,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
	10,500,00 - 21,000,000 (to 1,500 ft)	USGS (1971)
Current Number of Index Wells:	7	
Date of Last Water-level Sweep:	1995 (79 wells measured)	

Notes:
[1] Predevelopment Estimate

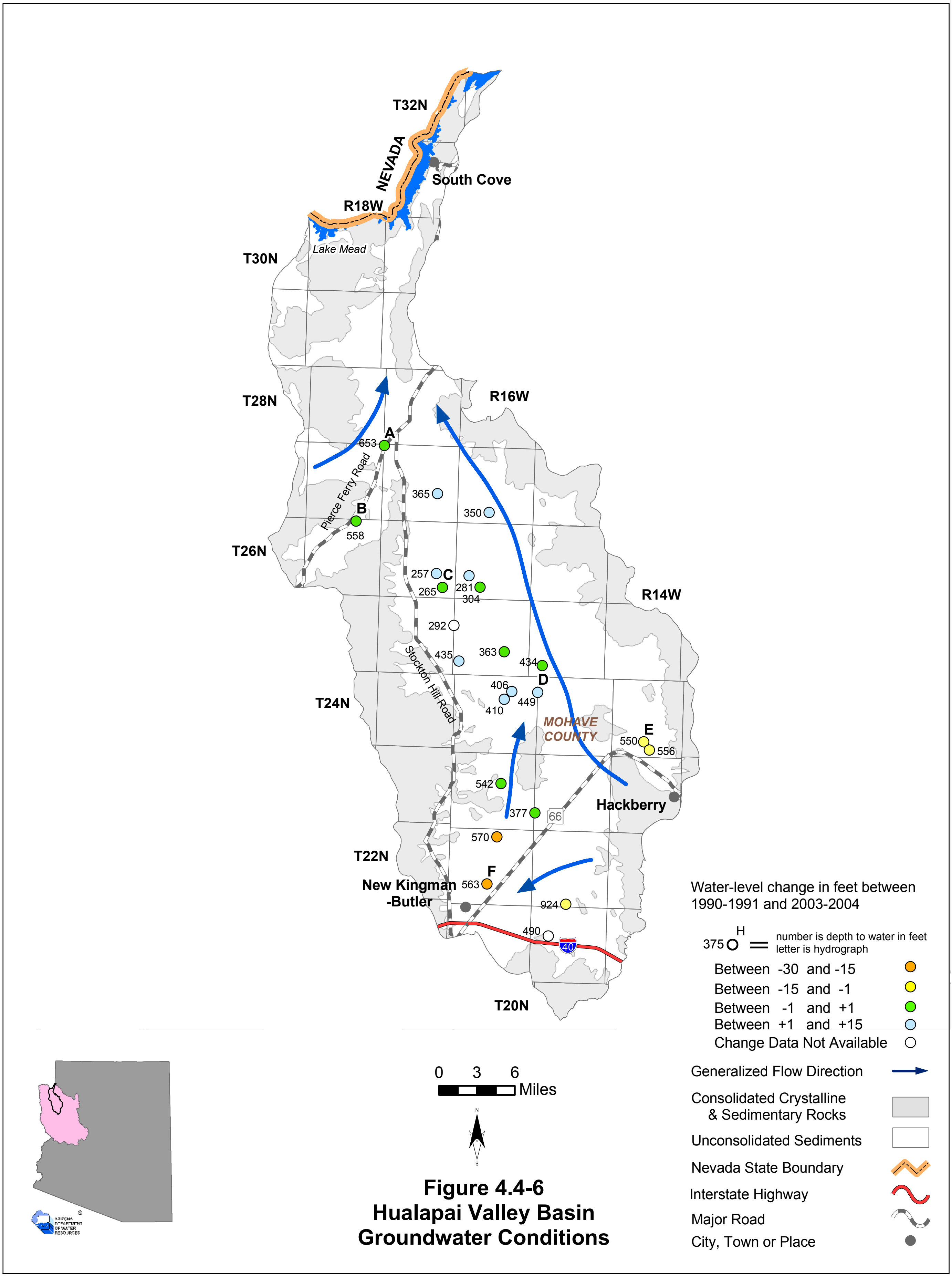


Figure 4.4-6
Hualapai Valley Basin
Groundwater Conditions

Figure 4.4-7
Hualapai Valley Basin
Hydrographs Showing Depth to Water in Selected Wells

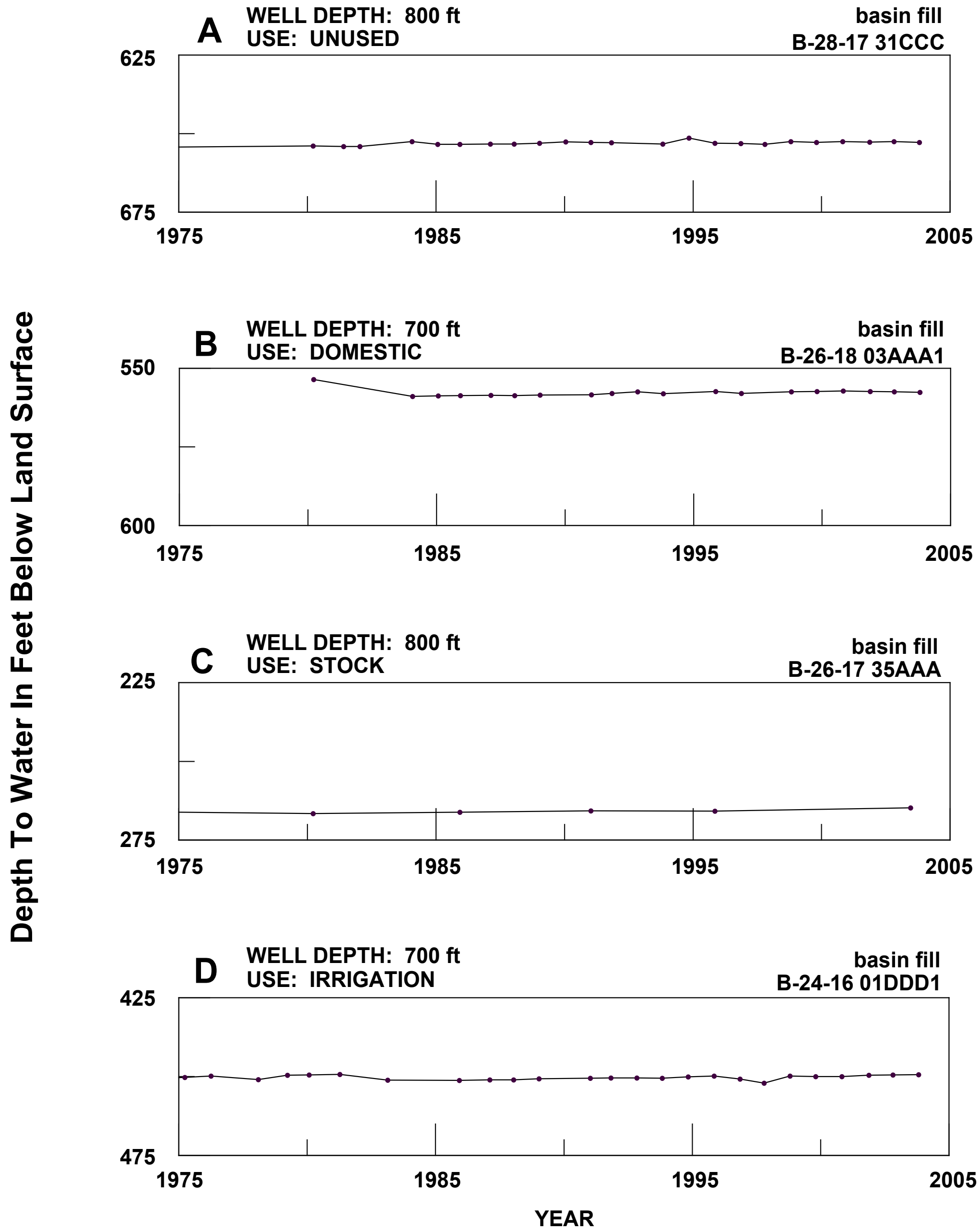
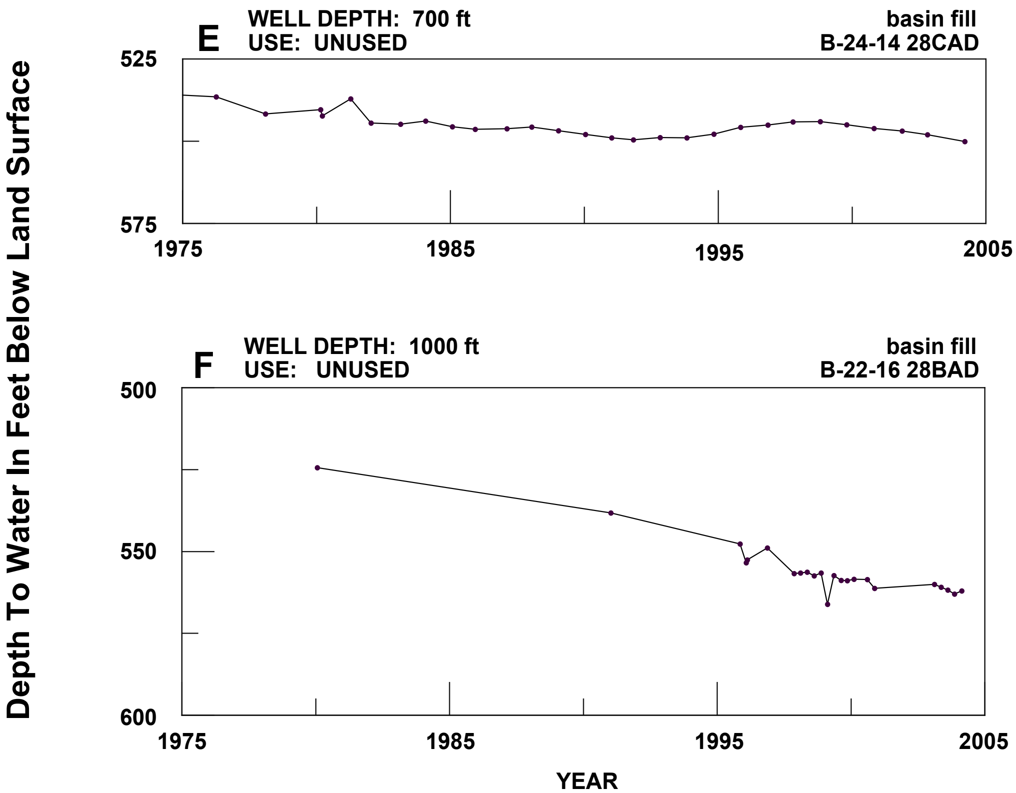


Figure 4.4-7 (Con't)
Hualapai Valley Basin
Hydrographs Showing Depth to Water in Selected Wells



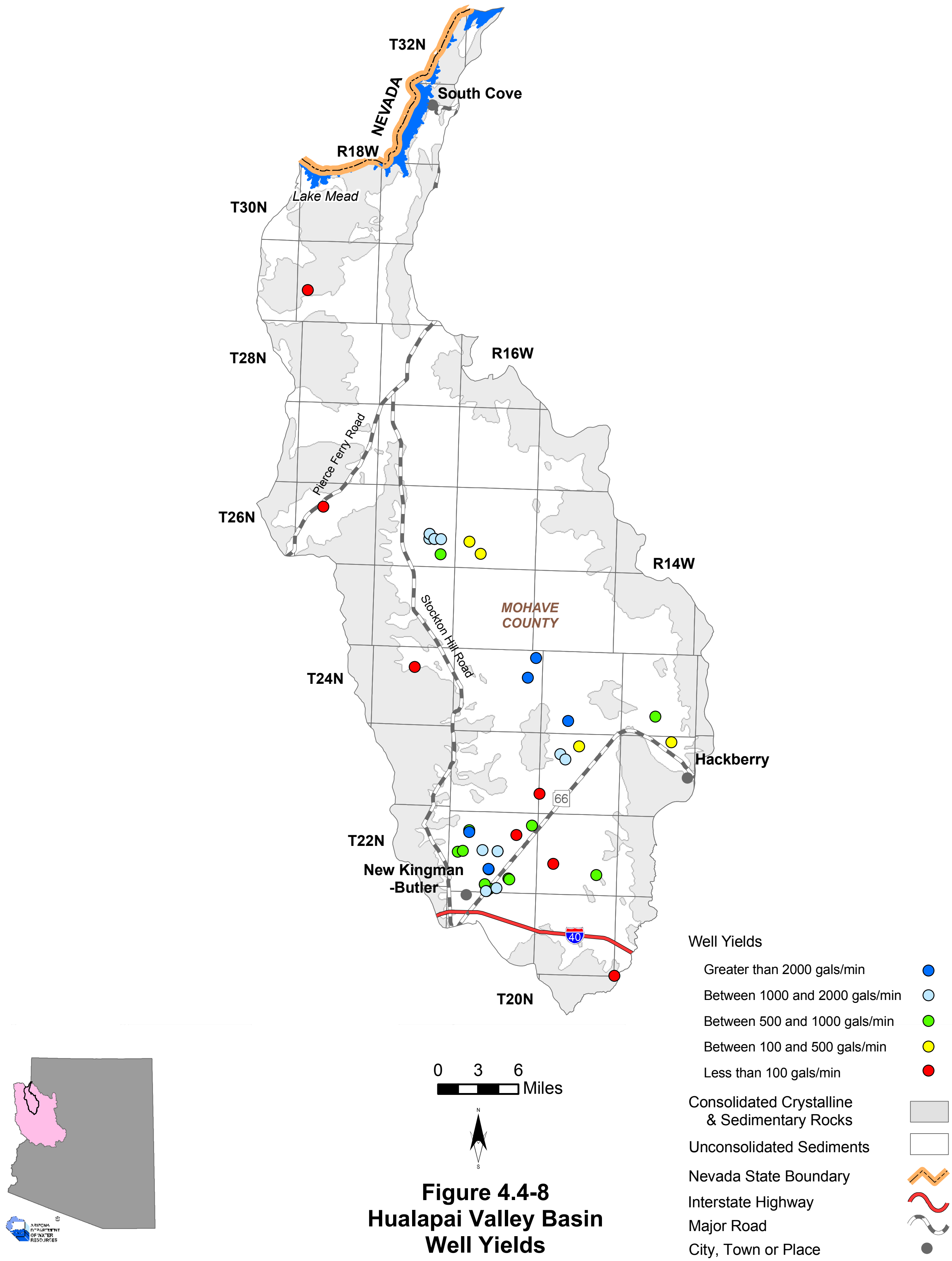


Figure 4.4-8
Hualapai Valley Basin
Well Yields

4.4.7 Water Quality of the Hualapai Valley Basin

Drinking water standard exceedences in wells, springs and mine sites including location and parameter(s) exceeded are shown in Table 4.4-7A. There are no impaired lakes or streams in this basin. Figure 4.4-9 shows the location of exceedences keyed to Table 4.4-7A. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mine Sites

- Refer to Table 4.4-7A.
- Drinking water standard exceedences in wells and springs have been reported for 31 sites in the basin.
- The drinking water standards for fluoride and radionuclides were the most frequently exceeded standards at sites in this basin.
- Most fluoride exceedences are in the northern portion of the basin. Radionuclide exceedences are scattered throughout the basin.
- Other drinking water standards exceeded in this basin include antimony, chromium, lead and nitrate/nitrite.

Table 4.4-7 Water Quality Exceedences in the Hualapai Valley Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Exceeding Drinking Water Standard[2]
		Township	Range	Section	
1	Spring	30 North	17 West	7	F
2	Well	28 North	16 West	34	Rad
3	Well	28 North	16 West	34	Rad
4	Spring	28 North	17 West	24	F
5	Spring	27 North	15 West	17	F
6	Well	26 North	14 West	30	F
7	Well	26 North	16 West	29	F
8	Well	26 North	17 West	19	NO3
9	Well	26 North	17 West	35	Be
10	Well	25 North	14 West	9	Sb, As, Rad
11	Well	24 North	14 West	19	F
12	Well	24 North	16 West	1	As
13	Spring	24 North	17 West	33	Rad
14	Spring	23 North	14 West	27	Rad
15	Well	23 North	15 West	4	F
16	Well	23 North	16 West	7	NO3
17	Well	23 North	16 West	19	NO3
18	Well	23 North	16 West	29	NO3
19	Spring	23 North	17 West	9	As, Rad
20	Spring	23 North	17 West	11	As, Rad
21	Spring	23 North	17 West	26	As
22	Well	23 North	17 West	35	F
23	Well	22 North	14 West	19	Rad
24	Well	22 North	15 West	13	As
25	Well	22 North	16 West	27	Cr, Pb
26	Well	22 North	16 West	28	Pb
27	Well	22 North	16 West	33	Pb
28	Well	22 North	16 West	33	Pb
29	Well	22 North	16 West	34	Pb
30	Well	21 North	16 West	24	Rad
31	Well	20 North	15 West	6	Rad

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard	Parameter(s) Exceeding Use Standard
None identified by ADWR at this time						

Notes:

[1] Water quality samples collected between 1976 and 2000.

[2] Sb = Antimony
As = Arsenic
Cr = Chromium
F = Fluoride
Pb = Lead
NO3 = Nitrate/Nitrite
Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium

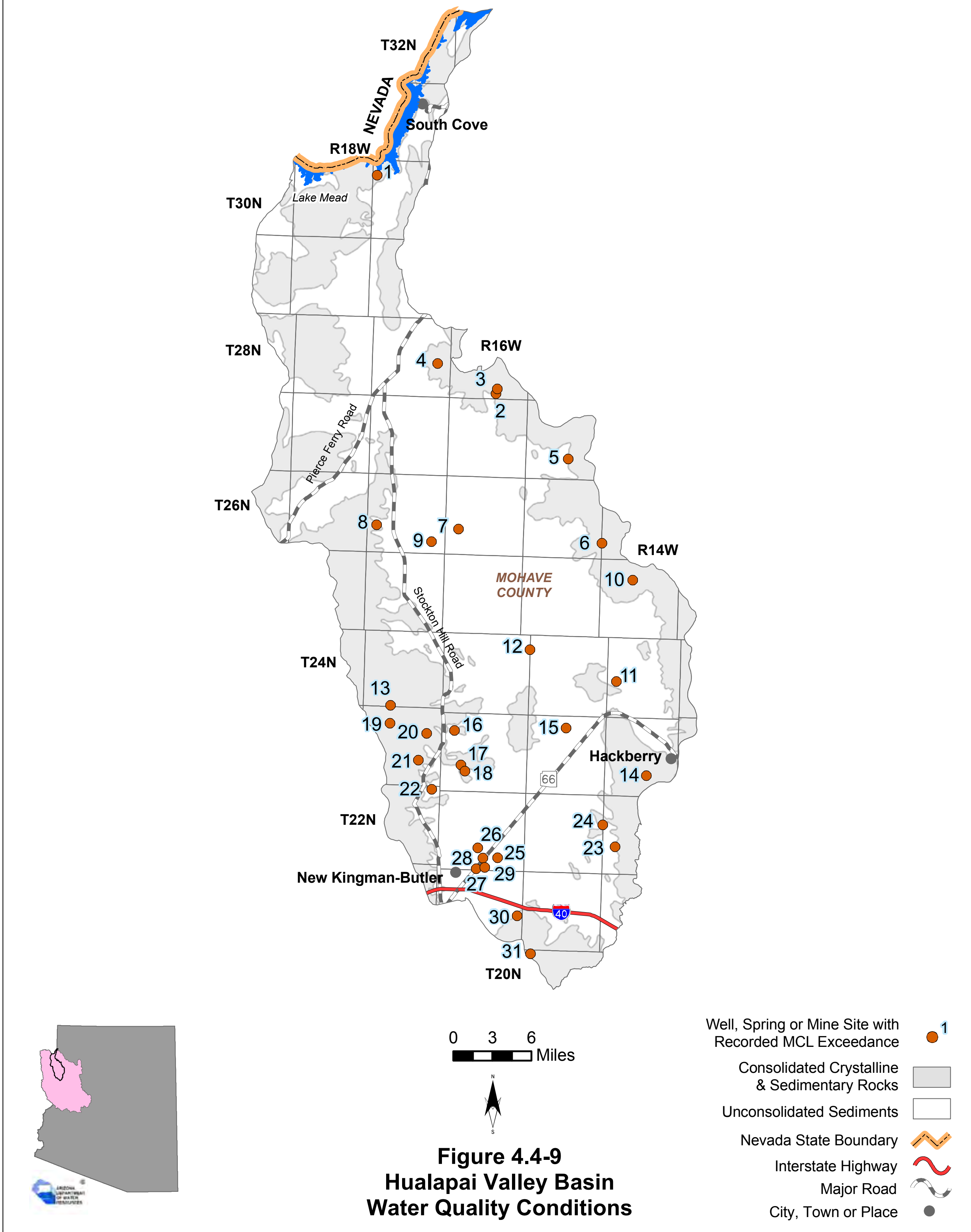


**Figure 4.4-9
Hualapai Valley Basin
Water Quality Conditions**

4.4.8 Cultural Water Demands in the Hualapai Valley Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 4.4-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 4.4-9. Figure 4.4-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 4.0.7.

Cultural Water Demands

- Refer to Table 4.4-8 and Figure 4.4-10.
- Population in this basin has almost tripled since 1980, increasing from 11,361 in 1980 to 31,543 in 2000. Projections suggest the population will more than double by 2050.
- Groundwater use has increased in this basin since 1971, with an average of 3,850 acre-feet pumped per year from 1971-1975 to an average of 8,450 acre-feet pumped per year from 2001-2003.
- There are no recorded surface water diversions in this basin.
- The USGS National Gap Analysis Program identified a very small area of agriculture northeast of New Kingman-Butler in T22N, R16W, however, the Department's records do not indicate agricultural water demand in this basin.
- Most of the municipal and industrial demand is in the vicinity of New Kingman-Butler with a smaller portion of municipal demand along Pierce Ferry Road.
- Municipal groundwater demand has grown from 5,500 acre-feet per year on average in 1991 to 8,300 acre-feet per year on average in 2003. The City of Kingman, in the Sacramento Valley Basin, obtains most of its water from well fields in this basin.
- Industrial groundwater demand is minimal in this basin, less than 300 acre-feet per year from 1991-2003. All industrial groundwater demand is for mining.
- There are three small mines or quarries in the basin, two north of Pierce Ferry Road and one on the basin boundary north of New Kingman-Butler.
- As of 2003 there were 725 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 41 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 4.3-9.
- There are two wastewater treatment facilities in this basin, Desert Fountain Wastewater Treatment Plant, which serves a subdivision in the New Kingman-Butler area and Kingman – Hilltop, which serves the City of Kingman.
- Information on population served and effluent generation was only available for the Kingman – Hilltop facility. This facility serves over 16,000 people and generates almost 2,000 acre-feet of effluent per year.
- The Kingman – Hilltop facility discharges to an evaporation pond and a wildlife area.

Table 4.4-8 Cultural Water Demands in the Hualapai Valley Basin[1]

Year	Recent (Census) and Projected (DES) Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)						
				Well Pumpage			Surface-Water Diversions			Data Source
		Q ≤ 35 gpm	Q > 35 gpm	Municipal[2]	Industrial	Irrigation	Municipal	Industrial	Irrigation	
1971										
1972										
1973					3,850			NR		
1974										
1975										
1976		177[3]	31[3]							
1977										
1978					4,850			NR		
1979										
1980	11,361									ADWR (1994)
1981	12,221									
1982	13,081									
1983	13,941	52	5		4,850			NR		
1984	14,800									
1985	15,660									
1986	16,520									
1987	17,380									
1988	18,240	49	2		4,850			NR		
1989	19,100									
1990	19,960									
1991	21,118									
1992	22,276									
1993	23,435	110	1	5,500	<300	NR		NR		
1994	24,593									
1995	25,751									
1996	26,910									
1997	28,068									USGS (2005)
1998	29,227	156	1	7,300	<300	NR		NR		
1999	30,385									
2000	31,543									
2001	32,758									
2002	33,972	90	1	8,300	<300	NR		NR		
2003	35,187									
2010	43,688									
2020	52,993									
2030	60,465									
2040	65,725									
2050	70,425									
ADDITIONAL WELLS: [4]		**91**	**0**							
WELL TOTALS:		**725**	**41**							

Notes:
NR = Not reported
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] The City of Kingman in the Sacramento Valley Basin obtains most of its water from well fields in this basin.
[3] Includes all wells through 1980.
[4] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 4.4-9 Effluent Generation in the Hualapai Valley Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf Irrigation	Wildlife Area	Discharged to Another Facility	Infiltration Basin			
Desert Fountain WWTP	NA	New Kingman-Butler	NA											
Kingman - Hilltop	City of Kingman	Kingman	16,010	1,792		X			X			Adv. Tr. 1	3,000	2004

Notes:
NA: Data not currently available to ADWR
WWTP: Wastewater Treatment Plant

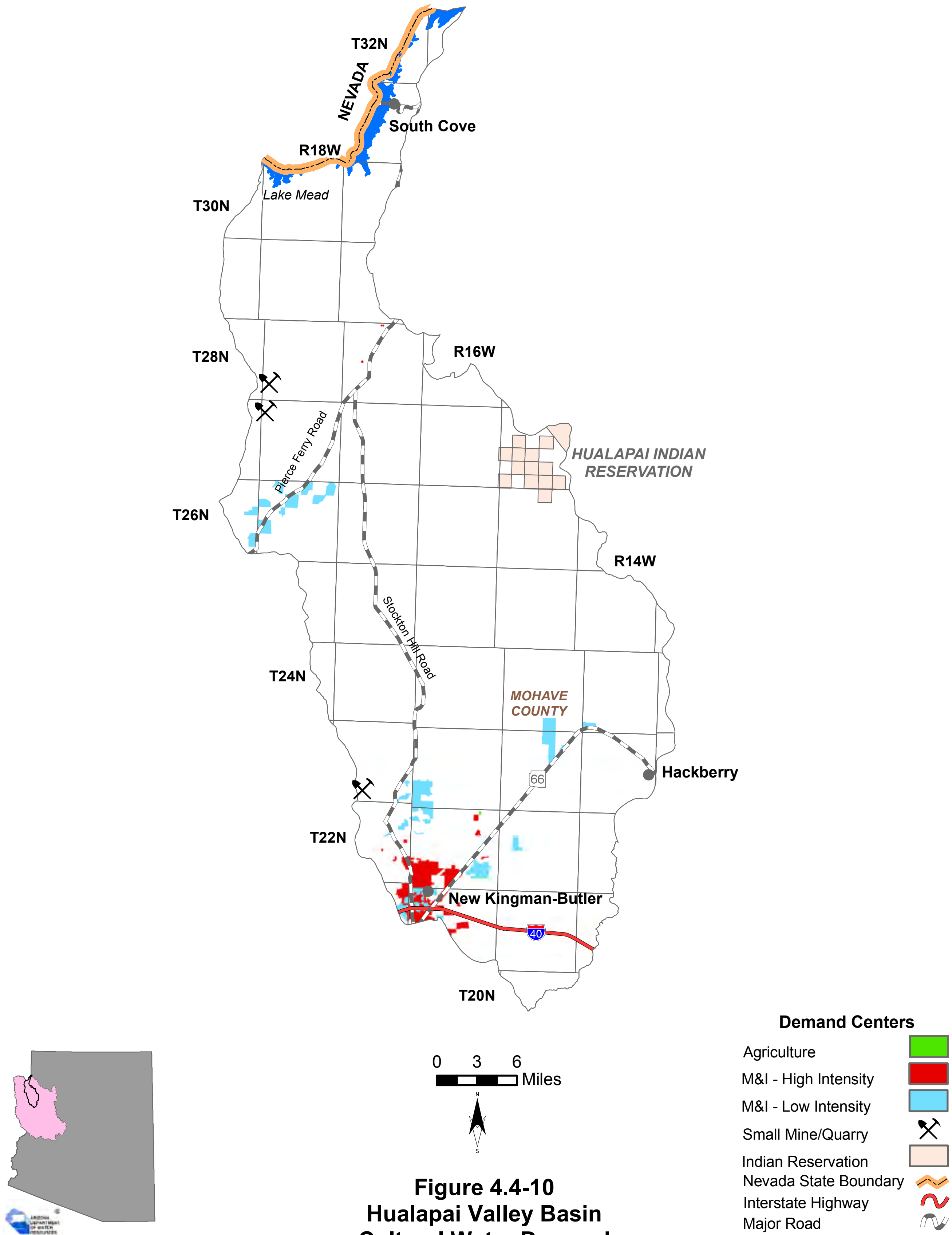


Figure 4.4-10
Hualapai Valley Basin
Cultural Water Demand

Primary Data Source: USGS National Gap Analysis Program, 2004

4.4.9 Water Adequacy Determinations in the Hualapai Valley Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 4.4-10. Figure 4.4-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

Water Adequacy Reports

- See Table 4.4-10A
- A total of 40 water adequacy determinations have been made in this basin through December, 2006.
- 32 determinations of inadequacy have been made; these determinations are found throughout the basin.
- The most common reason for an inadequacy determination was based on the applicant's decision not to submit necessary information and/or available hydrologic data were insufficient to make a determination.
- Other reasons for an inadequacy determination included insufficient supply and insufficient infrastructure.
- All lots receiving an adequacy determination are in Mohave County. Of the 17,632 lots in 39 subdivisions for which lot information is available, 10,969 lots, or 62% were determined to be adequate.

Analysis of Adequate Water Supply

- See Table 4.4-10B
- One analysis of adequate water supply for a master planned community has been issued for this basin. The analysis was for 23,000 lots and is located across a broad disconnected area. For more information on analysis of adequate water supply see Section 4.0.9.

Table 4.4-10 Adequacy Determinations in the Hualapai Valley Basin[1]

A. Water Adequacy Reports

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Arizona West Tract 1112	Mohave	23 North	15 West	11	256		Inadequate	A1	09/17/87	Truxton Canyon Water Company
2	Cedar Ridge Estates	Mohave	22 North	17 West	11, 14	38	22-300512	Inadequate	A1	09/04/98	Dry Lot Subdivision
3	Cerbat Ranches Unit 1	Mohave	22 North	17 West	12	125		Adequate		11/14/80	Cerbat Water Company, Inc.
4	Fountain Hills Estates	Mohave	22 North	17 West	13	66	22-300087	Adequate		09/26/96	Cerbat Water Company, Inc.
5	Greater Kingman Industrial Park	Mohave	22 North	15 West	5, 17	200		Adequate		07/27/73	Dry Lot Subdivision
6	Greater Kingman Industrial Park B	Mohave	22 North	15 West	5, 17	19	22-300156	Inadequate	A2	06/14/96	Dry Lot Subdivision
7	Hillview Ranches	Mohave	23 North	16 West	7	9	22-400741	Inadequate	A1, A2	07/02/02	Dry Lot Subdivision
8	Hualapai Vista Estates, Tract 3811	Mohave	22 North	16 West	12, 13	41	22-400832	Inadequate	A1, A2	10/17/02	Dry Lot Subdivision
9	Joshua Park Unit 1	Mohave	28 North	17 West	9	48	22-300558	Inadequate	A2	10/29/98	Dry Lot Subdivision
10	Joshua Park Unit 1	Mohave	28 North	17 West	9	141	22-402005	Inadequate	A1	01/26/06	Dry Lot Subdivision
11	Lake Juniper	Mohave	22 North	17 West	11, 14	16	22-400872	Inadequate	A1, A2	01/31/03	Lake Juniper HOA & Mohave County
12	Lake Juniper Estates	Mohave	22 North	17 West	11, 14	197		Adequate		02/22/91	Lake Juniper Water Company
13	Lake Mead Rancheros	Maricopa	25 North	15 West	3	259	053-500036	Inadequate	A1	11/30/2006	Dry Lot Subdivision
14	Lake Mead Rancheros # 1-12	Mohave	25 North	15 West	12, 15, 17, 19, 21, 23, 25, 27,	1,606		Inadequate	A1, A2	02/13/86	Dry Lot Subdivision
15	Lake Mead Ranchos Unit 3	Mohave	28 North	18 West	11	592	22-300328	Inadequate	A1	07/23/97	Dry Lot Subdivision
16	Lake Mead Ranchos Unit 5	Mohave	29 North	18 West	25	541	22-400713	Inadequate	A1, A2	05/21/02	Dry Lot Subdivision
17	Lake Mead Ranchos Unit 6	Mohave	29 North	18 West	27	402	22-402006	Inadequate	A1	01/26/06	Dry Lot Subdivision
18	Lake Mead Ranchos Unit 7	Mohave	29 North	18 West	23	567	22-400714	Inadequate	A1, A2	05/21/02	Dry Lot Subdivision
19	Lake Mead Ranchos Unit 7	Mohave	29 North	18 West	23	569	22-402007	Inadequate	A1	01/26/06	Dry Lot Subdivision
20	Lake Mohave Ranchos D	Mohave	26 North	18 West	1, 3, 5, 7, 9, 11, 13, 15	NA		Inadequate	A2, A3	11/23/77	Dry Lot Subdivision
21	Lake Mohave Ranchos Unit 6	Mohave	26 North	19 West	25	6	22-401294	Inadequate	D	04/26/04	NA
22	Mead-O-Rama	Mohave	29 North	18 West	35	421	22-401651	Adequate		03/04/05	Dry Lot Subdivision

Table 4.4-10 Adequacy Determinations in the Hualapai Valley Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
23	Mead-O-Rama # 2	Mohave	29 North	19 West	27	221		Inadequate	A2, A3	08/31/84	Dry Lot Subdivision
24	Mead-O-Rama # 3	Mohave	29 North	18 West	35	141		Inadequate	A2, A3	08/31/84	Dry Lot Subdivision
25	Mead-O-Rama # 4	Mohave	29 North	17 West	31	441		Inadequate	A2, A3	08/31/84	Dry Lot Subdivision
26	Pinion Pines Estates # 2	Mohave	20 North	15 West	6	21		Inadequate	A1, A2	03/01/77	Dry Lot Subdivision
27	Quail Valley Estates	Mohave	22 North	17 West	12	32		Adequate		11/24/81	Cerbat Water Company, Inc.
28	Red Wing Canyon Estates	Mohave	23 North	17 West	23	30		Inadequate	A1	05/04/89	Dry Lot Subdivision
29	Shadow Mountain Acres Unit 2 & 3	Mohave	24 North	14 West	27, 35	93	22-400424	Inadequate	A1, A2	11/29/00	Dry Lot Subdivision
30	Sunrise Mountain Estates	Mohave	23 North	16 West	33	35		Inadequate	A1, A2, A3	01/14/92	Dry Lot Subdivision
31	Sunward Ho! Ranches	Mohave	23 North	16 West	19, 30, 31, 33	430	22-300439	Inadequate	A1	04/03/98	Dry Lot Subdivision
32	Sunward Ho! Ranches, Amatista Acres	Mohave	23 North	16 West	29	17		Inadequate	A1	09/19/91	Dry Lot Subdivision
33	Sunward Ho! Ranches, Esmeralda Acres	Mohave	23 North	16 West	31	19		Inadequate	A1	09/19/91	Dry Lot Subdivision
34	Sunward Ho! Ranches Turquesa Acres	Mohave	23 North	16 West	30	35		Inadequate	A1	09/19/91	Dry Lot Subdivision
35	Sunward Ho Ranches, Zafiro Acres	Mohave	22 North	16 West	5	7	22-400065	Inadequate	A1	05/11/99	Dry Lot Subdivision
36	Sunward Ho! Ranches # 2, Sunnyvale Acres	Mohave	23 North	16 West	9	22	22-300075	Inadequate	A1 ,A2	11/20/95	Dry Lot Subdivision
37	Sunward Ho! Ranches # 2, Toro Acres	Mohave	23 North	16 West	18, 19	31		Inadequate	A1	09/19/91	Dry Lot Subdivision
38	Valle Vista	Mohave	24 North	15 West	34	1,200		Adequate		06/07/73	Truxton Canyon Water Company
39	Valle Vista # 1A, 3A	Mohave	23 North	15 West	10, 15	8,728		Adequate		03/19/75	Truxton Canyon Water Company
40	Valle Vista Unit 3 Tract 1204	Mohave	24 North	15 West	34	10	22-400514	Inadequate	A1	05/30/01	Truxton Canyon Water Company

B. Analysis of Adequate Water Supply

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section				
a	Mardian Ranch	Mohave	27-28 North	17-19 West	multiple	23,000	23-401823	01/08/07	NA

Notes:

[1] Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made. In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies.

[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.

[3] A. Physical/Continuous
1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
2) Insufficient Supply (existing water supply unreliable or physically unavaible; for groundwater, depth-to-water exceeds criteria)
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)
B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)
C. Water Quality
D. Unable to locate records
NA= not currently available to ADWR

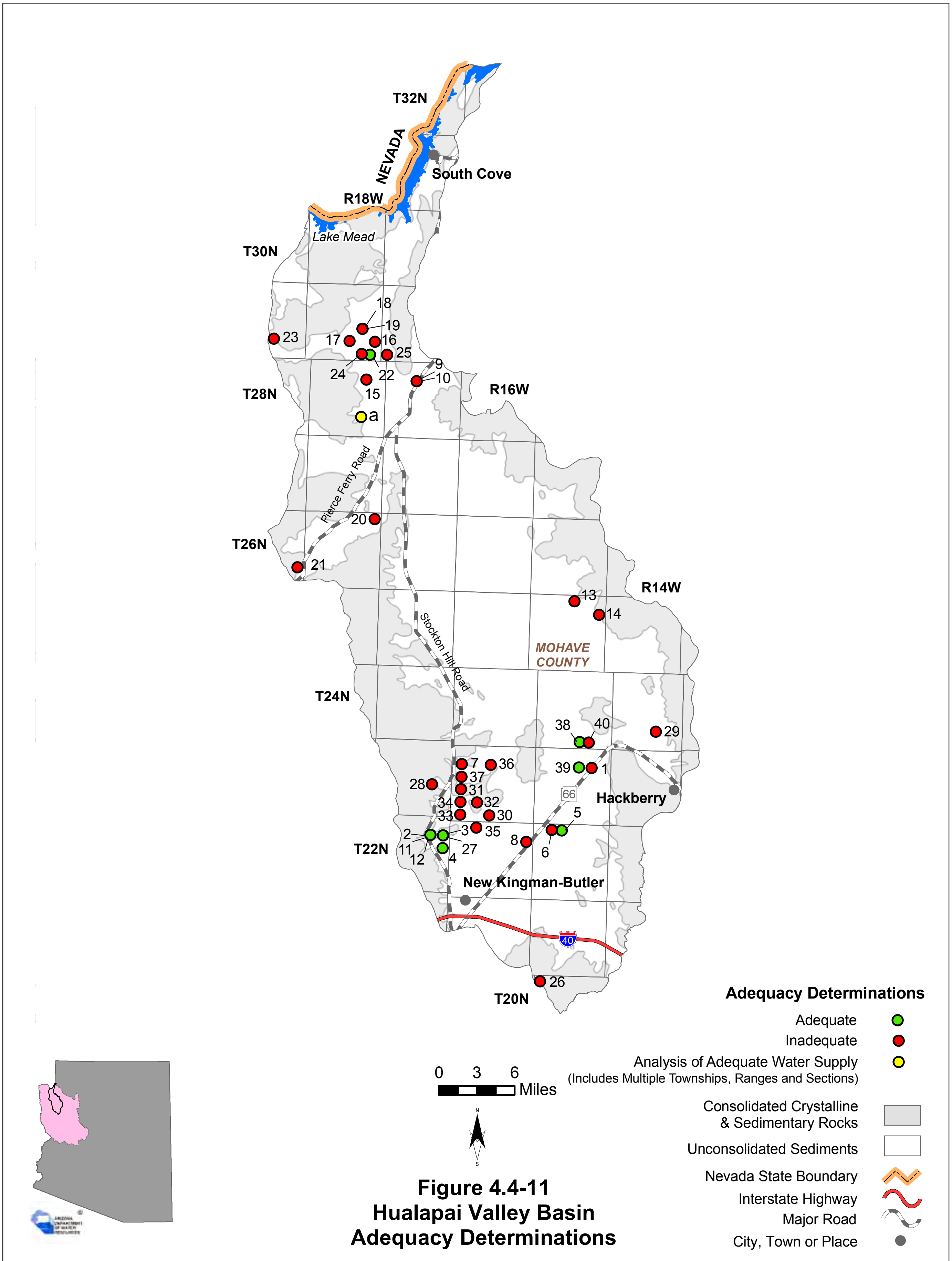


Figure 4.4-11
Hualapai Valley Basin
Adequacy Determinations

Hualapai Valley Basin
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Hualapai Valley Basin Index to Section 4.0

Section 4.5
Lake Havasu Basin

4.5.1 Geography of the Lake Havasu Basin

The Lake Havasu Basin, located in the southwestern part of the planning area, is the second smallest basin at 252 square miles. Geographic features and principal communities are shown on Figure 4.5-1. The basin is characterized by a valley adjacent to the Colorado River and Lake Havasu, which form the western boundary of the basin, and by lower elevation mountains along the north and eastern basin boundary. Vegetation types include lower Colorado River desertscrub and tamarisk and marsh vegetation along sections of the Colorado River.

- Principal geographic features shown on Figure 4.5-1 are:
  - The large community of Lake Havasu City
  - Chemehuevi Valley running parallel to the Colorado River and Lake Havasu
  - Standard Wash running north to south in the eastern part of the basin
  - The Mohave Mountains along the northeastern basin boundary with the highest point in the basin, Crossman Peak at 5,100 feet
  - The lowest point in the basin is approximately 470 feet at the Colorado River

- Not well shown on Figure 4.5-1 are the Bill Williams Mountains on the southeastern basin boundary and the Aubrey Hills, between the Colorado River and Highway 95 south of Lake Havasu City

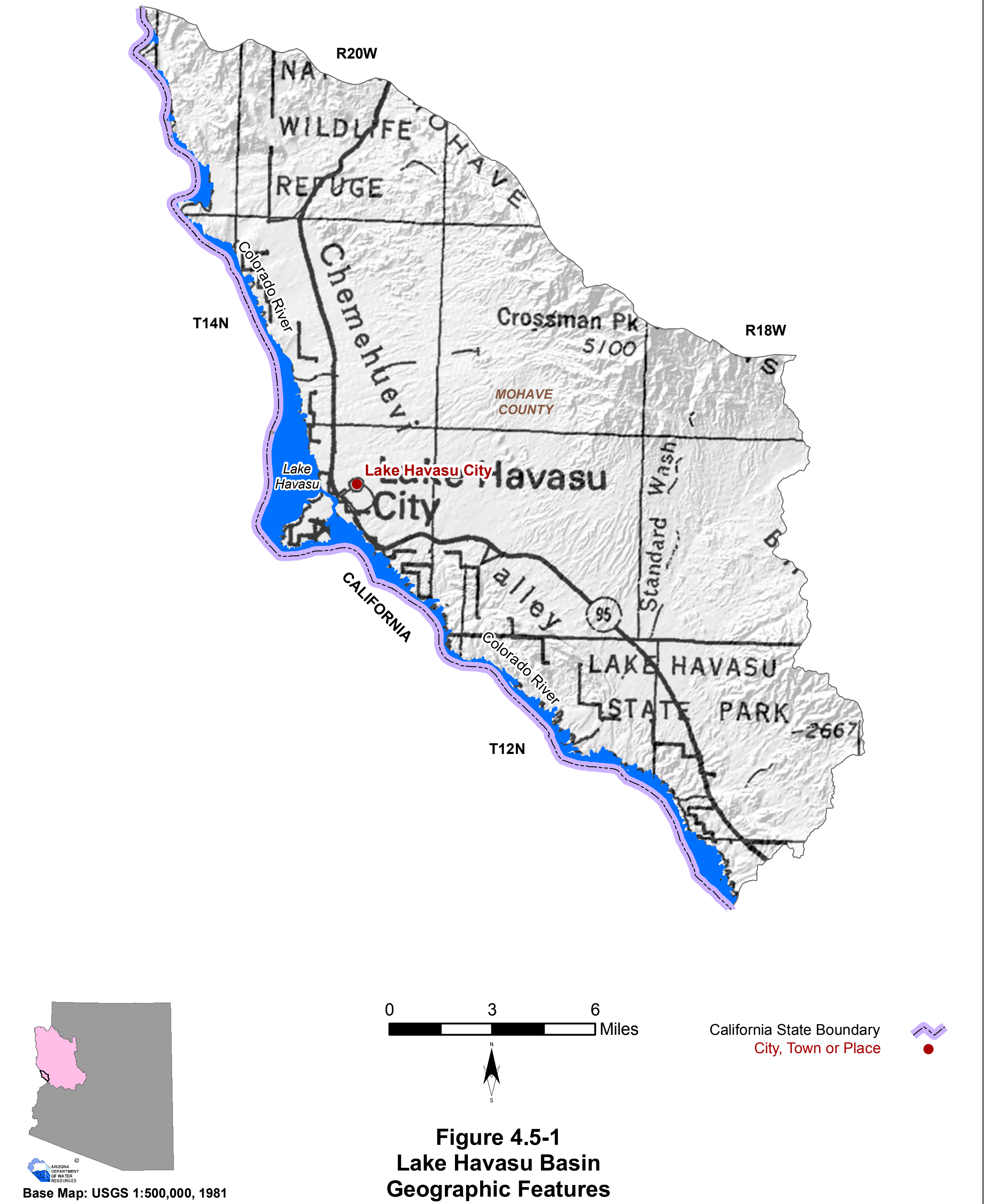


Figure 4.5-1
Lake Havasu Basin
Geographic Features

4.5.2 Land Ownership in the Lake Havasu Basin

Land ownership, including the percentage of ownership by category, for the Lake Havasu Basin is shown in Figure 4.5-2. The principal feature of land ownership in this basin is the large percentage of U.S. Bureau of Land Management lands. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

U.S. Bureau of Land Management (BLM)

- 59.7% of the land is federally owned and managed by the Lake Havasu Field Office of the Bureau of Land Management.
- BLM lands in this basin are primarily contiguous and located throughout the basin.
- This basin contains the largest percentage of BLM lands in the planning area.
- Primary land uses are recreation and grazing.

Private

- 15.3% of the land is private.
- The majority of the private land is contiguous and located around Lake Havasu City.
- Primary land uses are domestic and commercial.

State Trust Land

- 14.7% of the land in this basin is held in trust for the public schools and the Miner's Hospital under the State Trust Land system.
- Most state lands are surrounding Lake Havasu City. One portion of state land is located on an island created by the Bridgewater Channel in T13N, R20W.
- Primary land uses are recreation and grazing.

Wildlife Refuge

- 8.7% of the land is federally owned and managed by the U.S. Fish and Wildlife Service.
- All wildlife refuge lands are part of the Havasu National Wildlife Refuge located in the northwestern portion of the basin.
- Primary land uses are wildlife conservation and recreation.

Other (Game and Fish, County and Bureau of Reclamation Lands)

- 1.6% of the land is under ownership of Arizona State Parks.
- The portion of Arizona State Park land in T13N, R20W is Windsor Beach State Park and the larger portion of land along the southwestern basin boundary is Cattail Cove State Park.
- Primary land use is recreation.

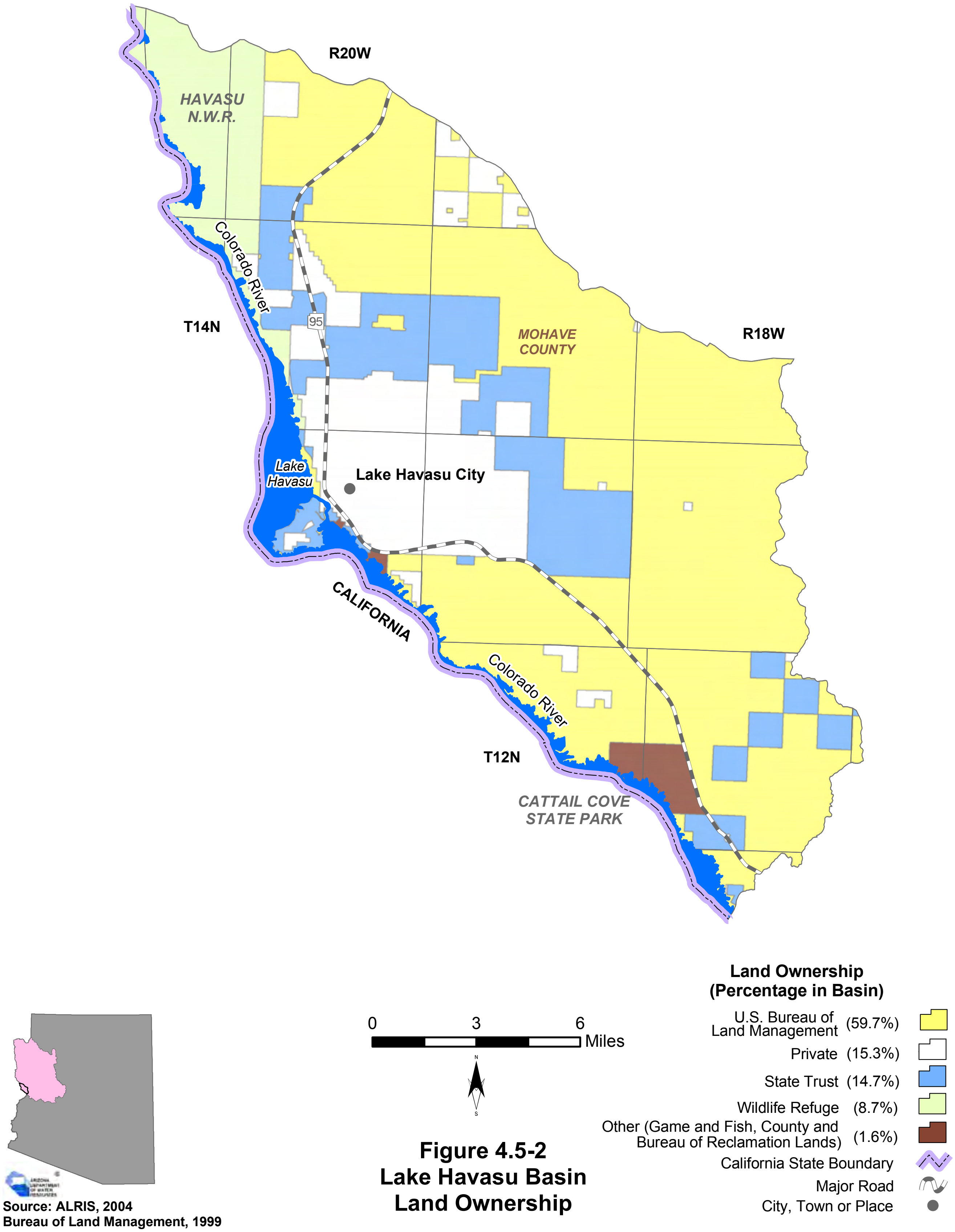


Figure 4.5-2
Lake Havasu Basin
Land Ownership

4.5.3 Climate of the Lake Havasu Basin

Climate data from NOAA/NWS Co-op Network stations are complied in Table 4.5-1 and the location is shown on Figure 4.5-3. Figure 4.5-3 also shows precipitation data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Lake Havasu Basin does not contain Evaporation Pan, AZMET and SNOTEL/Snowcourse stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 4.5-1A
- There are two NOAA/NWS Co-op network climate stations in the basin, Lake Havasu and Lake Havasu City.
- Of the two stations, data from different periods of record may be used as shown. The variety of periods may be due to discontinued measurements, date of installation or other availability issues.
- The stations are located at 480 feet and 500 feet.
- Maximum average temperatures are 96.6°F at Lake Havasu and 98.5°F at Lake Havasu City.
- Minimum average temperatures are 52.9°F at Lake Havasu and 54.5°F at Lake Havasu City.
- Station precipitation varies between the two stations with annual average precipitation of 2.90 inches at Lake Havasu City and 4.82 inches at Lake Havasu.
- Both stations report highest seasonal rainfall in the winter season (January - March), however, the Lake Havasu station reports relatively high precipitation in the summer season (July-September) as well.
- The driest season for both stations is spring (April – June).

SCAS Precipitation Data

- See Figure 4.5-3
- Additional precipitation data shows average annual rainfall as high as 12 inches in the Mohave Mountains along the eastern basin boundary and as low as four inches along the boundary with California.
- In general, precipitation increases as altitude increases in this basin. This basin is one of three basins in the planning area with a range of eight inches between areas of highest and lowest average annual precipitation, the lowest in the planning area.

Table 4.5-1 Climate Data for the Lake Havasu Basin

A.NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Lake Havasu	480	1967-1991[1]	96.6/Jul	52.9/Jan	1.65	0.39	1.59	1.19	4.82
Lake Havasu City	500	1991-2004[1]	98.5/Jul	54.5/Dec	1.45	0.16	0.68	0.60	2.90

Source: WRCC, 2003.

Notes:
[1]Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

Source: WRCC, 2003.

C. AZMET:

Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (*number of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content *(Number of measurements to calculate average)*					
			Jan	Feb	March	April	May	June
None								

Source: Natural Resources Conservation Service, 2005

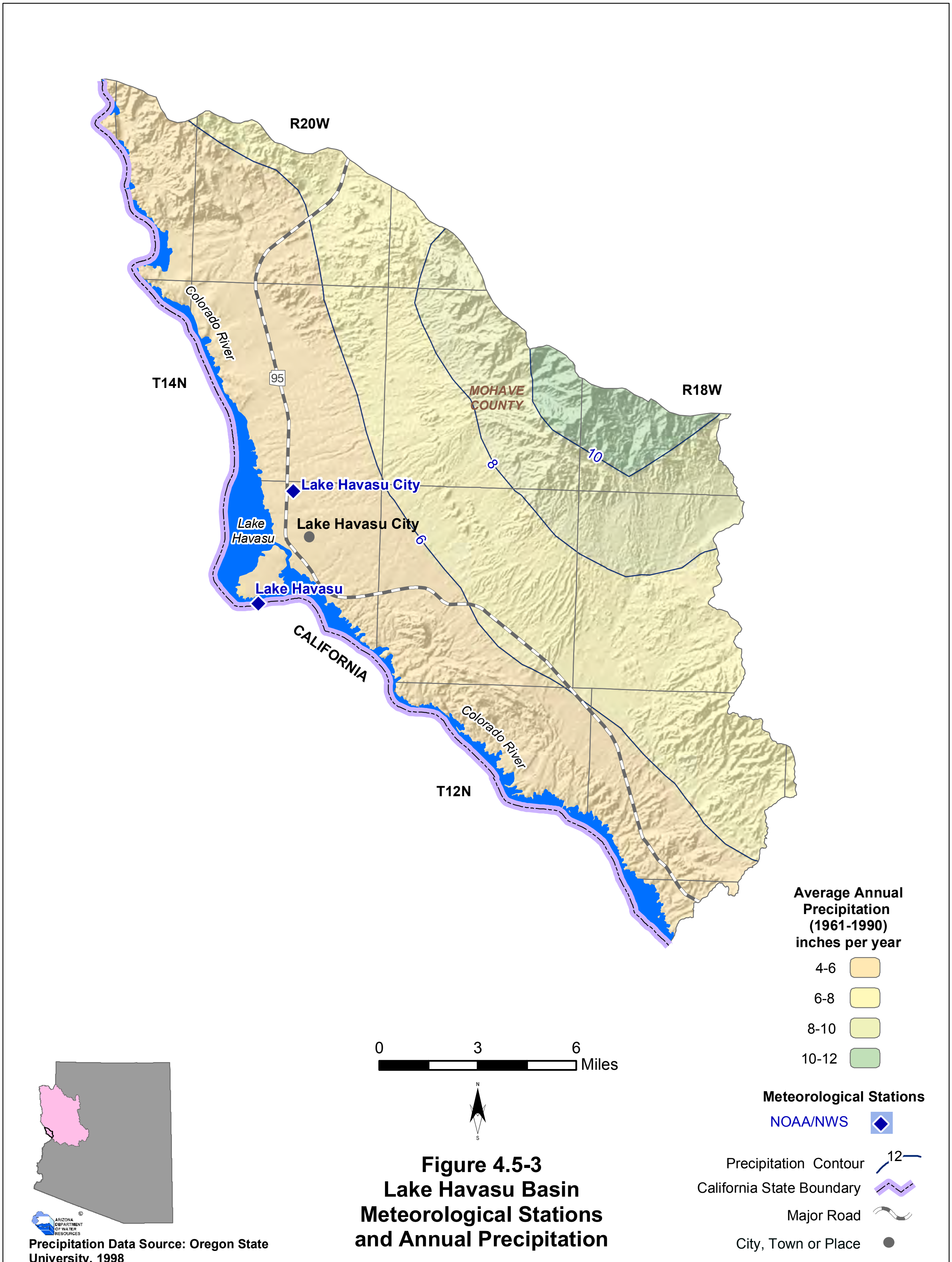


Figure 4.5-3
Lake Havasu Basin
Meteorological Stations
and Annual Precipitation

4.5.4 Surface Water Conditions in the Lake Havasu Basin

This basin does not contain streamflow data. Flood ALERT equipment in the basin is shown in Table 4.5-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.5-4. The location of large reservoirs and flood ALERT gages are shown on Figure 4.5-4. There are no runoff contours in this basin. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Flood ALERT Equipment

- Refer to Table 4.5-3.
- As of October 2005 there were four stations in the basin.
- Of the four stations one is a weather station, one is a repeater/precipitation station and two are precipitation/stage stations.

Reservoirs and Stockponds

- Refer to Table 4.5-4.
- The basin contains one large reservoir, Havasu, with a maximum capacity of 651,000 acre-feet. Lake Havasu is created by Parker Dam and is operated for hydroelectric power generation, irrigation and water supply.
- There are no other reservoirs or stockponds in this basin.

Table 4.5-2 Streamflow Data for the Lake Havasu Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
None													

Sources: USGS NWIS, USGS 1998 and USGS 2007.

Table 4.5-3 Flood ALERT Equipment in the Lake Havasu Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
7490	Desert Hills	Precipitation/Stage	NA	Mohave County FCD
7530	Ram Peak Repeater	Repeater/Precipitation	NA	Mohave County FCD
7550	Horizon 6	Precipitation/Stage	NA	Mohave County FCD
7630	Lake Havasu City	Weather Station	NA	Mohave County FCD

Notes:
FCD = Flood Control District
NA = Not available

Table 4.5-4 Reservoirs and Stockponds in the Lake Havasu Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE[1]	JURISDICTION
None	Havasu (Parker Dam)[2]	Bureau of Reclamation	651,000[3]	H,I,S	Federal

Sources: US Army Corps of Engineers 2005, BOR 2006

B. Other Large Reservoirs (50 acre surface area or greater)[4]

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE	JURISDICTION
None identified by ADWR at this time					

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 0
Total maximum storage: 0 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)[2]

Total number: 0
Total surface area: 0 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 0 (from water right filings)

Notes:
[1]H=hydroelectric; I=irrigation; S=water supply
[2]Dam is located in Parker Basin but lake storage is in Lake Havasu and Sacramento Valley Basins
[3] Includes 28,600 acre-feet of dead storage
[4] Capacity data not available to ADWR

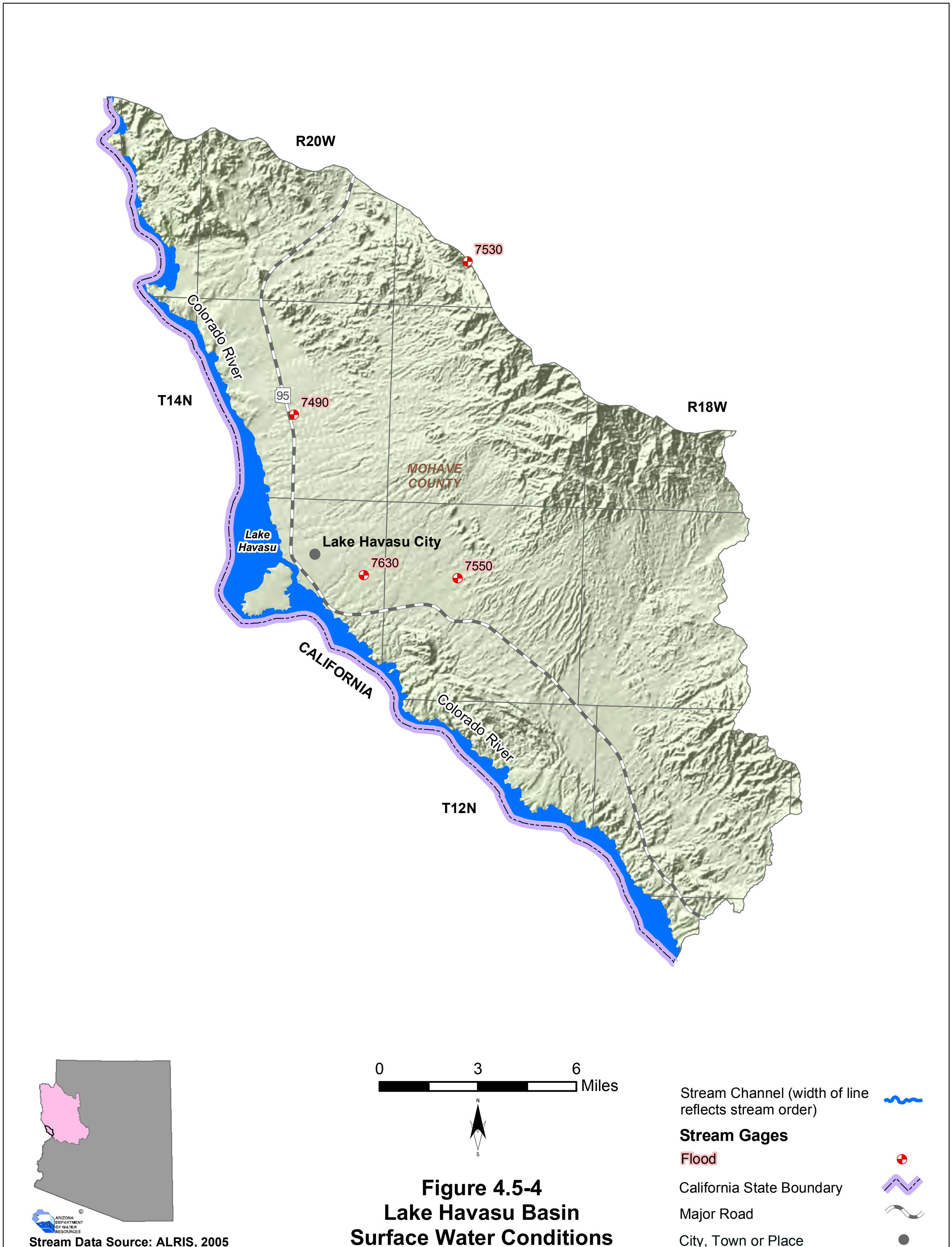


Figure 4.5-4
Lake Havasu Basin
Surface Water Conditions

4.5.5 Perennial/Intermittent Streams and Major Springs in the Lake Havasu Basin

The total number of springs in the basin is shown on Table 4.5-5. There are no major or minor springs in this basin. The locations of perennial and intermittent streams are shown on Figure 4.5-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- There is one perennial stream, the Colorado River, located along the western basin boundary.
- There are no major or minor springs in the basin.
- There are three springs with discharges less than one gpm identified by the USGS in this basin.

Table 4.5-5 Springs in the Lake Havasu Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)	Date Discharge Measured
		Latitude	Longitude		
None identified by ADWR at this time					

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)	Date Discharge Measured
	Latitude	Longitude		
None identified by ADWR at this time				

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and USGS, 2006): 3

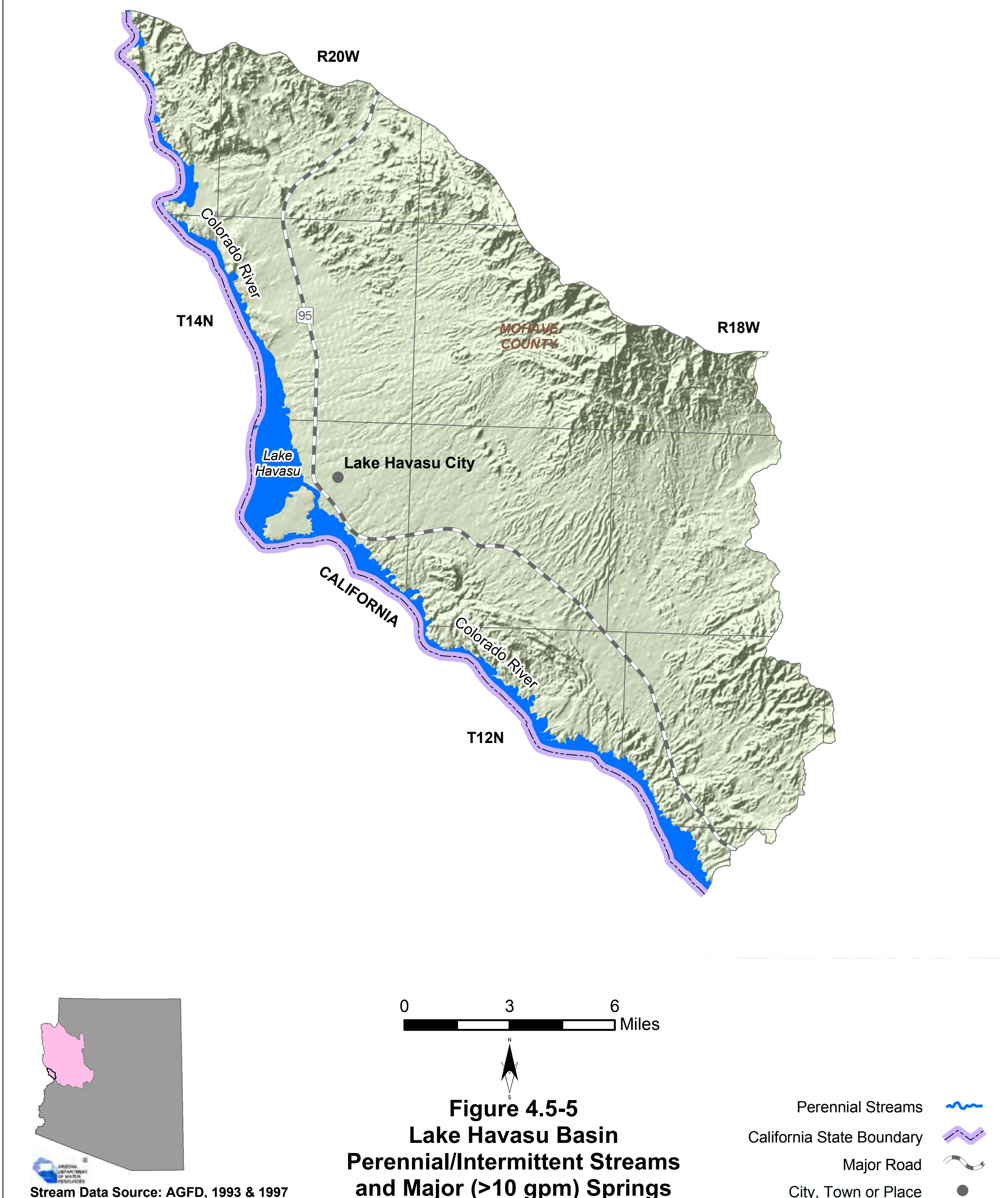


Figure 4.5-5
Lake Havasu Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

4.5.6 Groundwater Conditions of the Lake Havasu Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 4.5-6. Figure 4.5-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 4.5-7 contains hydrographs for selected wells shown on Figure 4.5-6. Figure 4.5-8 shows well yields in three yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields, is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 4.5-6 and Figure 4.5-6.
- The major aquifer in this basin is basin fill.
- Flow direction is from north to south in this basin.

Well Yields

- Refer to Table 4.5-6 and Figure 4.5-8.
- As shown on Figure 4.5-8 well yields in this basin range from 100 gallons per minute (gpm) to 2,000 gpm.
- One source of well yield information, based on 17 reported wells, indicates that the median well yield in this basin is 1,500 gpm.
- Recorded well yields are similar in the vicinity of Lake Havasu City.

Natural Recharge

- Refer to Table 4.5-6.
- The estimate of natural recharge for this basin is 35,000 acre-feet per year.

Water in Storage

- Refer to Table 4.5-6.
- There are two storage estimates for this basin, ranging from one million acre-feet to two million acre-feet. The most recent estimate, from a 1986 Freethey and Anderson study indicates that there is two million acre-feet in storage to a depth of 1,200 feet. This is a predevelopment estimate.

Water Level

- Refer to Figure 4.5-6. The water level is shown for one well measured in 2003-2004.
- The Department annually measures one index well in this basin.
- In 1998-1999, the year of the last water level sweep, 30 wells were measured.
- The only well with water level data in this basin is at a depth of 74 feet.
- A hydrograph corresponding to the well shown on Figure 4.5-6 but covering a longer time period is shown in Figure 4.5-7.

Table 4.5-6 Groundwater Data for the Lake Havasu Basin

Basin Area, in square miles:	252	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Basin Fill	
Well Yields, in gal/min:	NA	Measured by ADWR and/or USGS
	Range 310-3,600 Median 1,500 (17 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 30-500	ADWR (1990 and 1994)
	Range 0-2,500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	35,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	NA	ADWR (1990 and 1994)
	2,000,000[1] (to 1,200 ft)	Freethey and Anderson (1986)
	1,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
Current Number of Index Wells:	1	
Date of Last Water-level Sweep:	1998-99 (30 wells measured)	

Notes:
NA = Not Available
[1]Predevelopment Estimate

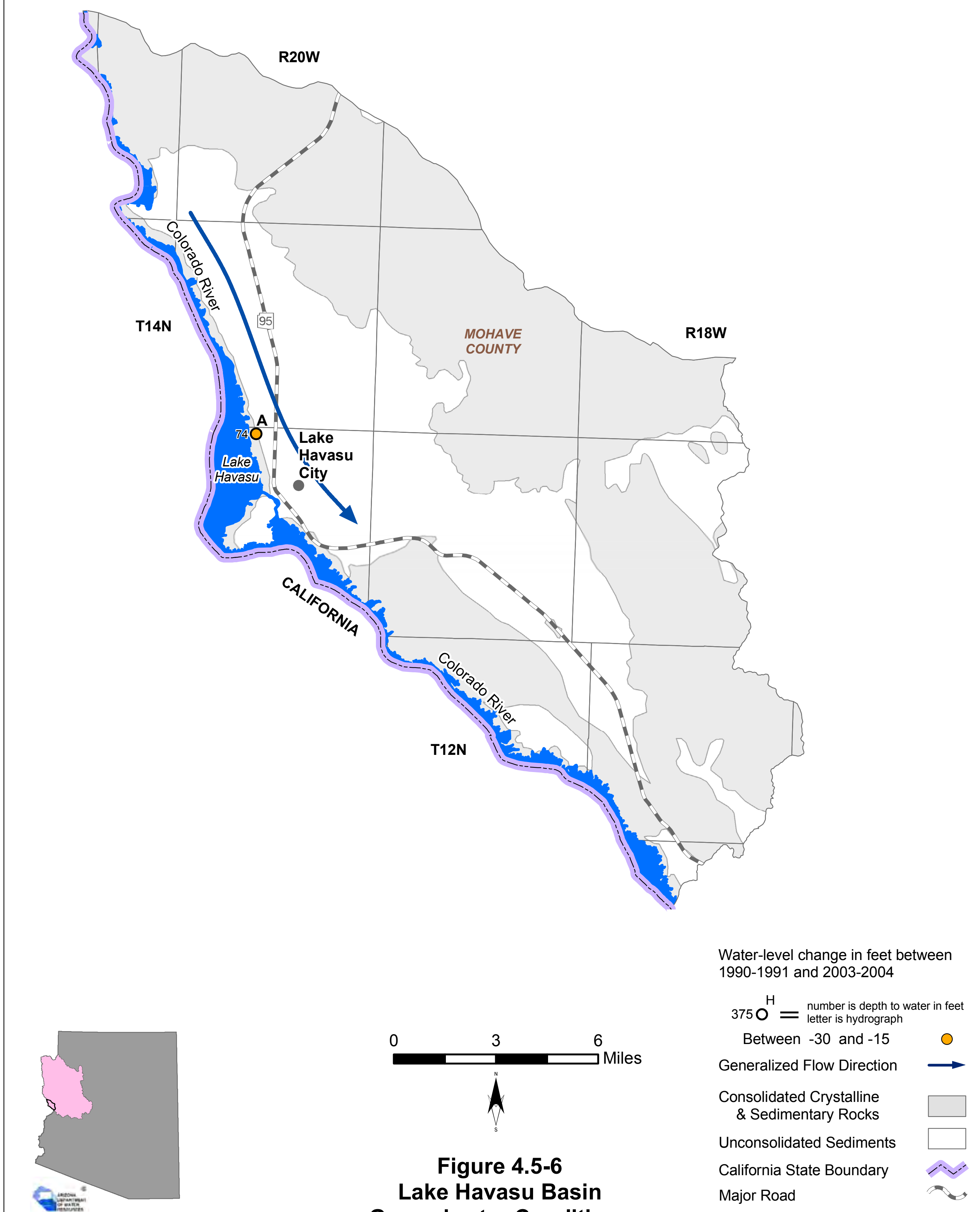
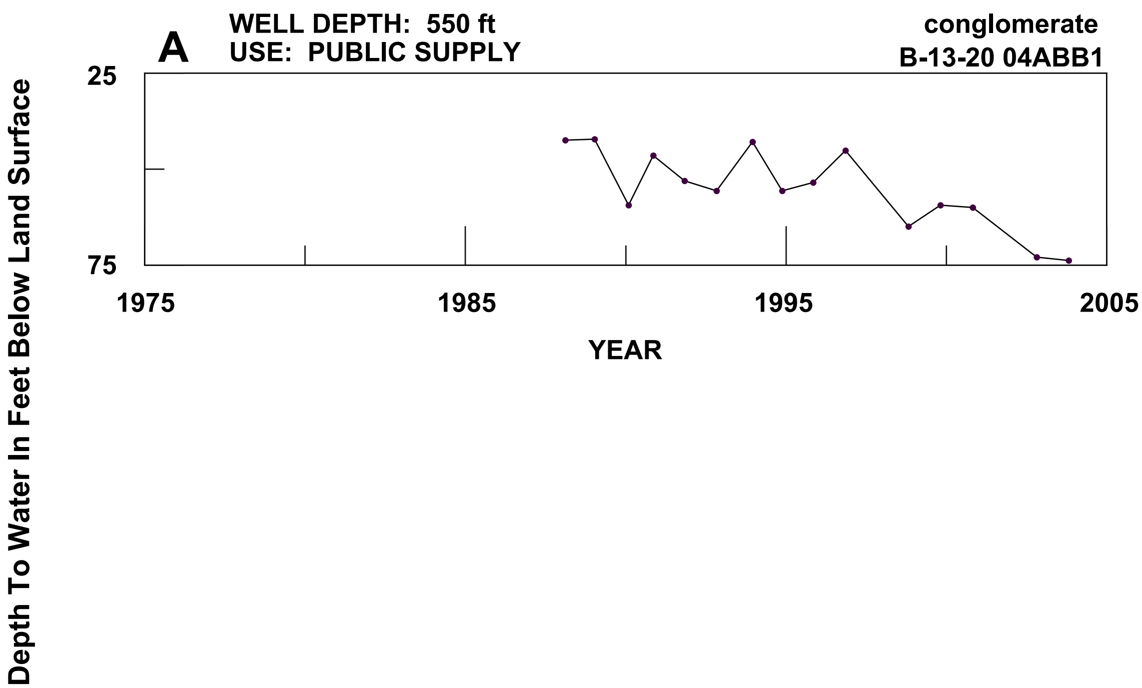


**Figure 4.5-6
Lake Havasu Basin
Groundwater Conditions**

Figure 4.5-7
Lake Havasu Basin
Hydrographs Showing Depth to Water in Selected Wells



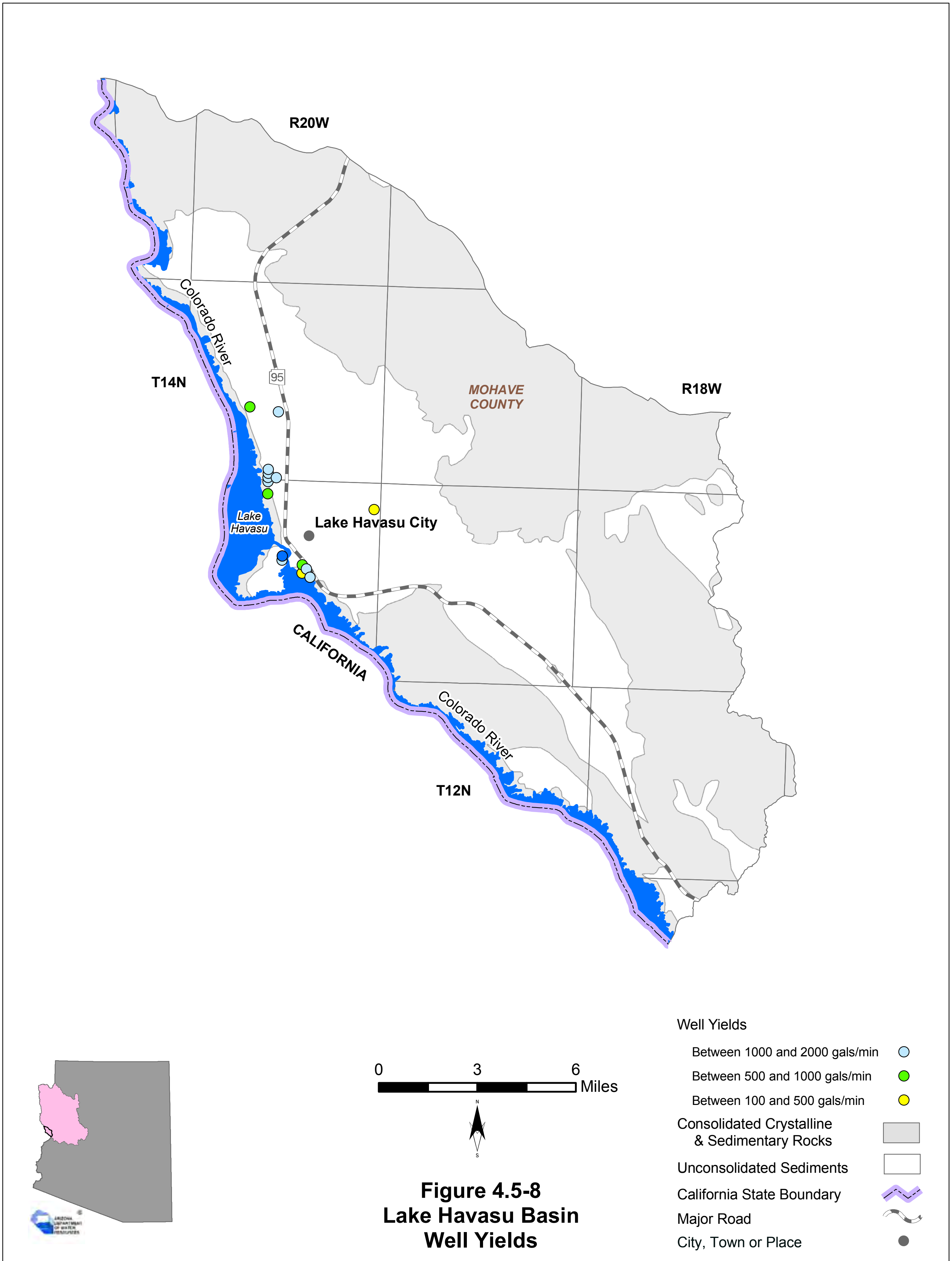


Figure 4.5-8
Lake Havasu Basin
Well Yields

4.5.7 Water Quality of the Lake Havasu Basin

Drinking water standard exceedences in wells, springs and mine sites including location and parameter(s) exceeded are shown in Table 4.5-7A. There are no impaired lakes or streams in this basin. Figure 4.5-9 shows the location of exceedences keyed to Table 4.5-7A. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mine Sites

- Refer to Table 4.5-7A.
- Drinking water standard exceedences in wells have been reported for 20 sites in the basin.
- The drinking water standard for nitrates/nitrites was the most frequently exceeded standard at sites in this basin.
- Most nitrate/nitrite exceedences are in the vicinity of Lake Havasu City.
- Other drinking water standards exceeded in this basin include arsenic, chromium and organics.

Table 4.5-7 Water Quality Exceedences in the Lake Havasu Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Exceeding Drinking Water Standard[2]
		Township	Range	Section	
1	Well	14 North	20 West	21	As
2	Well	14 North	20 West	21	NO3
3	Well	14 North	20 West	21	NO3
4	Well	13 North	20 West	3	NO3
5	Well	13 North	20 West	3	Cr
6	Well	13 North	20 West	3	Cr, Organics
7	Well	13 North	20 West	9	NO3
8	Well	13 North	20 West	10	Organics
9	Well	13 North	20 West	10	Organics
10	Well	13 North	20 West	10	Organics
11	Well	13 North	20 West	15	As
12	Well	13 North	20 West	15	As
13	Well	13 North	20 West	15	NO3
14	Well	13 North	20 West	15	As
15	Well	13 North	20 West	16	NO3
16	Well	13 North	20 West	16	Organics
17	Well	13 North	20 West	16	NO3
18	Well	13 North	20 West	16	NO3
19	Well	13 North	20 West	16	NO3
20	Well	13 North	20 West	22	NO3

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard	Parameter(s) Exceeding Use Standard
None identified by ADWR at this time						

Notes:

[1] Water quality samples collected between 1976 and 2000.

[2] As = Arsenic
Cr = Chromium
NO3 = Nitrate/Nitrite
Organics = One or more of several volatile and semi-volatile organic compounds and pesticides

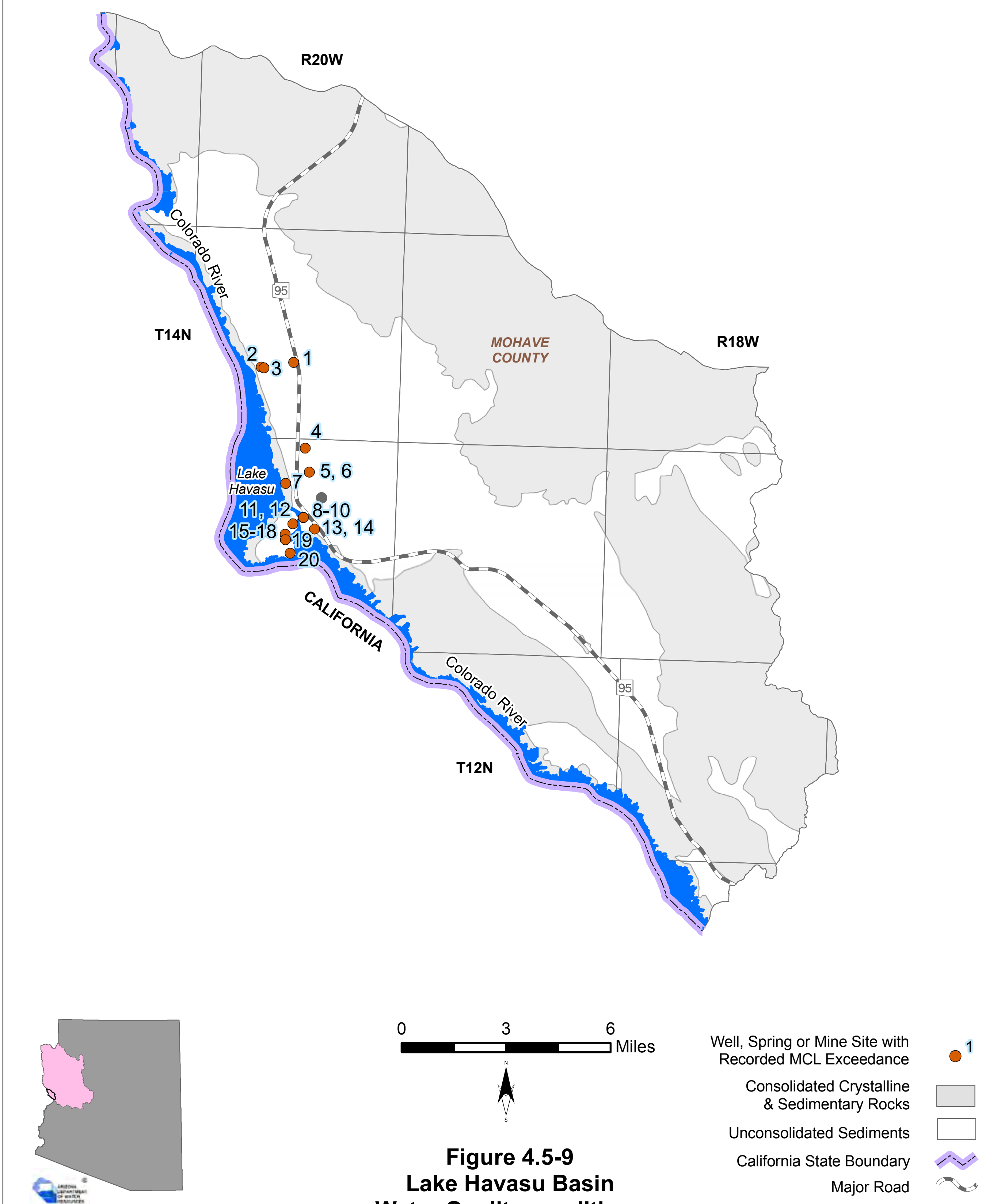


Figure 4.5-9
Lake Havasu Basin
Water Quality conditions

4.5.8 Cultural Water Demands in the Lake Havasu Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 4.5-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 4.5-9. Figure 4.5-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 4.0.7.

Cultural Water Demands

- Refer to Table 4.5-8 and Figure 4.5-10.
- Population in this basin has more than doubled since 1980, increasing from 17,487 in 1980 to 44,591 in 2000. Projections suggest a similar rate of growth through 2050.
- Groundwater use has increased in this basin since 1971, with an average of 6,000 acre-feet pumped per year from 1971-1975 and an average of 15,980 acre-feet pumped per year from 2001-2003.
- The cultural water demand table for this basin reflects the amount of water pumped from wells and diverted from streams for use. Some of these water uses may be accounted as Colorado River water based on an entitlement system established by Decree by the U.S. Supreme Court in Arizona v. California et.al. Further information on Colorado River entitlements in this planning area is provided in Section 4.0.6.
- Surface water diversions are minimal in this basin, less than 300 acre-feet per year from 1991-2000.
- All surface water diversions are for municipal use at two state parks in the vicinity of Lake Havasu City.
- The only demand center in this basin is high intensity municipal and industrial located in the vicinity of Lake Havasu City.
- Municipal groundwater demand has grown from 13,600 acre-feet per year on average in 1991 to 15,200 acre-feet per year on average in 2003.
- Industrial groundwater demand is minimal in this basin. Less than 300 acre-feet per year were used in 2001-2003 for a small mine or quarry.
- As of 2003 there were 112 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 29 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 4.5-9.
- There are seven wastewater treatment facilities in this basin.
- Over 40,000 people are served by these facilities. Only three facilities have information on treatment volumes, Island Plant Wastewater Treatment Plant (WWTP), Mulberry WWTP and Sweetwater. Together these plants generate over 2,100 acre-feet of effluent per year.

- Of the six facilities with information on the effluent disposal method, two facilities discharge effluent for golf course or turf irrigation, two facilities discharge to other facilities and two facilities discharge effluent to infiltration basins.

Table 4.5-8 Cultural Water Demands in the Lake Havasu Basin[1]

Year	Recent (Census) and Projected (DES) Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)[3]						
				Well Pumpage			Surface-Water Diversions			Data Source
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial	Irrigation	Municipal	Industrial	Irrigation	
1971		44[2]	15[2]	6,000			NR[4]			ADWR (1994)
1972										
1973										
1974										
1975										
1976				14,000			NR			
1977										
1978										
1979										
1980	17,487									
1981	18,376	14	3	16,000			NR			
1982	19,265									
1983	20,154									
1984	21,043									
1985	21,932									
1986	22,821	15	5	12,000			NR			
1987	23,710									
1988	24,599									
1989	25,488									
1990	26,377									
1991	28,198	20	4	13,600	450	NR	<300	NR	NR	USGS (2005) ADWR (2005)
1992	30,019									
1993	31,841									
1994	33,662									
1995	35,484									
1996	37,305	7	0	14,900	550	NR	<300	NR	NR	
1997	39,127									
1998	40,948									
1999	42,770									
2000	44,591									
2001	45,893	6	1	15,200	<300	NR	<300	NR	NR	
2002	47,195									
2003	48,497									
2010	57,612									
2020	64,496									
2030	70,527									
2040	75,076									
2050	79,393									
ADDITIONAL WELLS:[5]		**6**	**1**							
WELL TOTALS:		**112**	**29**							

Notes:
NR = Not reported
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] Includes all wells through 1980.
[3] Includes pumpage and diversion of Colorado River Contract Water.
[4] The 1994 ADWR Arizona Water Resources Assessment included surface water diversions for this basin for the Havasu National Wildlife Refuge.
[5] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 4.5-9 Effluent Generation in the Lake Havasu Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf Irrigation	Wildlife Area	Discharged to Another Facility	Infiltration Basins			
Havasu Falls RV Park	Private	Lake Havasu City	NA			X						Primary/Secondary	NA	
Island Plant WWTP	Lake Havasu City	Lake Havasu City	15,200	1,232				Havasu Island				Adv. Trt.I & Nutrient Removal	NA	2004
Lake Havasu City Collection System	Lake Havasu City	Lake Havasu City	5,500	NA						Mulberry		NA	20,500	2000
Mulberry WWTP	Lake Havasu City	Lake Havasu City	7,800	896				East & West London Bridge				Adv. Trt.I & Nutrient Removal	NA	2004
North Regional WWTF	Lake Havasu City	Lake Havasu City	12,000	NA						Island		Secondary	NA	2000
Sun Lake Village	Private	Lake Havasu City	NA			X						Primary	NA	
Sweetwater	Lake Havasu SD	Lake Havasu City	323	11	NA							Secondary	137	2001
Total			40,823	2,139										

Notes:
NA: Data not currently available to ADWR
WWTP: Waste Water Treatment Plant
WWTF: Waste Water Treatment Facility
Adv. Tr 1: Advanced treatment level I
SD: Sanitiation District

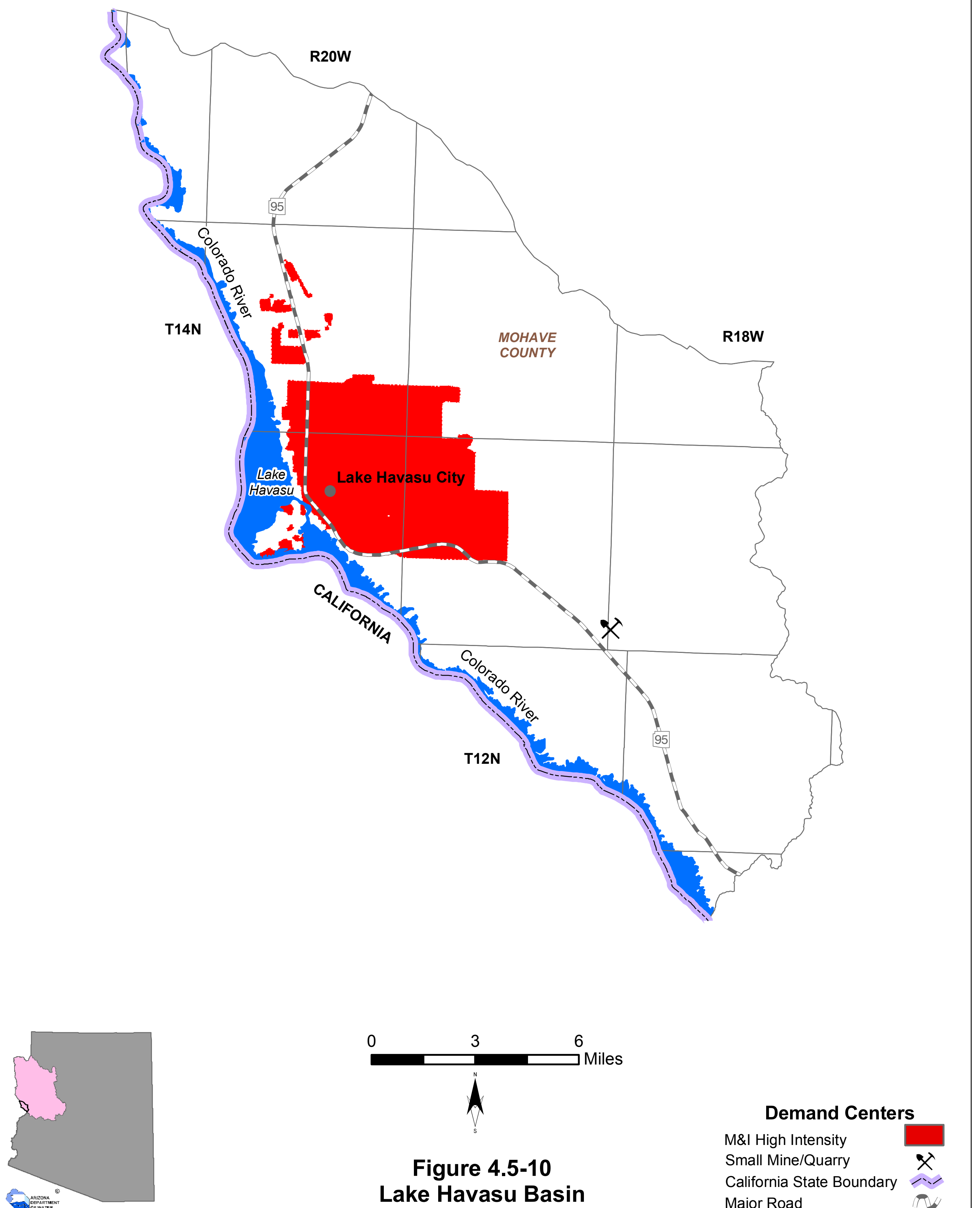


Figure 4.5-10
Lake Havasu Basin
Cultural Water Demand

Primary Data Source: USGS National Gap Analysis Program, 2004

4.5.9 Water Adequacy Determinations in the Lake Havasu Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 4.5-10. Figure 4.5-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

- A total of 13 water adequacy determinations have been made in this basin through December, 2006.
- One determination of inadequacy has been made north of Lake Havasu City.
- This inadequacy determination was based on the applicant's failure to demonstrate a legal right to use the water or failure to demonstrate their legal authority to serve the subdivision.
- The Lake Havasu City service area has a designation of adequate water supply. Subdivisions that are served by the city are therefore determined to have an adequate water supply and are not required to independently apply for an adequacy determination.
- All lots receiving an adequacy determination are in Mohave County. The total number of lots receiving a water adequacy determination is not available.

Table 4.5-10 Adequacy Determinations in the Lake Havasu Basin[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Aztec Junction Tract 3019	Mohave	12 North	18 West	10	NA		Adequate		06/13/88	Valley Pioneer Water Company
2	Canterbury Estates Tract 3702A	Mohave	14 North	20 West	21	63	22-400683	Adequate		03/26/02	Havasu Water Company
3	Canterbury Estates Tract 3702B	Mohave	14 North	20 West	21	45	22-400798	Adequate		10/28/02	Arizona American Water Company
4	Havasu RV Resort	Mohave	14 North	20 West	15	169	22-401108	Adequate		11/12/03	Arizona American Water Company
5	Havasu RV Resort Phase II	Mohave	14 North	20 West	15	96	22-401889	Adequate		10/18/05	Arizona American Water Company - Havasu
6	Inn at Tamarisk	Mohave	14 North	20 West	16, 17, 21	212		Adequate		01/05/84	Havasu Water Company
7	North Pointe	Mohave	14 North	20 West	17	455	22-401582	Adequate		12/28/04	Arizona American Water Company - Havasu
8	Refuge, The	Mohave	14 North	20 West	20, 21	362	22-400660	Adequate		02/05/02	Citizens Utilities
9	Sunlake Village Tract 3700A	Mohave	14 North	20 West	21	35	22-300024	Adequate		08/08/95	Havasu Water Company
10	Sunlake Village Tract 3700B	Mohave	14 North	20 West	21	40	22-300407	Adequate		03/09/98	Havasu Water Company
11	Sunlake Village Tract 3700C	Mohave	14 North	20 West	21	52	22-400081	Adequate		12/03/99	Havasu Water Company
12	Sunlake Village Tract 3700D	Mohave	14 North	20 West	21	35	22-400206	Adequate		12/03/99	Havasu Water Company
13	Tamarisk Resort & Country Club	Mohave	14 North	20 West	20	NA		Inadequate	B	01/05/84	Havasu Water Company

Notes:

[1]Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made. In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies.

[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.

[3] A. Physical/Continuous
- 1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
- 2) Insufficient Supply (existing water supply unreliable or physically unavaible;for groundwater, depth-to-water exceeds criteria)
- 3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)

B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)
C. Water Quality
D. Unable to locate records
NA= not currently available to ADWR

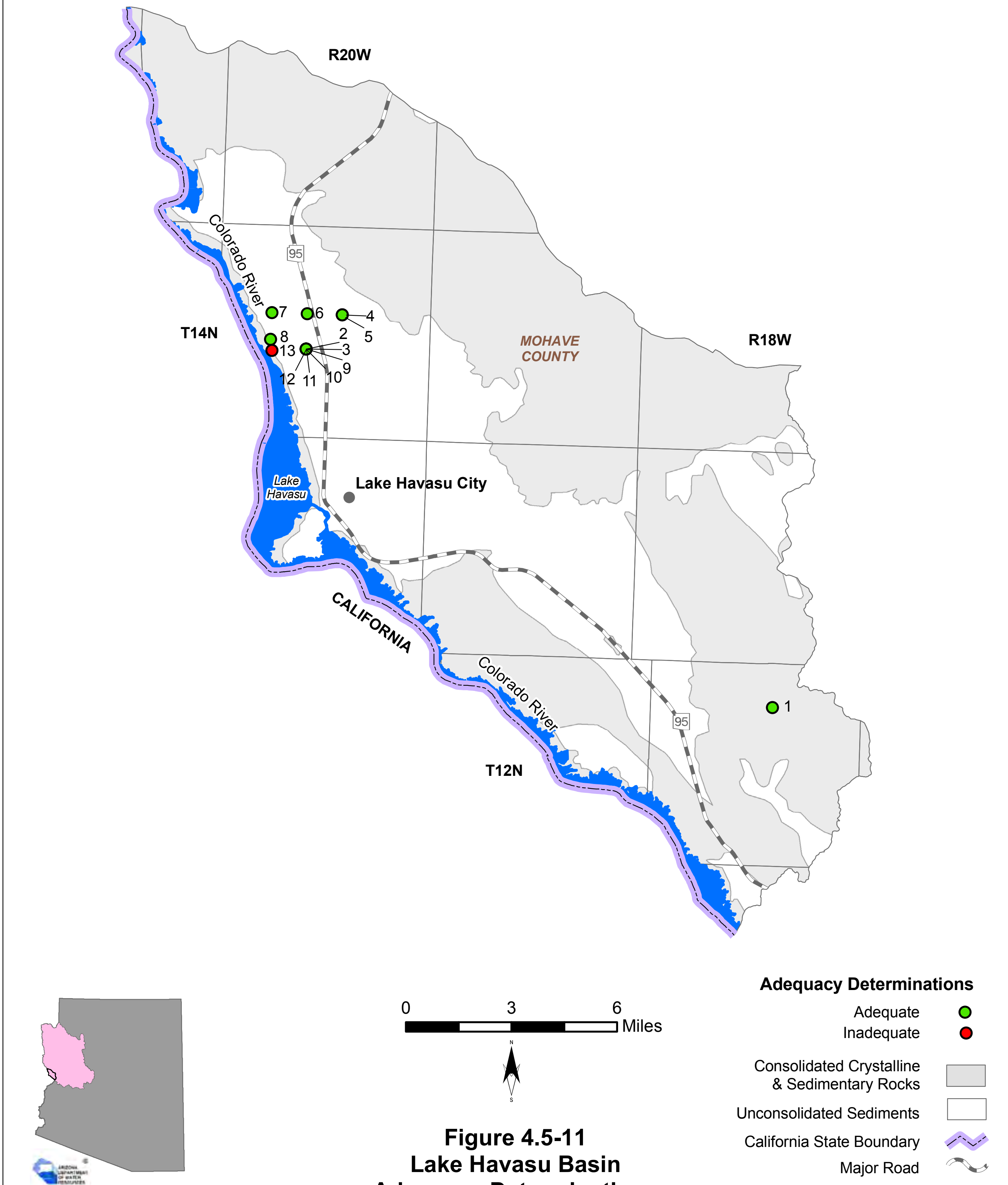


Figure 4.5-11
Lake Havasu Basin
Adequacy Determinations

Lake Havasu Basin

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A

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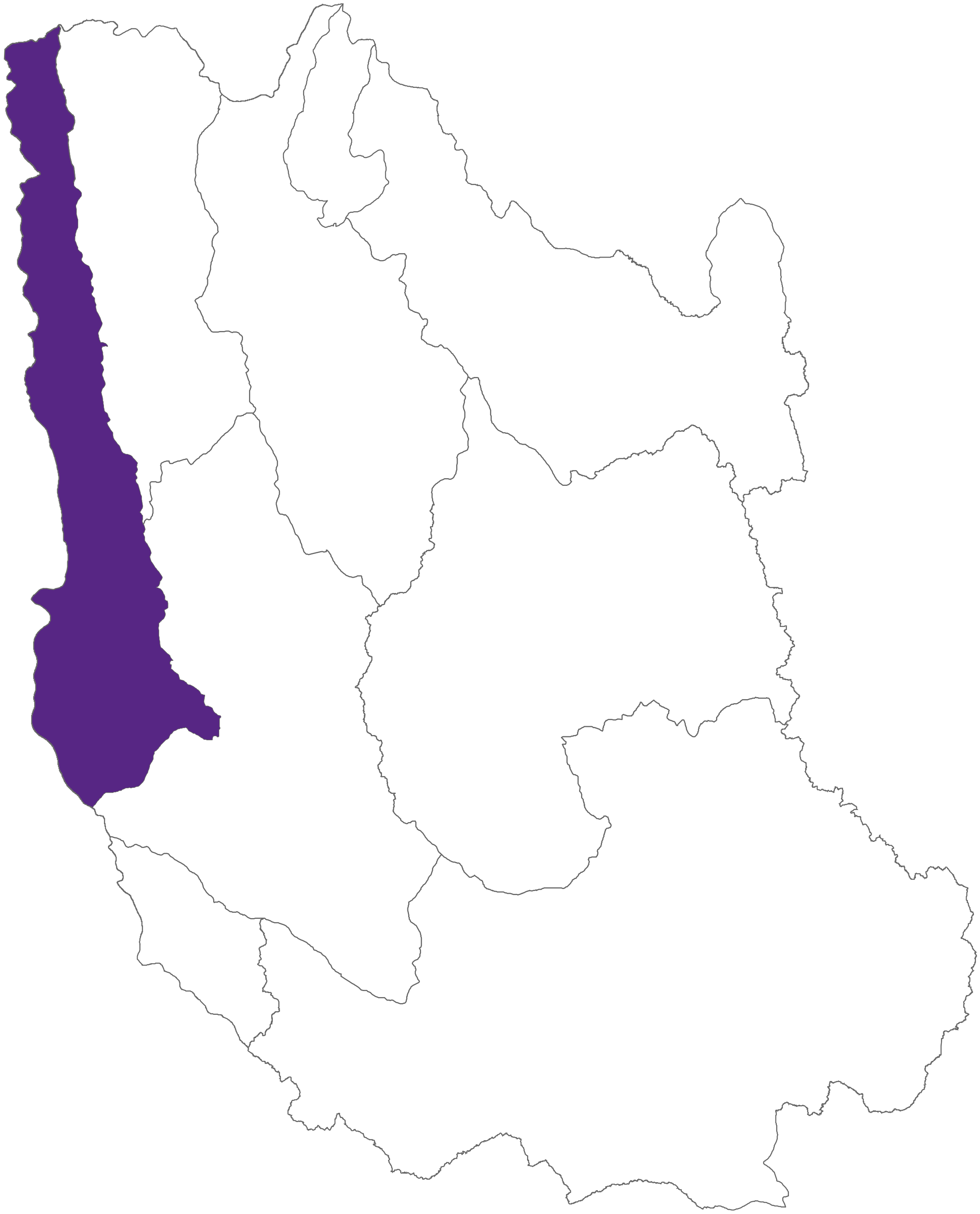
Lake Havasu Basin Index to Section 4.0

Section 4.6
Lake Mohave Basin



4.6.1 Geography of the Lake Mohave Basin

The Lake Mohave Basin is a small-size basin located in the northwestern portion of the planning area at 980 square miles. Geographic features and principal communities are shown on Figure 4.6-1. The basin is characterized by a broad valley along the Colorado River in the southern part of the basin and by mountains in the northern part of the basin. The Colorado River, Lake Mohave and Lake Mead define the western and northern basin boundary. Vegetation types include lower Colorado River Sonoran desertscrub, Mohave desertscrub and tamarisk and marsh vegetation along sections of the Colorado River.

- Principal geographic features shown on Figure 4.6-1 are:
  - The principal communities of Bullhead City, Golden Shores, Mohave Valley and Oatman
  - National Park Service facilities at Cottonwood East and Willow Beach and the Bureau of Reclamation site, Hoover Dam
  - Small communities/sites of Riviera and Katherine Landing
  - Mohave Valley in the southern part of the basin running parallel to the Colorado River
  - Silver Creek Wash running east to west from Oatman to Bullhead City
  - The Black Mountains that define the eastern basin boundary with the highest point in the basin, Mount Perkins at 5,456 feet northeast of Cottonwood East at the basin boundary
  - The lowest point in the basin is about 500 feet near Golden Shores at the Colorado River

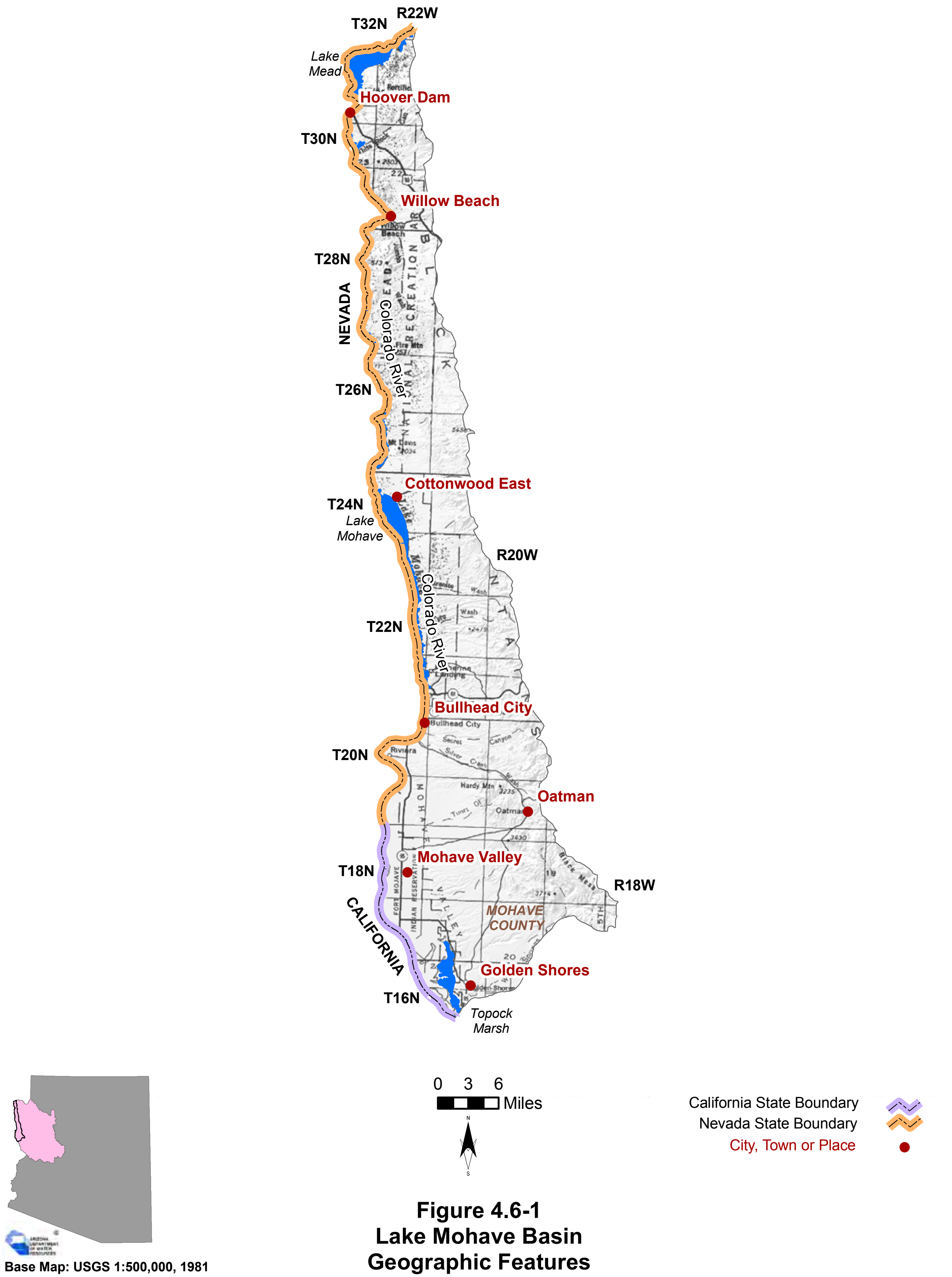


Figure 4.6-1
Lake Mohave Basin
Geographic Features

4.6.2 Land Ownership in the Lake Mohave Basin

Land ownership, including the percentage of ownership by category, for the Lake Mohave Basin is shown in Figure 4.6-2. The principal feature of land ownership in this basin is the largest variety of land ownership of any basin in the planning area. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

U.S. Bureau of Land Management (BLM)

- 44.5% of the land is federally owned and managed by the Kingman Field Office of the Bureau of Land Management.
- BLM lands in this basin are primarily contiguous and located in the eastern portion of the basin.
- The basin contains a portion of two wilderness areas, the 112,400-acre Warm Springs Wilderness in T17N, R20W and the 27,660-acre Mt. Nutt Wilderness in T20N, R20W.
- Primary land uses are recreation and grazing.

National Parks, Monuments and Recreation Areas

- 33.9% of the land is federally owned and managed by the National Park Service (NPS) as the Lake Mead National Recreation Area.
- The NPS lands are located in the northern and west central portions of the basin.
- Primary land use is recreation

Private

- 11.9% of the land is private.
- The majority of the private land is located in the vicinity of Bullhead City and Mohave Valley. Private land around Mohave Valley occurs in a checkerboard pattern with tribal lands.
- Primary land uses are domestic, commercial and farming.

Indian Reservation

- 3.8% of the land is under ownership of the Fort Mojave Tribe.
- Tribal lands are found in the southern portion of the basin and the majority of the lands are interspersed with private lands.
- Primary land uses are domestic and farming.

State Trust Land

- 3.3% of the land in this basin is held in trust for the public schools and the Miner's Hospital under the State Trust Land system.
- State lands are scattered throughout the southern portion of the basin.
- Primary land use is grazing.

Wildlife Refuge

- 1.9% of land is federally owned and managed by the U.S. Fish and Wildlife Service.
- All wildlife refuge lands are part of the Havasu National Wildlife Refuge located along the

southwestern basin boundary.
- Primary land uses are wildlife conservation and recreation.

Other (Game and Fish, County and Bureau of Reclamation Lands)
- 0.7% of the land is under ownership of the Bureau of Reclamation and the Arizona Game and Fish Department.
- The portion of "other" land in T21N, R19W is managed by the U.S. Bureau of Reclamation. The other small parcel of land in T17N, R21W is managed by the Arizona Game and Fish Department as the Colorado River Nature Center.
- Primary land use is recreation.

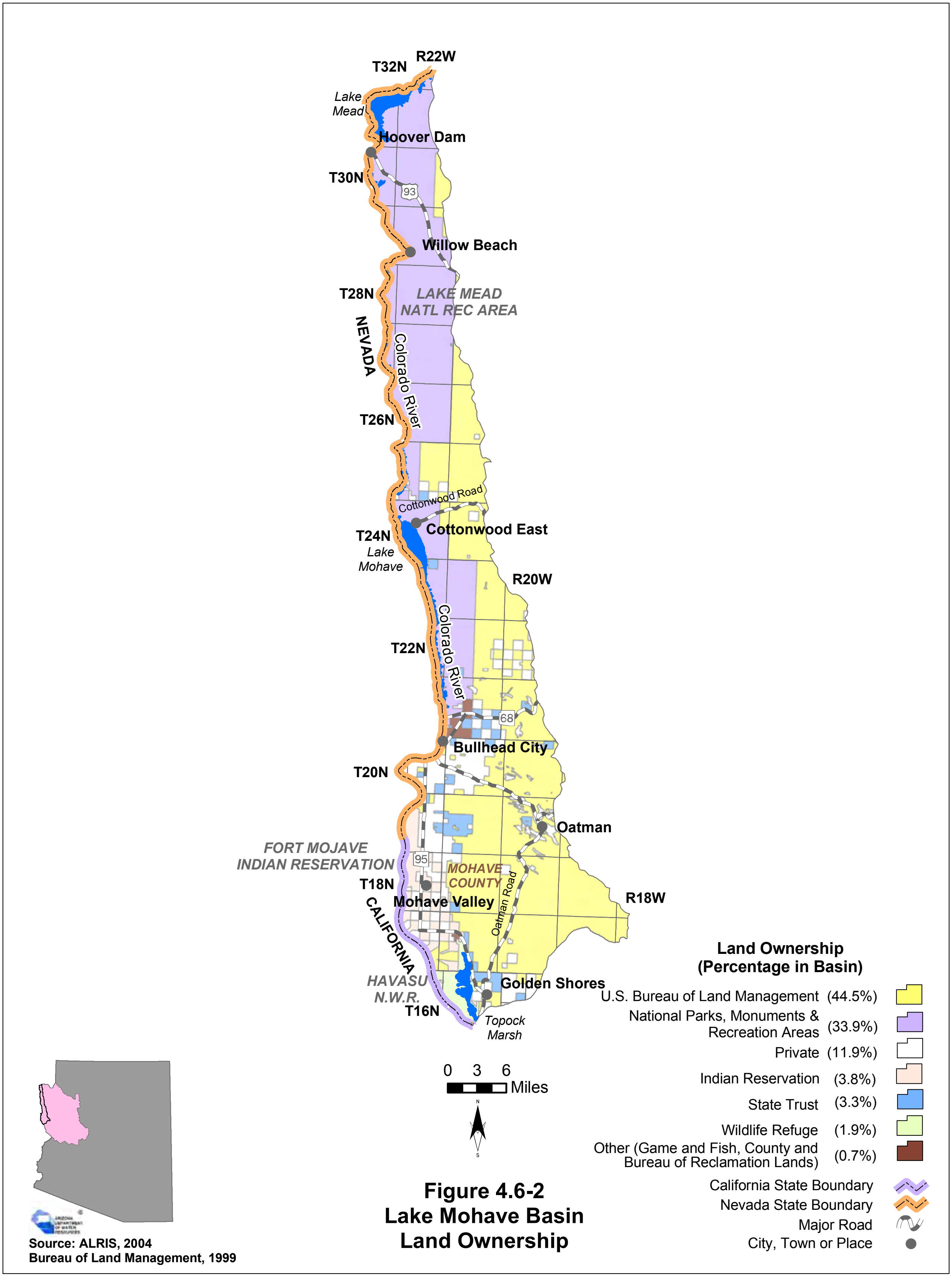


Figure 4.6-2
Lake Mohave Basin
Land Ownership

Source: ALRIS, 2004
Bureau of Land Management, 1999

4.6.3 Climate of the Lake Mohave Basin

Climate data from NOAA/NWS Co-op Network, Evaporation Pan and AZMET stations are complied in Table 4.6-1 and the location is shown on Figure 4.6-3. Figure 4.6-3 also shows precipitation data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Lake Mohave Basin does not contain SNOTEL/Snowcourse stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 4.6-1A
- There are three NOAA/NWS Co-op network climate stations in the basin.
- Of the three stations, data from different periods of record may be used as shown. The variety of periods may be due to discontinued measurements, date of installation or other availability issues.
- Station elevation ranges from 540 feet at Bullhead City to 760 feet at Willow Beach.
- All three stations have maximum average temperatures of approximately 95°F.
- Minimum average temperatures range from 51.4°F at Willow Beach to 54.3°F at Bullhead City.
- Station precipitation is similar at all three stations with an annual average precipitation range of 4.63 inches at Davis Dam #2 to 5.84 inches at Bullhead City.
- All stations report highest average seasonal rainfall in the winter season (January - March).
- The driest season for all stations is spring (April – June).

Evaporation Pan

- Refer to Table 4.6-1B
- There is one site at Davis Dam #2.
- This site, at 660 feet, has an annual pan evaporation rate of 154.32 inches.
- This is the only evaporation pan station in the planning area.

AZMET

- Refer to Table 4.6-1C
- There are two AZMET stations in the basin at Mohave and Mohave #2.
- Average annual evaporation at the Mohave site, located at 495 feet, is 81.14 inches.
- Average annual evaporation at the Mohave #2 site, located at 432 feet, is 80.19 inches.
- These are the only AZMET stations in the planning area.

SCAS Precipitation Data

- See Figure 4.6-3
- Additional precipitation data shows rainfall as high as 12 inches in the Black Mountains near Oatman, and as low as zero inches in a number of areas along the boundary with Nevada. This is the lowest average annual precipitation in the planning area.
- In general, precipitation increases as elevation increases in the basin. The range of 12 inches between areas of highest and lowest precipitation is average for the planning area.

Table 4.6-1 Climate Data for the Lake Mohave Basin

A.NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Bullhead City	540	1971-2000	95.6/Jul	54.3/Dec	2.87	0.26	1.41	1.30	5.84
Davis Dam #2	660	1958-1977[1]	95.2/Jul	52.2/Jan	1.49	0.44	1.30	1.41	4.63
Willow Beach	760	1971-2000	95.8/Jul	51.4/Jan	2.31	0.56	1.55	1.21	5.63

Source: WRCC, 2003.

Notes:
[1]Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
Davis Dam #2	660	1958 - 1977	154.32

Source: WRCC, 2003.

C. AZMET:

Station Name	Elevation (feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (*number of years to calculate averages*)
Mohave	495	1992 - current	81.14 (6)
Mohave #2	492	2003 - current	80.19 (2)

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content *(Number of measurements to calculate average)*					
			Jan	Feb	March	April	May	June
None								

Source: Natural Resources Conservation Service, 2005

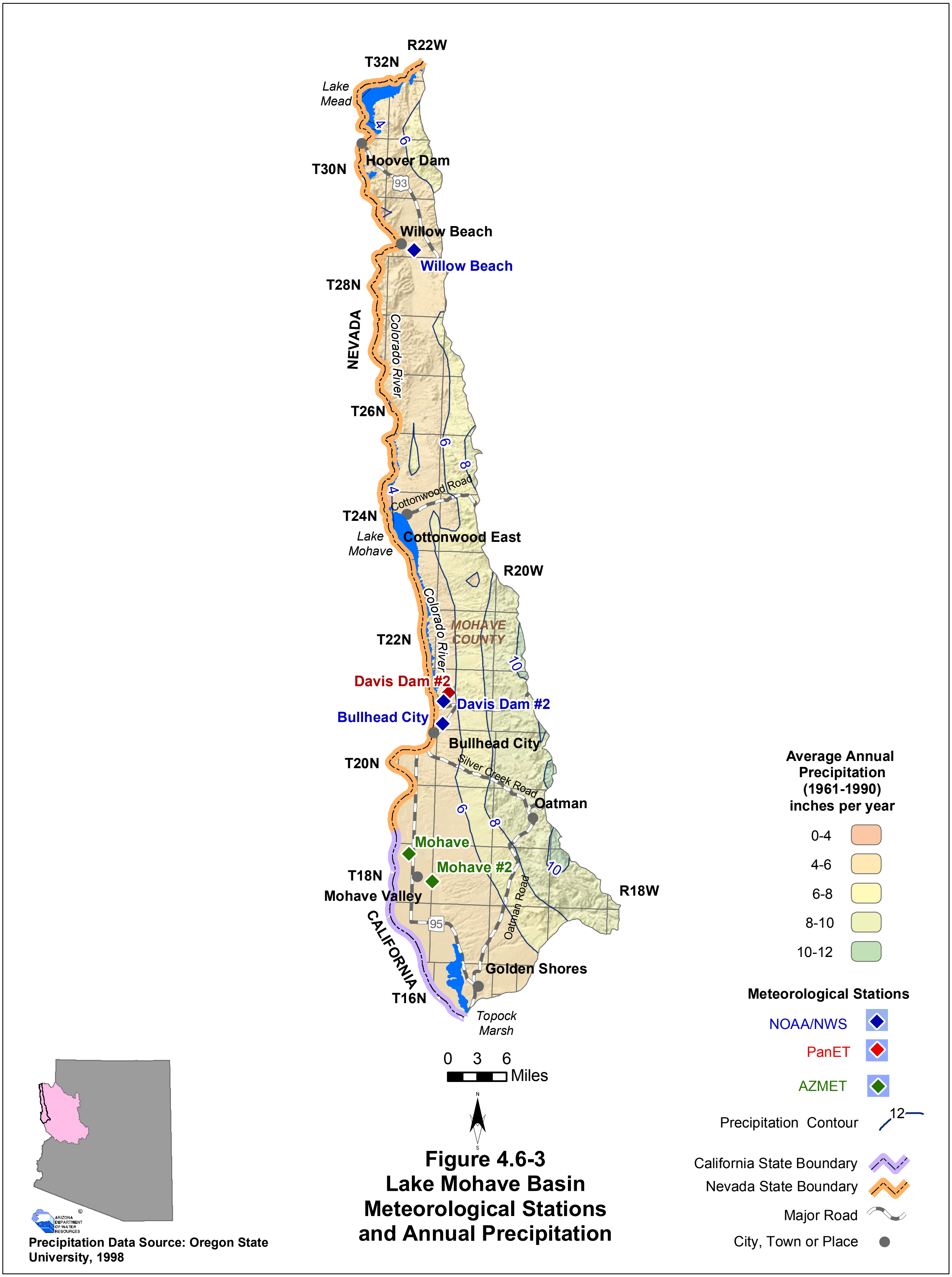


Figure 4.6-3
Lake Mohave Basin
Meteorological Stations
and Annual Precipitation

4.6.4 Surface Water Conditions in the Lake Mohave Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 4.6-2. Flood ALERT equipment in the basin is shown on Table 4.6-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.6-4. The location of streamflow gages, using the USGS number, is shown on Figure 4.6-4. The location of large reservoirs and flood ALERT equipment as well as USGS runoff contours are also shown on Figure 4.6-4. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Streamflow Data

- Refer to Table 4.6-2.
- Data from two stations located at the Colorado River below Hoover Dam and Davis Dam are shown in the table and on Figure 4.6-4.
- Seasonal flow is regulated by releases from the dams and therefore is similar in all seasons. The average seasonal flow for both stations is highest in the spring (April-June) when 29% of the annual average seasonal flow occurs at the station below Hoover Dam and 32% occurs at the station below Davis Dam. The average seasonal flow is lowest in the fall (October-December) for both stations.
- Maximum annual flow for both stations occurred in 1984; 21,350,096 acre-feet at the Colorado River below Hoover Dam station and 21,596,249 acre-feet at the Colorado River below Davis Dam station. Minimum annual flow was 5,919,516 acre-feet at the station below Hoover Dam in 1934 and 7,406,290 acre-feet in 1982 at the station below Davis Dam.

Flood ALERT Equipment

- Refer to Table 4.6-3.
- As of October 2005 there were seven stations in the basin.
- Of the seven stations one is a repeater/precipitation station, one is a weather station, one is a precipitation only station and four are precipitation/stage stations.

Reservoirs and Stockponds

- Refer to Table 4.6-4.
- The basin contains two large reservoirs, Mead and Mohave.
- Lake Mead, created by Hoover Dam, has a maximum capacity of 29,755,000 acre-feet and is used for hydroelectric power generation, irrigation and as a water supply.
- Lake Mohave, created by Davis Dam, has a maximum storage capacity of 1,818,300 acre-feet and is used for hydroelectric power generation.
- Other large reservoirs in the basin include the Topock Marsh, Lost Lake and Beal Lake. All reservoirs are used for recreation; Lost Lake and Beal Lake are also used as fish and wildlife ponds.
- There are two small reservoirs in the basin with a combined surface area of 30 acres.
- There are three registered stockponds in the basin.

Runoff Contours

- Refer to Figure 4.6-4
- Runoff is 0.1 inches per year along the eastern basin boundary.

Table 4.6-2 Streamflow Data for the Lake Mohave Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9421500	Colorado River below Hoover Dam[1]	171,700	NA	4/1934 to current	24	29	26	21	5,919,516 (1934)	9,183,655	10,109,870	21,350,096 (1984)	70
9423000	Colorado River below Davis Dam[1]	169,300	NA	5/1905 to current	21	32	29	18	7,406,290 (1982)	8,499,496	10,102,448	21,596,249 (1984)	44

Sources: USGS NWIS, USGS 1998 and USGS 2007.

Notes:
[1]Station is located in NV
NA = Not available

Table 4.6-3 Flood ALERT Equipment in the Lake Mohave Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
1560	Gold Road Crest Repeater	Repeater/Precipitation	12/4/2001	Mohave County FCD
1590	Boundary Cone	Precipitation/Stage	12/6/2001	Mohave County FCD
1610	Silver Creek Wash	Precipitation/Stage	12/5/2001	Mohave County FCD
1620	Montana Wash	Precipitation/Stage	12/5/2001	Mohave County FCD
1640	El Rodeo Channel	Precipitation/Stage	12/6/2001	Mohave County FCD
1680	Mohave Valley	Weather Station	NA	Mohave County FCD
7420	Golden Shores	Precipitation	NA	Mohave County FCD
7610	Bullhead City	Weather Station	NA	Mohave County FCD

Notes:
FCD = Flood Control District
NA = Not available

Table 4.6-4 Reservoirs and Stockponds in the Lake Mohave Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE[1]	JURISDICTION
1	Mead (Hoover Dam)[2]	Bureau of Reclamation	29,755,000[3]	C,H,I,RR,S	Federal
2	Mohave (Davis Dam)	Bureau of Reclamation	1,818,300[4]	H, S	Federal

Sources: US Army Corps of Engineers 2005, BOR 2006

B. Other Large Reservoirs (50 acre surface area or greater)[5]

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE[1]	JURISDICTION
3	Topock Marsh	Bureau of Reclamation	4,000	R	Federal
4	Lost Lake	US Fish & Wildlife Service	568	F,R	Federal
5	Beal Lake	US Fish & Wildlife Service	300	F,R	Federal

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 0
Total maximum storage: 0 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)[3]

Total number: 2
Total surface area: 30 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 3 (from water right filings)

Notes:
[1]C=flood control; F=fish & wildlife pond; H=hydroelectric; I=irrigation; R=recreation; RR=river regulation; S=water supply
[2] Dam is located in Lake Mohave Basin and lake storage is located in Lake Mohave, Detrital Valley, Hualapai Valley and Meadview Basins.
[3] Includes 2,378,000 acre-feet of dead storage.
[4] Includes 8,530 acre-feet of dead storage.
[5] Capacity data not available to ADWR

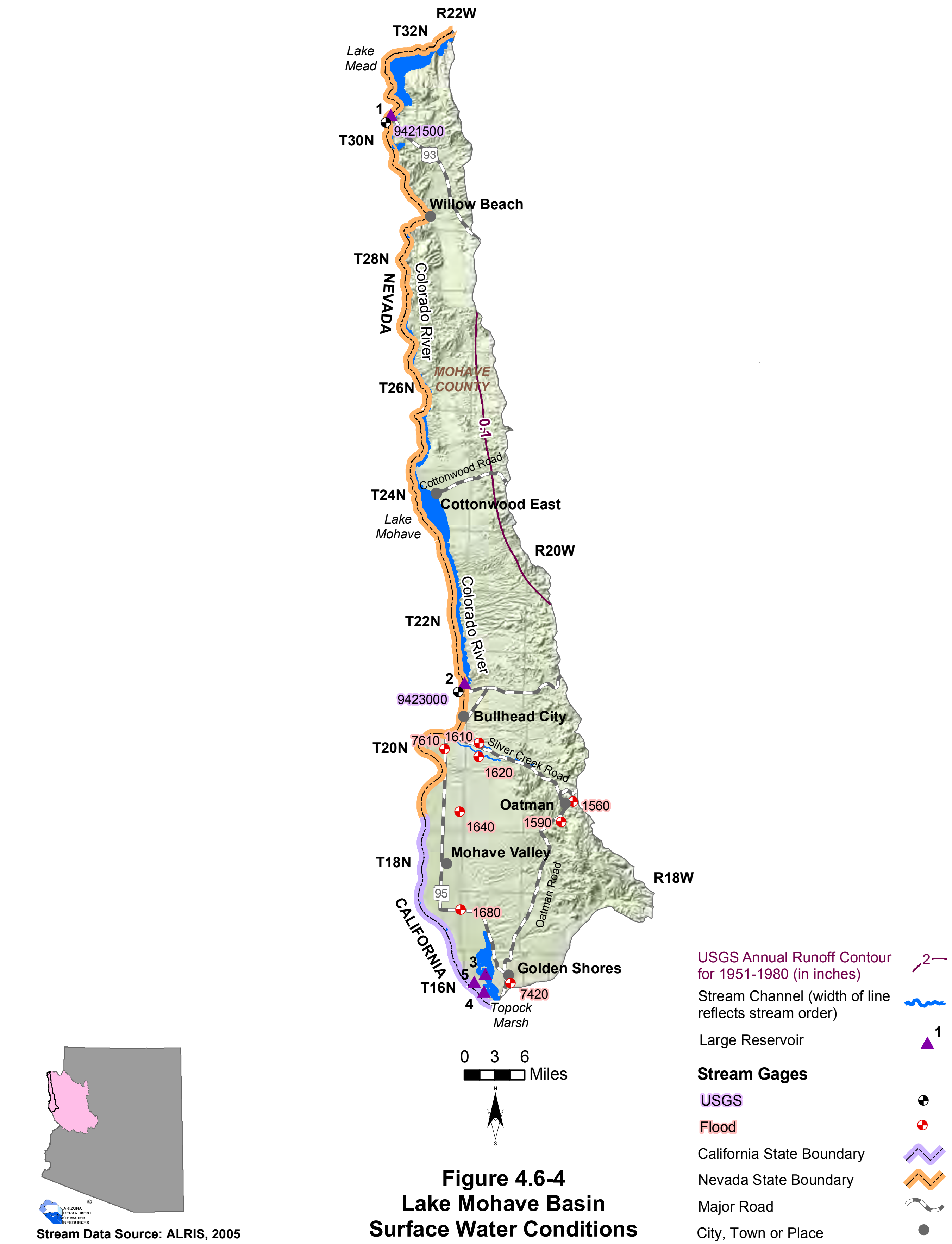


Figure 4.6-4
Lake Mohave Basin
Surface Water Conditions

4.6.5 Perennial/Intermittent Streams and Major Springs in the Lake Mohave Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 4.6-5. The locations of major springs as well as perennial and intermittent streams are shown on Figure 4.6-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- There is one perennial stream, the Colorado River, located along the western basin boundary.
- There are nine major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time.
- Listed discharge rates may not be indicative of current conditions. All of the measurements were made during or prior to 1983.
- All of the major springs are found in the northern portion of the basin between Hoover Dam and Willow Beach. The greatest discharge rates were measured north of Willow Beach (two unnamed springs, 100 gpm).
- All major springs discharge 100 gpm or less.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 4.6-5B. There are two minor springs identified in this basin.
- The total number of springs identified by the USGS varies from 27 to 29, depending on the database reference.

Table 4.6-5 Springs in the Lake Mohave Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Unnamed	360008	1144420	100	During or prior to 1971
2	Unnamed	355956	1144410	100	During or prior to 1971
3	Hot - Ringbolt Rapids	355739	1144326	48	During or prior to 1983
4	Palm Tree- Cold[2]	355942	1144415	40	During or prior to 1983
5	Arizona Seep	355542	1144220	32	During or prior to 1983
6	Arizona Hot Spot[2]	360022	1144431	32	During or prior to 1983
7	Palm Tree Hot[2]	355942	1144420	32	During or prior to 1983
8	Unnamed	360015	1144420	30	During or prior to 1971
9	Unnamed	360001	1144424	20	10/23/1970

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Unnamed[3]	355925	1144421	5	During or prior to 1979
Box	351649	1142906	1	NA

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and USGS, 2006): 27 to 29

Notes:
[1]Most recent measurement identified by ADWR
[2]Spring is not displayed on current USGS topo maps
[3]Location approximated by ADWR
NA=Not available

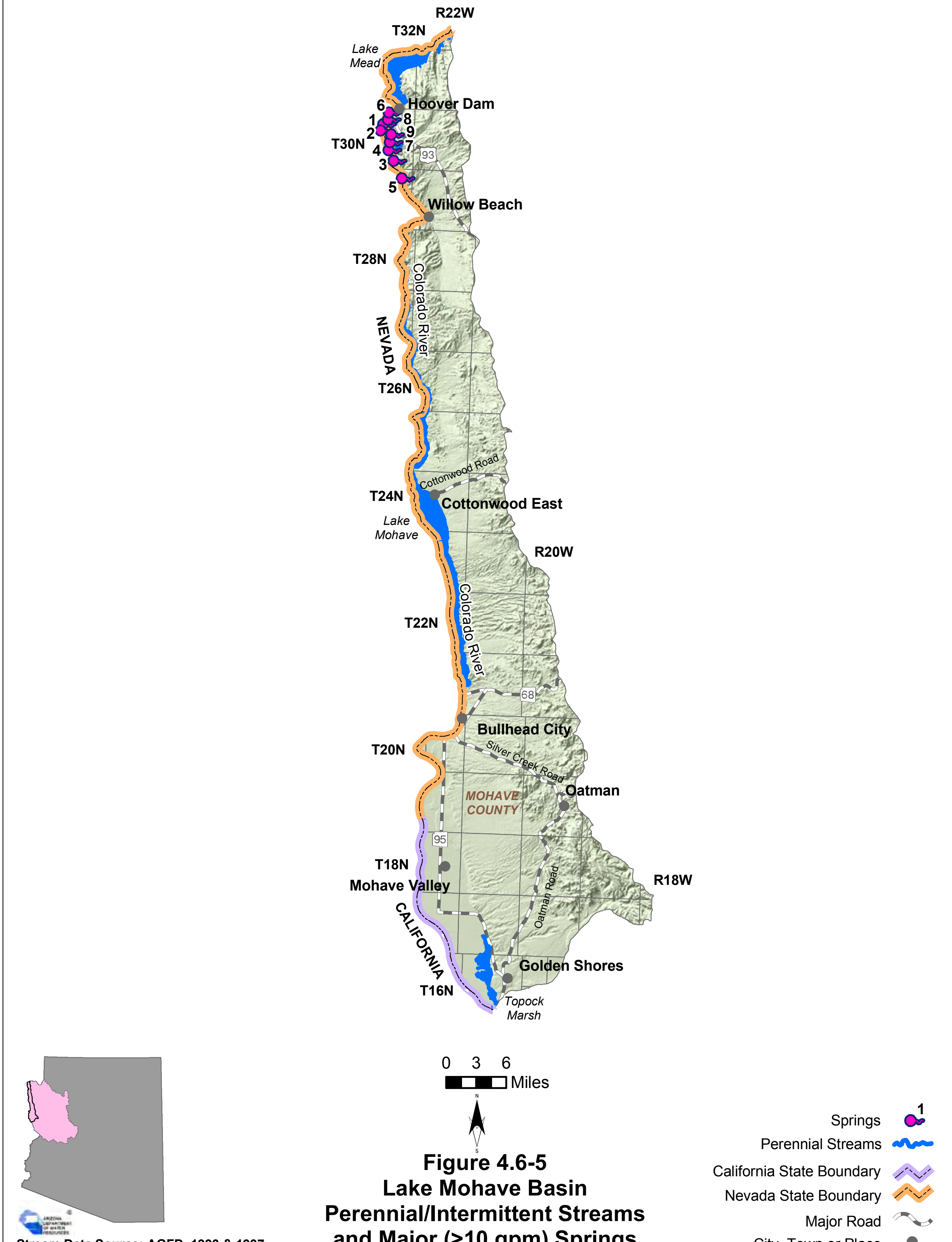


Figure 4.6-5
Lake Mohave Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

4.6.6 Groundwater Conditions of the Lake Mohave Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 4.6-6. Figure 4.6-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 4.6-7 contains hydrographs for selected wells shown on Figure 4.6-6. Figure 4.6-8 shows well yields in five yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields, is found in Volume 1, Section 1.3.19.

Major Aquifers
- Refer to Table 4.6-6 and Figure 4.6-6.
- The major aquifer in this basin is recent stream alluvium.
- Flow direction is from north to south in this basin.

Well Yields
- Refer to Table 4.6-6 and Figure 4.6-8.
- As shown on Figure 4.6-8 well yields in this basin range from less than 100 gallons per minute (gpm) to greater than 2,000 gpm.
- One source of well yield information, based on 96 reported wells, indicates that the median well yield in this basin is 1,000 gpm.
- All recorded well yields are in the southern portion of the basin. There is a cluster of wells that yield greater than 2,000 gpm around Mohave Valley.

Natural Recharge
- Refer to Table 4.6-6.
- The estimate of natural recharge for this basin is 183,000 acre-feet per year.
- Recharge comes principally from infiltration of Colorado River water.

Water in Storage
- Refer to Table 4.6-6.
- There are three storage estimates for this basin, ranging from 1.2 million acre-feet to eight million acre-feet. The most recent estimate, from a 1994 ADWR study indicated that there is 1.2 million acre-feet in storage to a depth of 1,200 feet.
- The predevelopment estimate of storage for this basin is eight million acre-feet to a depth of 1,200 feet.

Water Level
- Refer to Figure 4.6-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures three index wells in this basin.
- There are no recorded well sweeps in this basin.
- There are only three water depths recorded in this basin. The deepest is 427 feet south of Bullhead City and the shallowest is 337 feet north of Mohave Valley.
- Hydrographs corresponding to selected wells shown on Figure 4.6-6 but covering a longer time period are shown in Figure 4.6-7.

Table 4.6-6 Groundwater Data for the Lake Mohave Basin

Basin Area, in square miles:	980	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Recent Stream Alluvium	
Well Yields, in gal/min:	3,205 (1 well measured)	Measured by ADWR and/or USGS
	Range 15-5,000 Median 1,000 (96 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 30-1,000	ADWR (1990 and 1994)
	Range 0-2,500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	183,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	1,200,000 (to 1,200 ft)	ADWR (1994)
	8,000,000[1] (to 1,200 ft)	Freethey and Anderson (1986)
	6,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
Current Number of Index Wells:	3	
Date of Last Water-level Sweep:	NA	

Notes:
NA = Not Available
[1]Predevelopment Estimate

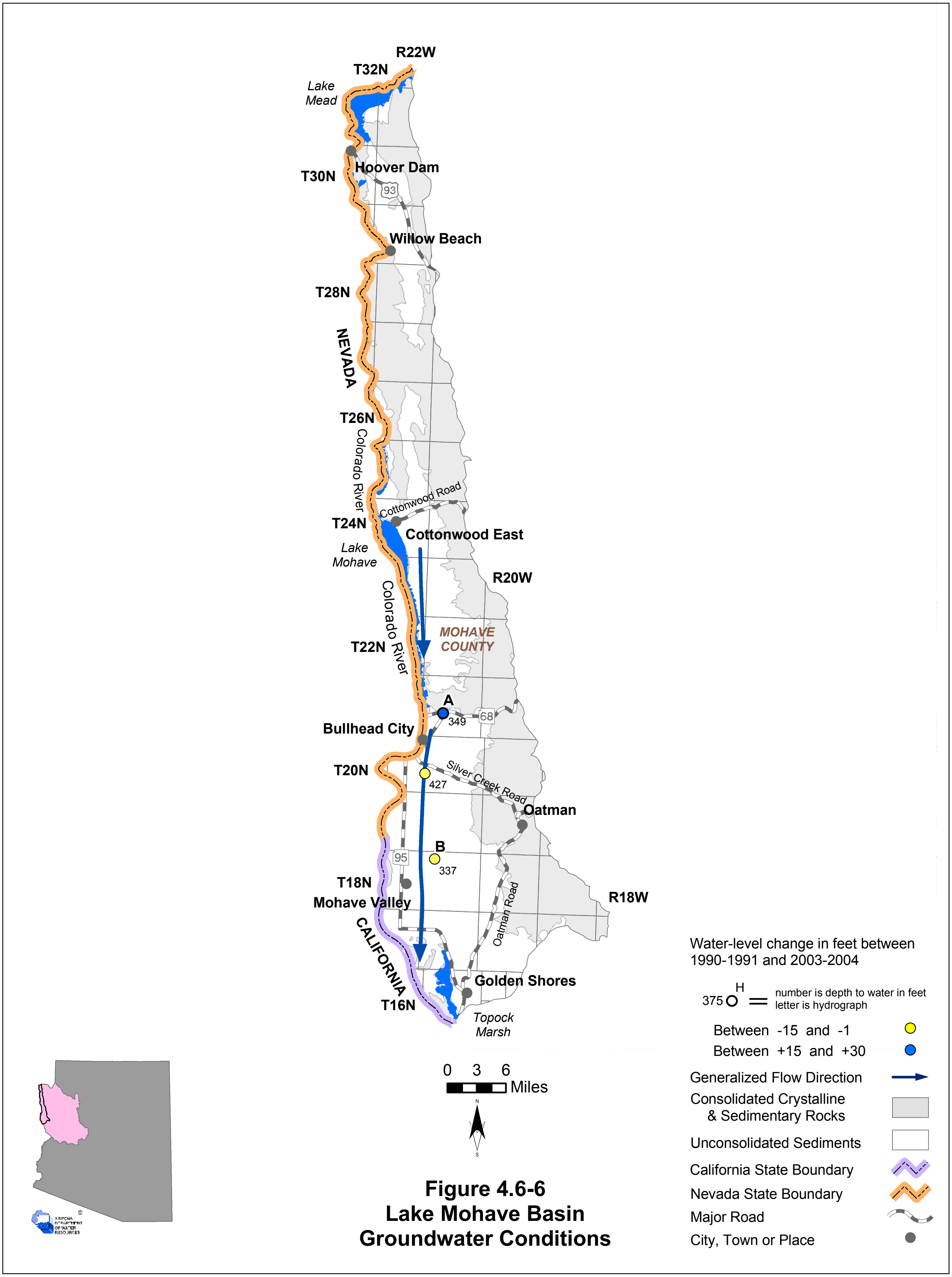
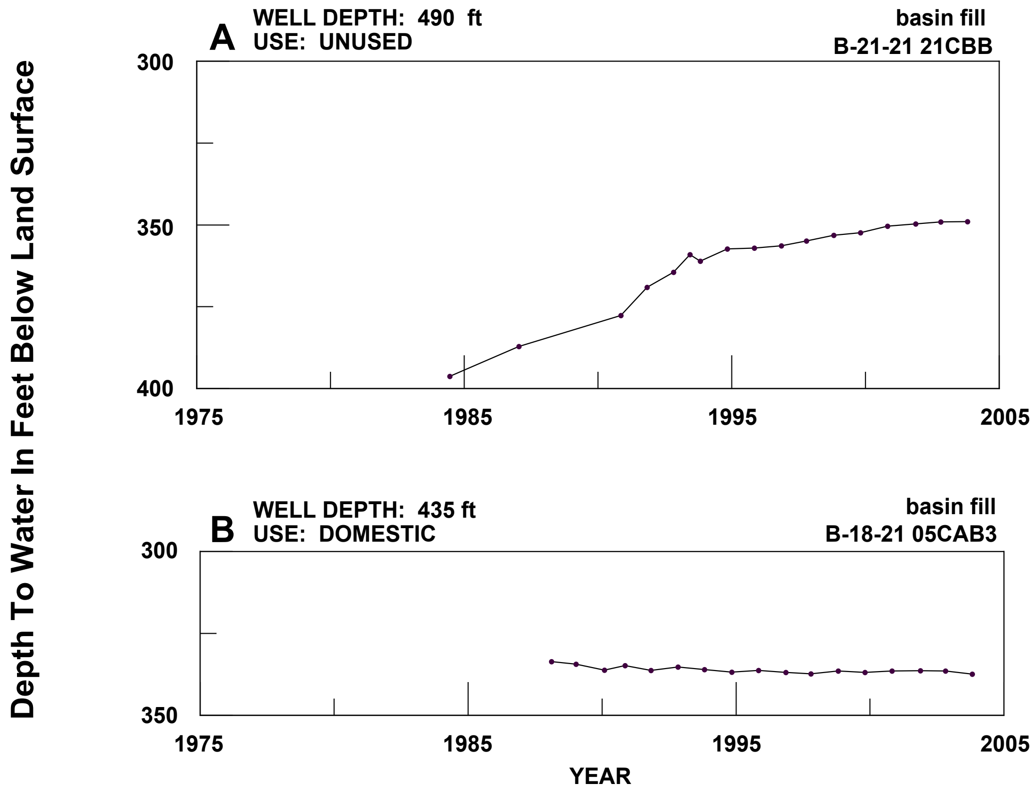


Figure 4.6-6
Lake Mohave Basin
Groundwater Conditions

Figure 4.6-7
Lake Mohave Basin
Hydrographs Showing Depth to Water in Selected Wells



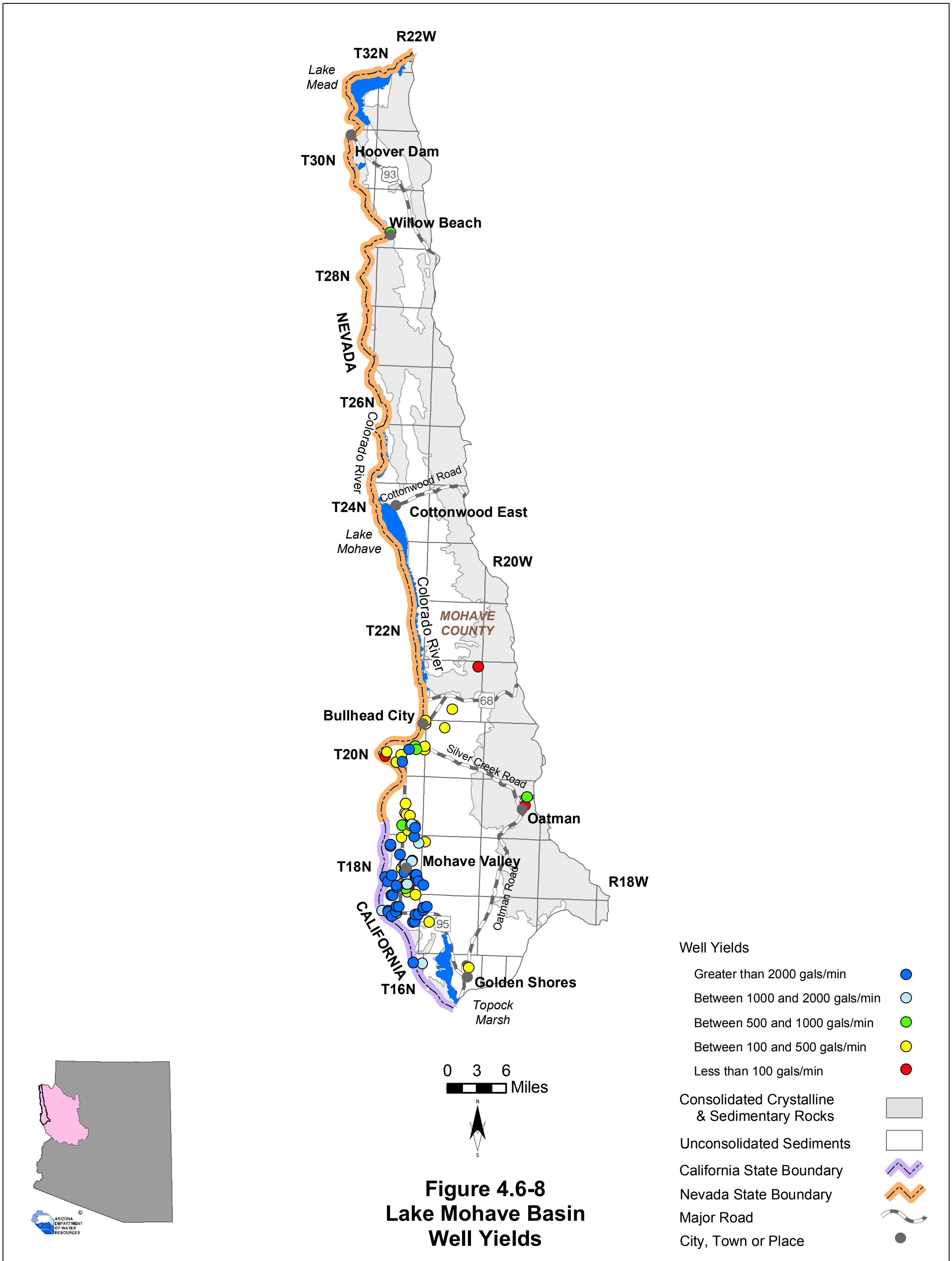


Figure 4.6-8
Lake Mohave Basin
Well Yields

4.6.7 Water Quality of the Lake Mohave Basin

Drinking water standard exceedences in wells, springs and mine sites including location and parameter(s) exceeded are shown in Table 4.6-7A. Impaired lakes and streams with site type, name, length of impaired stream reach, area of impaired lake, designated use standard and parameter(s) exceeded is shown in Table 4.6-7B. Figure 4.6-9 shows the location of exceedences and impairment keyed to Table 4.6-7. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mine Sites

- Refer to Table 4.6-7A.
- Drinking water standard exceedences in wells and springs have been reported for 64 sites in the basin.
- The drinking water standard for arsenic was the most frequently exceeded standard at sites in this basin.
- There are two clusters of arsenic exceedences, one around Bullhead City and the other south of Fort Mohave.
- Other drinking water standards exceeded in this basin include cadmium, fluoride, lead, nitrate/nitrite, mercury and total dissolved solids.

Lakes and Streams

- Refer to Table 4.2-7B.
- Water quality standards were exceeded in one 40-mile reach of the Colorado River between Hoover Dam and Lake Mohave.
- The drinking water standard exceeded was selenium.
- The Colorado River between Hoover Dam and Lake Mohave is not part of the ADEQ water quality improvement effort called the Total Maximum Daily Load (TMDL) program at this time.

Table 4.6-7 Water Quality Exceedences in the Lake Mohave Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Exceeding Drinking Water Standard[2]
		Township	Range	Section	
1	Spring	30 North	23 West	10	F
2	Spring	30 North	23 West	10	Hg
3	Spring	30 North	23 West	15	Hg, TDS
4	Spring	30 North	23 West	26	Hg
5	Well	29 North	22 West	29	As
6	Spring	29 North	23 West	12	Hg, TDS
7	Well	27 North	21 West	29	As, TDS
8	Well	27 North	22 West	1	As
9	Well	21 North	21 West	21	As, F, NO3
10	Well	21 North	21 West	27	As
11	Well	21 North	21 West	27	As
12	Well	21 North	21 West	29	As, Pb
13	Well	21 North	21 West	29	As, F
14	Well	21 North	21 West	31	As, Pb
15	Well	20 North	22 West	1	As
16	Well	20 North	22 West	1	NO3
17	Well	20 North	22 West	12	Cd
18	Well	20 North	22 West	14	As
19	Well	20 North	22 West	16	Pb
20	Well	20 North	22 West	16	Pb
21	Well	20 North	22 West	19	NO3
22	Well	20 North	22 West	19	TDS
23	Well	20 North	22 West	19	As, NO3
24	Well	20 North	22 West	25	As
25	Well	20 North	22 West	25	As
26	Well	20 North	22 West	25	As
27	Well	20 North	22 West	26	As, Hg
28	Well	20 North	22 West	26	As
29	Well	20 North	22 West	26	As
30	Well	20 North	22 West	26	F
31	Well	20 North	22 West	26	As
32	Well	20 North	22 West	26	As
33	Well	20 North	22 West	26	As
34	Well	20 North	22 West	26	As, F
35	Well	20 North	22 West	26	F
36	Well	20 North	22 West	26	As, F
37	Well	20 North	22 West	26	As, F
38	Well	20 North	22 West	29	As, NO3
39	Well	20 North	22 West	32	As
40	Well	20 North	22 West	32	As
41	Well	20 North	22 West	35	As, Hg
42	Well	20 North	22 West	35	As, NO3
43	Well	20 North	22 West	35	As, NO3, Hg
44	Well	20 North	23 West	24	As
45	Well	19 North	20 West	26	As
46	Well	19 North	22 West	1	As
47	Well	19 North	22 West	14	As
48	Well	19 North	22 West	26	As
49	Well	19 North	22 West	34	TDS
50	Well	19 North	22 West	35	NO3
51	Well	19 North	22 West	36	F
52	Well	18 North	20 West	7	Pb, NO3

Table 4.6-7 Water Quality Exceedences in the Lake Mohave Basin (cont'd)[1]

A. Wells, Springs and Mines cont'd

Map Key	Site Type	Site Location			Parameter(s) Exceeding Drinking Water Standard[2]
		Township	Range	Section	
53	Well	18 North	22 West	25	As
54	Well	18 North	22 West	27	As
55	Well	18 North	22 West	35	As
56	Well	18 North	22 West	35	As
57	Well	18 North	22 West	36	As
58	Well	17 North	19 West	4	As
59	Well	17 North	21 West	17	As
60	Well	17 North	22 West	3	Pb
61	Well	17 North	22 West	4	As
62	Well	17 North	22 West	10	As, Pb
63	Well	17 North	22 West	11	TDS
64	Well	17 North	22 West	13	As
65	Well	17 North	22 West	14	Pb

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard[3]	Parameter(s) Exceeding Use Standard[2]
a	Stream	Colorado River (Hoover Dam to Lake Mohave)	40	NA	A&W	Se

Notes:

NA = Not applicable
[1] Water quality samples collected between 1970 and 2004.
[2] As = Arsenic
Cd = Cadmium
F = Fluoride
Pb = Lead
NO3 = Nitrate/Nitrite
Hg = Mercury
TDS = Total Dissolved Solids
Se = Selenium
[3] A&W = Aquatic and Wildlife

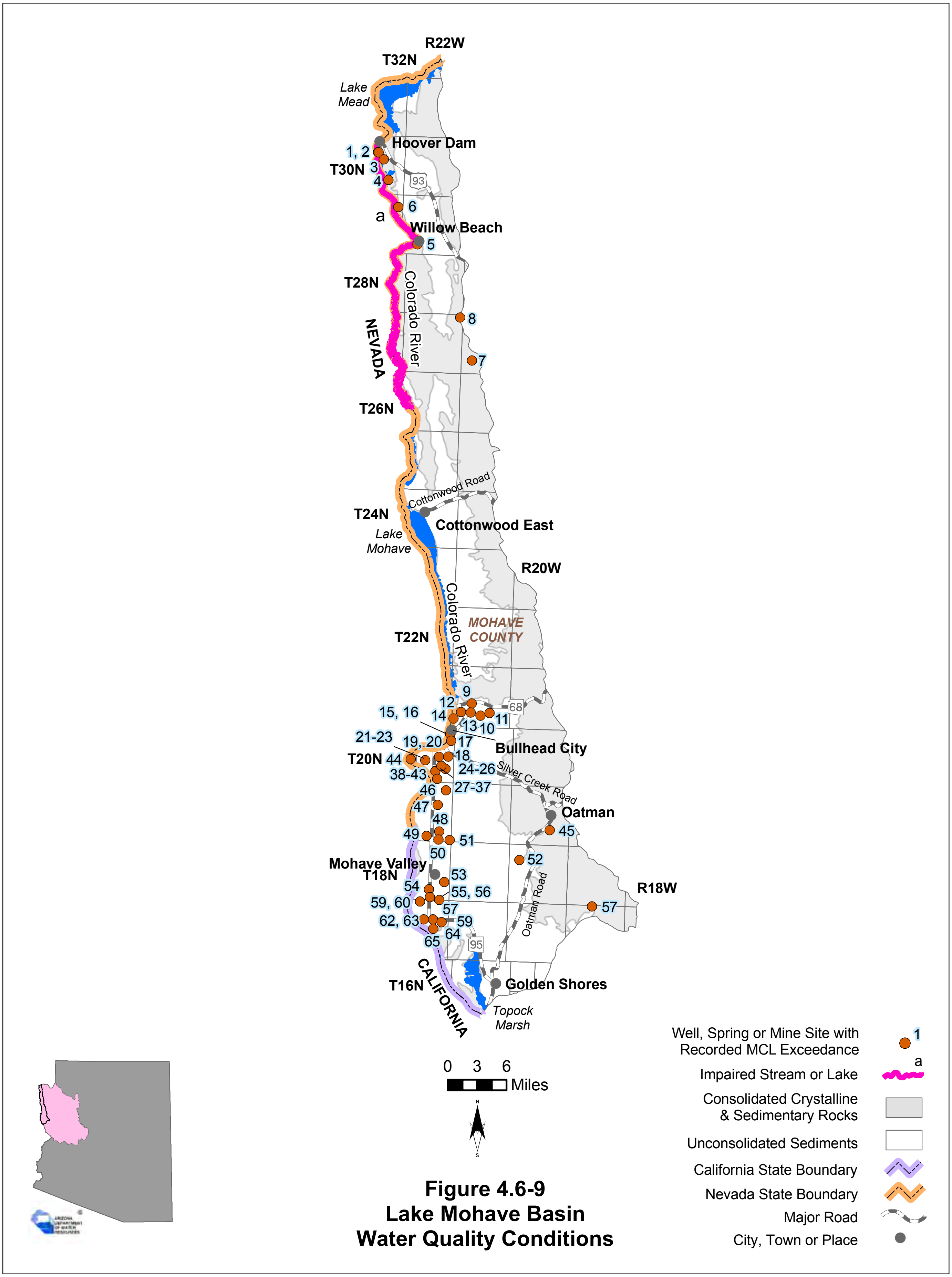


Figure 4.6-9
Lake Mohave Basin
Water Quality Conditions

4.6.8 Cultural Water Demands in the Lake Mohave Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 4.6-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 4.6-9. Figure 4.6-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 4.0.7.

Cultural Water Demands

- Refer to Table 4.6-8 and Figure 4.6-10.
- Population in this basin has increased substantially since 1980, increasing from 13,653 in 1980 to 51,549 in 2000. Projections suggest a similar rate of growth through 2050.
- Groundwater use has increased in this basin since 1971, with an average of 17,500 acre-feet per year from 1971-1975 and an average of 56,500 acre-feet pumped per year from 2001-2003.
- The cultural water demand table for this basin reflects the amount of water pumped from wells and diverted from streams for use. Some of these water uses may be accounted as Colorado River water based on an entitlement system established by Decree by the U.S. Supreme Court in Arizona v. California et.al. Further information on Colorado River entitlements in this planning area is provided in Section 4.0.6.
- Surface water diversions in this basin were relatively minimal in the 1970s, with a significant increase in surface water diversions in from 1980-1985. Current surface water diversions are similar to those from 1980-1999 with an average of 65,100 acre-feet per year from 1991-2000.
- The majority of surface water use from 1990-2003 was for agricultural irrigation on the Fort Mojave Indian Reservation in the vicinity of Mohave Valley.
- Municipal and industrial demand is found along Highway 95 north of Mohave Valley and in the vicinity of Bullhead City. Although the USGS National Gap Analysis Program GIS cover used for Figure 4.6-10 does not show high intensity municipal and industrial use in the vicinity of Bullhead City, this use exists in this area.
- Municipal groundwater demand has grown from 18,300 acre-feet per year on average in 1991 to 24,000 acre-feet per year on average in 2003.
- Industrial groundwater demand is minimal in this basin, at an average of 1,000 acre-feet per year from 2001-2003. Industrial groundwater demand is for three small mines or quarries and a golf course in the vicinity of Bullhead City.
- In 2001-2003 an average of 3,600 acre-feet of surface water per year was used for industrial demand. All industrial surface water demand comes from the South Point power plant on the Fort Mojave Reservation.
- There are three power plants in this basin. Two are hydroelectric, located at Davis and Hoover Dams and the third is the gas-fired South Point power plant located on the Fort Mojave Reservation south of Mohave Valley.
- As of 2003 there were 1,870 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 187 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 4.6-9.
- There are fifteen wastewater treatment facilities in this basin.
- Information on population served was available for only six facilities and information on effluent generation was available for nine facilities. These facilities serve over 15,000 people and generate almost 3,000 acre-feet of effluent per year.
- Of the nine facilities with information on the effluent disposal method: three discharge to evaporation ponds; three discharge for golf or turf irrigation; two discharge effluent to unlined impoundments that recharge the aquifer; one discharges to a watercourse; one discharges for irrigation; and one discharges to a wildlife area.

Table 4.6-8 Cultural Water Demands in the Lake Mohave Basin[1]

Year	Recent (Census) and Projected (DES) Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)[2]						Data Source
				Well Pumpage			Surface-Water Diversions			
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial	Irrigation	Municipal	Industrial	Irrigation	
1971		807[3]	173[3]	17,500			2,600			ADWR (2007)
1972										
1973										
1974										
1975										
1976				22,000			14,400			
1977										
1978										
1979										
1980	13,653									
1981	15,353	394	9	27,300			46,600			
1982	17,053									
1983	18,752									
1984	20,452									
1985	22,152									
1986	23,852	254	3	29,500			53,600			
1987	25,551									
1988	27,251									
1989	28,951									
1990	30,651									
1991	32,740	185	1	18,300	900	35,800	540	NR	56,600	USGS (2005) BIA (1998)
1992	34,830									
1993	36,920									
1994	39,010									
1995	41,100									
1996	43,190	136	1	20,600	900	34,500	660	NR	68,100	
1997	45,280									
1998	47,369									
1999	49,459									
2000	51,549									
2001	52,936	47	0	24,000	1,000	31,500	500	3,600	61,000	
2002	54,322									
2003	55,709									
2010	65,416									
2020	82,051									
2030	94,301									
2040	101,874									
2050	107,782									
ADDITIONAL WELLS:[4]		**47**								
WELL TOTALS:		**1,870**	**187**							

Notes:
NR = Not reported.
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] Includes pumpage and diversion of Colorado River Contract Water.
[3] Includes all wells through 1980.
[4] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 4.6-9 Effluent Generation in the Lake Mohave Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf Irrigation	Wildlife Area	Discharged to Another Facility	Infiltration Basins			
Adobe Highlands Apt. WWTF	Private	Bullhead City	NA											
Bullhead Biltmore	Private	Bullhead City	NA											
Citizens Utilities	Private	Bullhead City	NA	3.3	NA									2003
Davis Dam Evaporation Ponds	Bureau of Reclamation	Dam				X								
Fort Mohave Treatment Wetland	Ft. Mohave Indian Tribe	Ft. Mohave Indian Reservation	400	45					X			Secondary	NA	2000
Hoover Dam WWTF	Bureau of Reclamation	Dam	NA											
Katherine's Landing WWTF	National Park Service	Park	NA			X						NA		
Riverbend	NA	Bullhead City	NA											
Section 10	Bullhead City	Bullhead City	12,000	1,792				Rotary Park/ Chaparral			X	Adv.Tr.II	10,000	2004
Section 18 WWTF	Bullhead City	Bullhead City	2,000	392			X	Laughlin Ranch				Adv. Tr. II	18,500	2004
Sierra	AZ American Water	Bullhead City	NA	467				Riverview Golf Course				NA		2004
Sun Ridge	NA	Bullhead City	500	78	X							Adv. Tr. 1	NA	1996
Sunrise Vista Utilities	Private	Bullhead City	419	51							X	NA		2002
Tierra Grande[1]	NA	Bullhead City	280	37		X						Adv. Tr. 1	3,720	2000
Wishing Well WWTP	AZ American Water	Ft. Mohave	NA	134				Desert Lakes				Secondary	NA	2004
Total			15,199	2,954										

Notes:
NA: Data not currently available to ADWR
WWTF: Waste Water Treatment Facility
WWTP: Waste Water Treatment Plant
Ad. Tr. 1: Advanced treatment level 1
Adv. Tr. II: Advanced Treatment level II
[1]Scheduled to close in May 2005

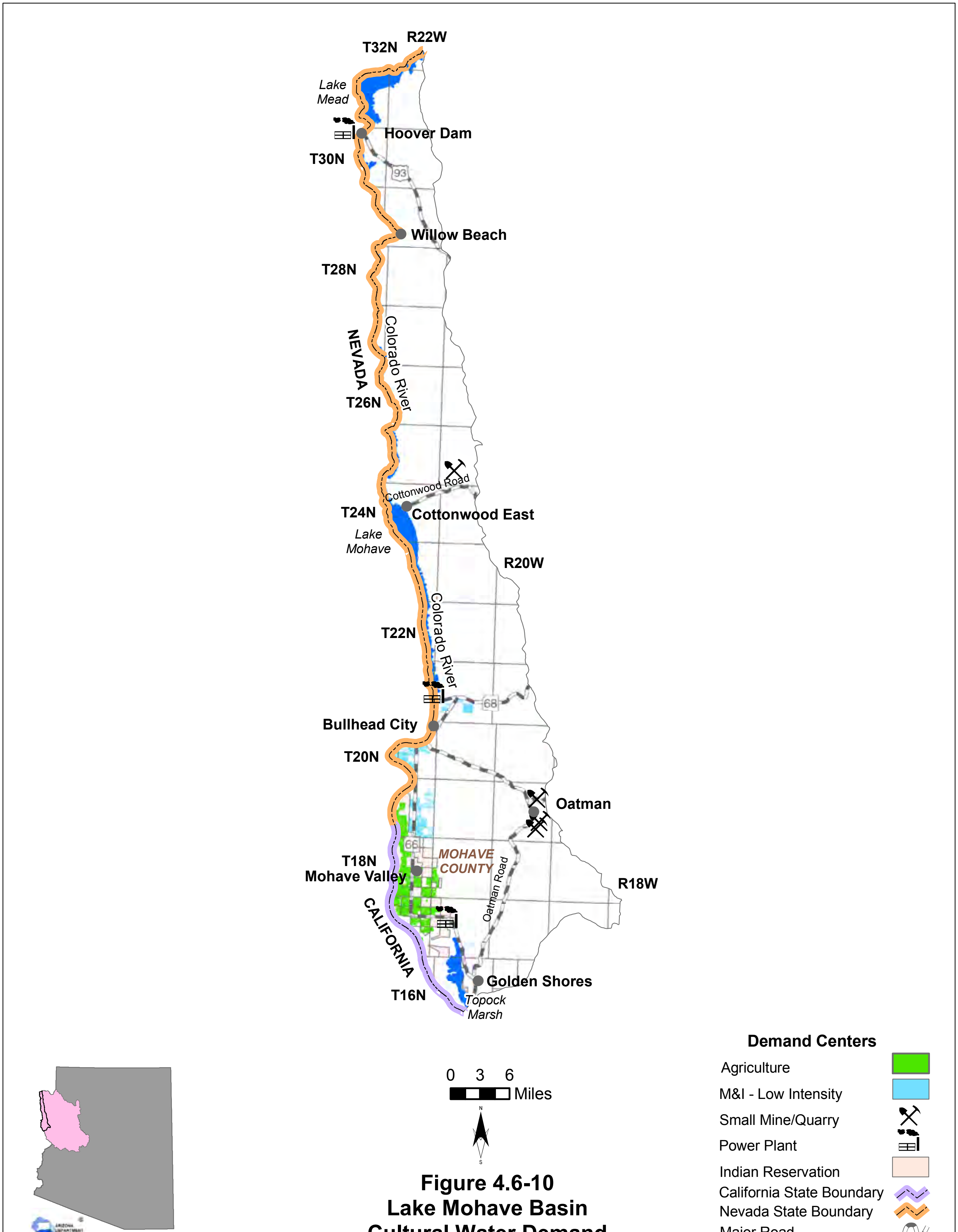


Figure 4.6-10
Lake Mohave Basin
Cultural Water Demand

Primary Data Source: USGS National Gap Analysis Program, 2004
Lower Colorado River Accounting System, 2003

4.6.9 Water Adequacy Determinations in the Lake Mohave Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 4.6-10. Figure 4.6-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

Water Adequacy Reports

- See Table 4.6-10A
- A total of 254 water adequacy determinations have been made in this basin through December, 2006.
- Three determinations of inadequacy have been made, two are located north of Mohave Valley and the third is south of Bullhead City.
- The determinations of inadequacy were based on: the applicant's failure to demonstrate a legal right to use the water or failure to demonstrate their legal authority to serve the subdivision; the applicant did not submit the necessary information and/or available hydrologic data were insufficient to make a determination; and water quality.
- All lots receiving an adequacy determination are in Mohave County. The total number of lots receiving a water adequacy determination is not available. Of the 31,898 lots in 236 subdivisions, 31,626 lots or 99% were determined to be adequate.

Analysis of Adequate Water Supply

- See Table 4.6-10B
- Two analyses of adequate water supply have been issued for this basin, for a total of 189 lots. For more information on analysis of adequate water supply see Section 4.0.9.

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin[1]

A. Water Adequacy Reports

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Agua View Tract 1051	Mohave	17 North	22 West	23	56		Adequate		02/28/94	Fort Mohave Tribal Utilities
2	American Business Park	Mohave	19 North	22 West	35	NA		Adequate		10/19/88	Bermuda Water Company, Inc.
3	American Business Park Tract 4075	Mohave	19 North	22 West	35	NA		Adequate		10/19/92	Bermuda Water Company, Inc.
4	Arroyo Park at Desert Foothills Estates, Tract 5046	Mohave	20 North	21 West	5	63	22-300215	Adequate		11/18/96	Citizens Utilities Company-Mohave
5	Arroyo Vista Estates	Mohave	19 North	22 West	12	NA		Adequate		01/06/88	Bermuda Water Company, Inc.
6	Arroyo Vista Estates Tract 4077E Unit 2	Mohave	19 North	22 West	12	36	22-400526	Adequate		06/29/01	Bermuda Water Company, Inc.
7	Aztec Village Tract 4144A	Mohave	19 North	22 West	23	7		Adequate		04/20/93	Bermuda Water Company, Inc.
8	Bermuda Dunes Tract 4039A	Mohave	17 North	22 West	15	NA		Adequate		12/11/84	Bermuda Water Company, Inc.
9	Bermuda Dunes Tract 4039C	Mohave	17 North	22 West	15	NA		Adequate		01/07/88	Bermuda Water Company, Inc.
10	Bermuda Dunes Tract 4039D	Mohave	17 North	22 West	15	NA		Adequate		11/15/88	Bermuda Water Company, Inc.
11	Bermuda Dunes Tract 4059B	Mohave	17 North	22 West	15	NA		Adequate		11/21/85	Bermuda Water Company, Inc.
12	Bermuda Meadows (A)	Mohave	17 North	22 West	15	4		Adequate		03/04/92	Fort Mohave Tribal Utilities Authority
13	Bermuda Meadows (B)	Mohave	17 North	22 West	15	8		Adequate		02/27/92	Fort Mohave Tribal Utilities Authority
14	Beverly Hills Estates Tract 4028	Mohave	19 North	22 West	25	NA		Adequate		05/02/83	Dry Lot Subdivision
15	Black Mountain Park	Mohave	20 North	22 West	23	988		Adequate		05/01/90	Citizens Utilities Company-Mohave
16	Bluewater Shores	Mohave	20 North	22 West	17	4		Adequate		03/13/90	Citizens Utilities Company-Mohave
17	The Borgata on Mountain View Tract 4205	Mohave	19 North	22 West	14	107	22-402045	Adequate		06/22/06	Bermuda Water Company
18	Brett Canyon Estates Tract 4196	Mohave	19 North	22 West	25	55	22-401809	Adequate		08/04/05	Bermuda Water Company
19	Buena Vista # 4	Mohave	20 North	22 West	16	NA		Adequate		11/12/75	Oasis Utility Company
20	Bullhead Airpark Phase 1 Tract 5009	Mohave	21 North	21 West	31, 32	7	22-300153	Adequate		07/23/97	North Mohave Valley Corporation
21	Bullhead Plaza	Mohave	20 North	22 West	18	NA		Adequate		05/17/82	Oasis Water Company
22	Camp Mohave Heights	Mohave	19 North	22 West	23	NA		Adequate		10/23/89	Citizens Utilities Company-Mohave
23	Casa Blanca	Mohave	20 North	23 West	13	13		Adequate		04/09/91	Citizens Utilities Company-Mohave
24	Casa de Rio Villas Condos	Mohave	20 North	22 West	17	60		Adequate		09/28/83	Citizens Utilities Company-Mohave
25	Casa Grande Condominiums	Mohave	21 North	21 West	21	19		Adequate		06/26/92	North Mohave Water Company
26	Central Village A	Mohave	20 North	22 West	19	46		Adequate		03/21/78	Citizens Utilities Company-Mohave
27	Chaparral Country Club Tract 5029	Mohave	20 North	22 West	29	30		Adequate		11/22/94	Citizens Utilities Company-Mohave
28	Chaparral del Rio Condominiums	Mohave	20 North	22 West	29	90		Adequate		07/28/89	Citizens Utilities Company-Mohave
29	Chaparral Terrace	Mohave	20 North	22 West	29	NA		Adequate		10/11/85	Citizens Utilities Company-Mohave

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
30	Chaparral Villas Condominiums	Mohave	20 North	22 West	29	NA		Adequate		10/25/88	Citizens Utilities Company-Mohave
31	Clearwater Hills # 1	Mohave	19 North	22 West	11	120		Adequate		10/15/80	Bermuda Water Company, Inc.
32	Clearwater Hills # 2	Mohave	19 North	22 West	11	81		Adequate		04/12/82	Bermuda Water Company, Inc.
33	Clearwater Hills # 3	Mohave	19 North	22 West	11	75		Adequate		06/13/85	Bermuda Water Company, Inc.
34	Colorado River Estates	Mohave	20 North	22 West	25, 26	136		Adequate		04/02/90	Dry Lot Subdivision
35	Colorado Riverfront Terrace	Mohave	17 North	22 West	23	61		Adequate		06/22/89	Bermuda Water Company, Inc.
36	Courtney Greens Tract 4054	Mohave	19 North	22 West	23	42		Adequate		12/16/86	Bermuda Water Company, Inc.
37	Courtney Greens # 2 Tract 4054B	Mohave	19 North	22 West	23	30		Adequate		08/20/90	Bermuda Water Company, Inc.
38	Courtney Park East 4147A	Mohave	19 North	22 West	23	6		Adequate		07/22/93	Bermuda Water Company, Inc.
39	Courtney Park East Tract 4147-B	Mohave	19 North	22 West	23	64		Adequate		06/23/97	Bermuda Water Company, Inc.
40	Courtney Place Tract 4070	Mohave	19 North	22 West	23	5		Adequate		10/24/90	Bermuda Water Company, Inc.
41	Courtney Place Townhomes 4071A	Mohave	19 North	22 West	23	18		Adequate		09/24/92	Bermuda Water Company, Inc.
42	Coves on the Colorado River, The	Mohave	17 North	22 West	23	99	22-401766	Adequate		03/13/06	Fort Mohave Tribal Utilities Authority
43	Covina Gardens Condominiums	Mohave	20 North	22 West	29	12		Adequate		12/08/82	Citizens Utilities Company-Mohave
44	Coyote Run Tract 4176-A	Mohave	19 North	22 West	23	42	22-401144	Adequate		02/18/04	Arizona American Water Company
45	Del Rio Estates	Mohave	20 North	22 West	32	7	22-400542	Adequate		08/06/01	Citizens Utilities Company-Mohave
46	Delta City # 5	Mohave	17 North	21 West	7	2,173		Adequate		09/13/73	Bermuda Water Company, Inc.
47	Desert Canyon At Sun Ridge	Mohave	21 North	21 West	21	141	22-401837	Adequate		02/02/06	North Mohave Valley Corp.
48	Desert Foothills Estates #5011	Mohave	20 North	21 West	5	3,353		Adequate		04/18/95	Citizens Utilities Company-Mohave
49	Desert Glen	Mohave	20 North	22 West	13	103		Adequate		05/20/81	Citizens Utilities Company-Mohave
50	Desert Horizons Tract 4161	Mohave	19 North	22 West	23	44	22-400113	Adequate		09/21/99	Bermuda Water Company, Inc.
51	Desert Isle	Mohave	20 North	22 West	13	15		Adequate		11/15/90	Citizens Utilities Company-Mohave
52	Desert Lakes Estates Tract 4152A	Mohave	19 North	22 West	36	31	22-300025	Adequate		03/05/96	Bermuda Water Company, Inc.
53	Desert Lakes Estates Tract 4152B	Mohave	19 North	22 West	36	40	22-400220	Adequate		01/05/00	Bermuda Water Company, Inc.
54	Desert Lakes Estates Tract 4152-C	Mohave	19 North	22 West	36	42	22-400987	Adequate		10/22/03	Bermuda Water Company
55	Desert Lakes Estates Tract 4152-D, E, F & G	Mohave	19 North	22 West	36	159	22-401687	Adequate		09/27/05	Bermuda Water Company
56	Desert Lakes Estates Tract 4159 Unit H	Mohave	19 North	22 West	35	6	22-400475	Adequate		04/27/01	Bermuda Water Company, Inc.
57	Desert Lakes Golf Course & Estates	Mohave	19 North	22 West	36	233		Adequate		05/14/90	Bermuda Water Company, Inc.

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
58	Desert Lakes Golf Course & Estates # F	Mohave	19 North	22 West	35	38	22-300326	Adequate		10/29/97	Bermuda Water Company, Inc.
59	Desert Lakes Golf Course & Estates Tract 4163	Mohave	19 North	22 West	35	32	22-400697	Adequate		05/07/02	Bermuda Water Company
60	Desert Ridge Tract 4032A	Mohave	19 North	22 West	11	83		Adequate		02/23/84	Bermuda Water Company, Inc.
61	Dos Vientos Tract 4199	Mohave	19 North	22 West	23	15	22-401676	Adequate		04/11/05	Bermuda Water Company, Inc.
62	East Shore Villas # 1 Tract 5070	Mohave	20 North	22 West	9, 16	51	22-400175	Adequate		11/22/99	Citizens Utilities Company-Mohave
63	Edgewood Condominiums Tract 4021	Mohave	20 North	22 West	13	36		Adequate		08/18/81	Citizens Utilities Company-Mohave
64	El Camino Estates	Mohave	19 North	22 West	1	763		Adequate		12/07/89	Bermuda Water Company, Inc.
65	El Camino Village # 1	Mohave	19 North	22 West	1	251		Adequate		12/26/91	Bermuda Water Company, Inc.
66	El Rio Country Club Tract 4177-A	Mohave	18 North	22 West	11	161	22-401466	Adequate		05/04/05	Bermuda Water Company & Ft Mohave Tribal Utility
67	El Rio Country Club Tract 4177-B, Phase II	Mohave	18 North	22 West	11	143	22-401778	Adequate		09/01/05	Bermuda Water Company
68	Emerald River Estates Tract 4093	Mohave	19 North	22 West	25	45		Adequate		08/21/90	Bermuda Water Company, Inc.
69	Emerald River Estates Tract 4093-B	Mohave	19 North	22 West	25	62	22-400002	Adequate		08/24/99	Bermuda Water Company, Inc.
70	Estates at Cimarron Lake Tract 4200	Mohave	18 North	22 West	23	35	22-401688	Adequate		11/03/05	Willow Valley Water Company
71	Evergreen Addition	Mohave	18 North	22 West	27	38		Adequate		07/03/79	Willow Valley Water Company
72	Evergreen Addition # 3	Mohave	18 North	22 West	27	77		Adequate		10/19/87	Willow Valley Water Company
73	Fairway Estates # 1-4148A	Mohave	19 North	22 West	35	49		Adequate		10/22/92	Bermuda Water Company, Inc.
74	Fairway Estates # 2	Mohave	19 North	22 West	35	28		Adequate		04/26/93	Bermuda Water Company, Inc.
75	Fairway Estates Tract 4097A	Mohave	19 North	22 West	35	100		Adequate		05/08/91	Bermuda Water Company, Inc.
76	Fairway Estates Tract 4097B	Mohave	19 North	22 West	35	28		Adequate		07/12/91	Bermuda Water Company, Inc.
77	Fairway Estates Tract 4097C	Mohave	19 North	22 West	35	47	22-401366	Adequate		09/09/04	Bermuda Water Company
78	Fairway Estates Tract 4097D	Mohave	19 North	22 West	35	48	22-401201	Adequate		02/13/04	Bermuda Water Company
79	Fairway Estates Tract 4097E	Mohave	19 North	22 West	35	41	22-400538	Adequate		03/04/02	Bermuda Water Company, Inc.
80	Fox Creek Estates	Mohave	20 North	21 West	31	1,750		Adequate		11/02/88	Citizens Utilities Company-Mohave
81	Golden Shores Tract 4051	Mohave	16 North	21 West	11	32		Adequate		05/19/89	Golden Shores Water Company
82	Granmar Estates Tract 4181	Mohave	18 North	22 West	3	49	22-401259	Adequate		05/11/04	Bermuda Water Company
83	Greens at Los Lagos, The	Mohave	18 North	22 West	1	386	22-401675	Adequate		05/09/05	Bermuda Water Company, Arizona-American Water Co
84	Highlands, at Desert Foothills Estate	Mohave	20 North	21 West	5	211		Adequate		04/18/95	Citizens Utilities Company-Mohave

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
85	Holiday Hills	Mohave	20 North	21 West	29	658		Adequate		11/14/86	Citizens Utilities Company-Mohave
86	Holiday Shores	Mohave	20 North	22 West	18	200		Adequate		06/11/73	Oasis Utility Company
87	Holiday Shores # 4	Mohave	20 North	22 West	18	458		Adequate		11/23/73	Oasis Utility Company
88	Holiday Shores # 5	Mohave	20 North	22 West	18	120		Adequate		09/02/75	Oasis Utility Company
89	Holiday Shores # 6	Mohave	20 North	22 West	18	405		Adequate		11/13/75	Oasis Utility Company
90	Joy Lane Plaza	Mohave	19 North	22 West	26	13		Adequate		03/27/91	Bermuda Water Company, Inc.
91	La Mesa Acres Tract 4038	Mohave	19 North	22 West	13	51		Adequate		04/29/83	Bermuda Water Company, Inc.
92	La Paloma Condominiums	Mohave	21 North	21 West	21	195		Adequate		12/08/92	North Mohave Valley Corporation
93	Lagoon Estates # 6	Mohave	17 North	22 West	1	160		Adequate		07/20/76	Lagoon Estates Water Company
94	Lagoon, The	Mohave	20 North	22 West	9	72		Adequate		02/16/82	Citizens Utilities Company-Mohave
95	Lake Cimarron Estates, Unit II Tract 4187	Mohave	18 North	22 West	23	35	22-401661	Adequate		03/11/05	Willow Valley Water Company
96	Lake Mohave Highlands	Mohave	21 North	21 West	29	93		Adequate		08/15/73	Lake Mohave Highlands Water Company
97	Lake Mohave Highlands # 2	Mohave	21 North	21 West	29	10		Adequate		12/04/74	Lake Mohave Highlands Water Company
98	Lake Mohave Highlands # 3	Mohave	21 North	21 West	29	124		Adequate		02/28/75	Lake Mohave Highlands Water Company
99	Lake Mohave Highlands # 4	Mohave	21 North	21 West	29	7		Adequate		03/01/76	Lake Mohave Highlands Water Company
100	Lakeside Estates	Mohave	20 North	22 West	18	44		Adequate		05/05/81	Oasis Utility Company
101	Lakeview Village Tract 4097	Mohave	19 North	22 West	35	279		Adequate		05/02/90	Bermuda Water Company, Inc.
102	Las Estancias Tract 1199	Mohave	19 North	22 West	26	151		Adequate		08/28/73	Bermuda Water Company, Inc.
103	Legends Unit 2, at Desert Foothills Estates Tract 5099	Mohave	20 North	21 West	5	46	22-400625	Adequate		11/26/01	Citizens Utilities Company
104	Linda Vista	Mohave	19 North	22 West	23	42	22-400839	Adequate		11/19/02	Arizona American Water Company
105	Lone Star Commercial Park	Mohave	19 North	22 West	23	9		Adequate		08/20/90	Bermuda Water Company, Inc.
106	Los Altos Tract 4184	Mohave	19 North	22 West	25	21	22-401370	Adequate		08/22/05	Arizona-American Water Company
107	Los Lagos	Mohave	18 North	22 West	1	457		Adequate		10/16/90	Bermuda Water Company, Inc.
108	Los Pueblos, at Desert Foothills Tract 5077	Mohave	20 North	21 West	5	71	22-400235	Adequate		01/31/00	Citizens Utilities Company-Mohave
109	Mesa Vista Tract 4169	Mohave	19 North	22 West	24	131	22-400618	Adequate		03/04/02	Bermuda Water Company
110	Miracle View Condominiums	Mohave	20 North	22 West	26	32		Adequate		08/28/85	Citizens Utilities Company-Mohave
111	Mohave Mesa Estates Tract 4013	Mohave	19 North	22 West	27	14		Adequate		04/27/82	Dry Lot Subdivision

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
112	Mohave Sun Valley Airport	Mohave	18 North	22 West	25	170		Adequate		02/12/85	Bermuda Water Company, Inc.
113	Mohave Sunrise Tract 1084B	Mohave	19 North	22 West	11	99		Adequate		05/18/89	Bermuda Water Company, Inc.
114	Mohave Sunrise Tract 4085	Mohave	19 North	22 West	11	NA		Adequate		06/22/89	Bermuda Water Company, Inc.
115	Mohave Valley Business Park	Mohave	19 North	22 West	23	31		Adequate		05/02/86	Bermuda Water Company, Inc.
116	Monte Vista Estates	Mohave	18 North	22 West	23	22		Adequate		12/02/81	Dry Lot Subdivision
117	Moon Ridge	Mohave	19 North	22 West	25	99		Adequate		07/25/91	Bermuda Water Company, Inc.
118	Moon River Resort, Inc.	Mohave	18 North	22 West	3	89	22-400579	Adequate		12/10/01	Bermuda Water Company, Inc.
119	Moon Valley Tract 4120	Mohave	19 North	22 West	25	16		Adequate		09/05/91	Bermuda Water Company, Inc.
120	Mountain View Ranches	Mohave	18 North	21 West	5	34		Inadequate	A1	04/15/81	Dry Lot Subdivision
121	Mystic Canyon Tract 4197	Mohave	18 North	21 West	7	266	22-401832	Adequate		08/15/05	Bermuda Water Company
122	Mystic Canyon Tract 4197A	Mohave	18 North	21 West	7	119	053-500021	Adequate		10/20/06	Bermuda Water Company
123	Palm Estates # 2 Tract 4104	Mohave	19 North	22 West	14	56		Adequate		08/02/90	Bermuda Water Company, Inc.
124	Palm Estates # 2 Tract 4104B	Mohave	19 North	22 West	14	25	22-400003	Adequate		08/24/99	Bermuda Water Company, Inc.
125	Palm Villa Ranchos Tract 1226	Mohave	19 North	22 West	11	30		Adequate		12/08/82	Bermuda Water Company, Inc.
126	Palma Quartz	Mohave	20 North	22 West	17	33		Adequate		06/19/91	Citizens Utilities Company-Mohave
127	Palo Verde Place Tract 4006	Mohave	20 North	22 West	32	420		Adequate		05/27/80	Rio Utility Company, Inc.
128	Palo Verde Place Tract 4006E	Mohave	20 North	22 West	32	68		Adequate		07/02/92	Rio Utility Company, Inc.
129	Palo Verde Plaza Tract 5025	Mohave	20 North	22 West	35	15	22-300097	Adequate		03/20/96	Citizens Utilities Company-Mohave
130	Palo Verde Shores	Mohave	20 North	22 West	29	28	22-400330	Adequate		07/18/00	Citizens Utilities Company-Mohave
131	Park at Mesquite Creek, The	Mohave	18 North	22 West	12	226		Inadequate	B	01/16/92	Fort Mohave Tribal Utilities
132	Patriot Estates	Mohave	19 North	22 West	36	119	053-500031	Adequate		11/30/06	Bermuda Water Co.
133	Pebble Lake # 2	Mohave	19 North	22 West	34	299		Adequate		08/25/78	Pebble Lake Water Company
134	Pebble Lake # 3	Mohave	19 North	21 West	34	143		Adequate		05/08/80	Pebble Lake Water Company
135	Pegasus Ranch	Mohave	21 North	21 West	29	100		Adequate		10/22/92	Citizens Utilities Company-Mohave
136	Pegasus Ranch Estates, Unit 3 Tract 5083	Mohave	21 North	21 West	29	20	22-400638	Adequate		01/15/02	Citizens Utilities
137	Pegasus Ranch Tract 4019A	Mohave	21 North	21 West	29	26		Adequate		08/22/83	Citizens Utilities Company-Mohave
138	Pegasus Ranch Tract 5030	Mohave	21 North	21 West	29	14	22-300355	Adequate		10/29/97	Citizens Utilities Company-Mohave

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
139	Perry Acres # 2 Tract 4026	Mohave	18 North	22 West	13	157		Adequate		05/21/82	Mohave Valley Water Company
140	Perry Acres Tract 4007	Mohave	18 North	22 West	13	96		Adequate		10/07/80	Mohave Valley Water Company
141	Pine River Estates Tract 4128	Mohave	19 North	22 West	25	17		Adequate		09/05/91	Bermuda Water Company, Inc.
142	Pueblo Grove	Mohave	18 North	22 West	35	14		Adequate		09/18/81	Dry Lot Subdivision
143	Punto de Vista # 5	Mohave	21 North	21 West	27	233		Adequate		06/25/80	Thumb Butte Water Association
144	Rancho Colorado	Mohave	20 North	22 West	13	15		Adequate		07/28/88	Citizens Utilities Company-Mohave
145	Rancho Colorado B	Mohave	20 North	21 West	18, 19	1,886		Adequate		07/28/88	Citizens Utilities Company-Mohave
146	Rancho Grande Tract 4083	Mohave	19 North	22 West	14	71		Adequate		01/05/90	Bermuda Water Company, Inc.
147	Rio Camino Tract 4123	Mohave	19 North	22 West	23	34		Adequate		02/14/91	Bermuda Water Company, Inc.
148	Rio Hacienda	Mohave	19 North	22 West	14	102		Adequate		08/01/75	Bermuda Water Company, Inc.
149	Rio Lado Villas Condominiums	Mohave	20 North	23 West	13	25		Adequate		07/03/86	Citizens Utilities Company-Mohave
150	Rio Las Palmas	Mohave	20 North	22 West	1	48		Adequate		02/10/82	Citizens Utilities Company-Mohave
151	Rio Lindo Condominiums	Mohave	20 North	23 West	13	32		Adequate		04/25/84	Citizens Utilities Company-Mohave
152	Rio Lomas # 4	Mohave	19 North	22 West	11	104		Adequate		01/28/74	Bermuda Water Company, Inc.
153	Rio Vista Condominiums	Mohave	20 North	22 West	9	22		Adequate		05/05/81	Citizens Utilities Company-Mohave
154	Rio Vista Estates	Mohave	18 North	22 West	27	36		Adequate		04/12/88	Willow Valley Water Company
155	Rio Vista Ranches	Mohave	19 North	22 West	23	44		Adequate		12/12/75	Citizens Utilities Company-Mohave
156	River Retreat	Mohave	20 North	23 West	13	129		Adequate		12/11/74	Citizens Utilities Company-Mohave
157	River Road City Tract 1022	Mohave	17 North	22 West	11	141		Adequate		02/01/91	Fort Mohave Tribal Utilities
158	River View Mall	Mohave	20 North	22 West	23	8		Adequate		11/17/88	Citizens Utilities Company-Mohave
159	River View Ranches	Mohave	19 North	22 West	13	197		Adequate		01/23/80	Dry Lot Subdivision
160	Rivershore Villas Condominiums	Mohave	20 North	22 West	9	165		Adequate		03/26/81	Citizens Utilities Company-Mohave
161	Riverview Bluffs # 2A	Mohave	20 North	22 West	13	54		Adequate		08/28/89	Citizens Utilities Company-Mohave
162	Riverview Bluffs Condominiums	Mohave	20 North	22 West	13	63		Adequate		02/06/85	Citizens Utilities Company-Mohave
163	Riviera Commercial Park	Mohave	20 North	22 West	19	12		Inadequate	C	02/28/84	Citizens Utilities Company-Mohave
164	Riviere D' Azur Villas	Mohave	20 North	22 West	16	243		Adequate		05/01/90	Citizens Utilities Company-Mohave
165	Roadhaven Marina Condominiums	Mohave	20 North	22 West	16	58		Adequate		10/19/83	Oasis Utility Company

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
166	Roadhaven Marina Condominiums # 2	Mohave	20 North	22 West	16	51		Adequate		02/03/84	Oasis Utility Company
167	Roadhaven Marina Condominiums # 3	Mohave	20 North	22 West	16	60		Adequate		08/21/84	Citizens Utilities Company-Mohave
168	Roadhaven Resort of Bullhead City	Mohave	20 North	22 West	24	697		Adequate		02/03/84	Citizens Utilities Company-Mohave
169	Rodeo Park Tract 4145A	Mohave	19 North	22 West	23	24	22-400296	Adequate		02/28/01	Bermuda Water Company, Inc.
170	Rodeo Park Tract 4145B	Mohave	19 North	22 West	23	31	22-400755	Adequate		07/30/02	Bermuda Water Company
171	Rodeo Park Tract 4145C	Mohave	19 North	22 West	23	60	22-401117	Adequate		11/03/03	Bermuda Water Company, Inc.
172	Sage Hill Tract 4179A	Mohave	19 North	22 West	25	46	22-401219	Adequate		02/23/04	Bermuda Water Company, Inc
173	Sage Hill Tract 4179-B, Phase II	Mohave	19 North	22 West	25	53	22-401506	Adequate		11/24/04	Bermuda Water Company
174	Santa Evinita Tract 4167A	Mohave	19 North	22 West	23	34	22-400515	Adequate		07/17/01	Bermuda Water Company, Inc.
175	Santa Evinita Tract B	Mohave	19 North	22 West	23	40	22-400860	Adequate		03/17/03	Bermuda Water Company
176	Sellan Estates Tract 5024	Mohave	21 North	21 West	30	6	22-300051	Adequate		06/01/94	North Mohave Valley Water Company
177	Shores, The	Mohave	20 North	23 West	13	17		Adequate		06/28/77	Citizens Utilities Company-Mohave
178	Silver Ridge Townhouse Condos	Mohave	20 North	21 West	19	210		Adequate		03/06/91	Citizens Utilities Company-Mohave
179	Silver Sands Estates	Mohave	19 North	22 West	26	159		Adequate		06/19/90	Bermuda Water Company, Inc.
180	South Valley Park Tract 4068	Mohave	17 North	22 West	15	30		Adequate		01/07/88	Bermuda Water Company, Inc.
181	Stoneridge	Mohave	19 North	22 West	11	14		Adequate		09/18/90	Bermuda Water Company, Inc.
182	Sun Desert Estates	Mohave	19 North	22 West	25	49		Adequate		09/05/91	Bermuda Water Company, Inc.
183	Sun Ridge Tract 4042F	Mohave	21 North	21 West	30	237		Adequate		02/08/90	North Mohave Water Company
184	Sun Ridge Estates Tract 4024A	Mohave	21 North	21 West	21	364		Adequate		11/16/83	North Mohave Valley Water Company
185	Sun Ridge Estates Tract 4024B	Mohave	21 North	21 West	29	NA		Adequate		08/01/84	North Mohave Valley Water Company
186	Sun Ridge Estates Tract 4024C	Mohave	21 North	21 West	21	376		Adequate		10/25/85	North Mohave Valley Water Company
187	Sun Ridge Estates Tract 4042D	Mohave	21 North	21 West	30	175		Adequate		04/11/88	North Mohave Valley Water Company
188	Sun Ridge Estates Tract 4042F	Mohave	21 North	21 West	29	59		Adequate		08/02/89	North Mohave Valley Water Company
189	Sun Ridge Estates Tract 4042J	Mohave	21 North	21 West	21	36	22-400633	Adequate		01/15/02	North Mohave Valley Water Company
190	Sun Valley	Mohave	19 North	22 West	36	302		Adequate		07/18/83	Bermuda Water Company, Inc.
191	Sun Valley Tract 4017	Mohave	19 North	22 West	36	211		Adequate		01/08/82	Bermuda Water Company, Inc.
192	Sun Valley Tract 4018A, B	Mohave	19 North	22 West	36	302		Adequate		07/14/83	Dry Lot Subdivision

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
193	Sun Valley Tract 4063B	Mohave	19 North	22 West	36	NA	22-300367	Adequate		10/30/97	Bermuda Water Company, Inc.
					1	99					
194	Sun Valley Tract 4064A	Mohave	18 North	22 West	1	210		Adequate		12/11/91	Bermuda Water Company, Inc.
195	Sun Vally Unit 2 Tract 4185A	Mohave	18 North	22 West	1	53	22-401785	Adequate		07/18/05	Bermuda Water Company, Inc.
196	Sun Vally Unit 2 Tract 4185B	Mohave	18 North	22 West	1	18	22-401784	Adequate		10/06/05	Bermuda Water Company, Inc.
197	Sun Vally Unit 2 Tract 4185D	Mohave	18 North	22 West	1	50	22-401954	Adequate		01/03/06	Bermuda Water Company, Inc.
198	Sunrise Estates	Mohave	19 North	22 West	35	52		Adequate		08/19/86	Bermuda Water Company, Inc.
199	Sunrise Estates # 2	Mohave	19 North	22 West	35	49		Adequate		11/14/88	Bermuda Water Company, Inc.
200	Sunrise Vistas Tract 4108A	Mohave	19 North	21 West	18	146		Adequate		09/16/93	Sunrise Vistas Utilities Company
201	Sunrise Vistas Tract 4108B	Mohave	19 North	21 West	18	86		Adequate		08/23/94	Sunrise Vistas Utilities Company
202	Sunrise Vistas Tract 4108C	Mohave	19 North	21 West	18	92		Adequate		11/08/95	Sunrise Vistas Utilities Company
203	Sunrise Vistas Tract 4108D	Mohave	19 North	21 West	18	40	22-300296	Adequate		06/03/97	Sunrise Vistas Utilities Company
204	Sunrise Vistas Tract 4108E	Mohave	19 North	21 West	18	57	22-400170	Adequate		11/22/99	Sunrise Vistas Utilities Company
205	Sunrise Vistas Tract 4108F	Mohave	19 North	21 West	18	28	22-400071	Adequate		05/21/99	Sunrise Vistas Utilities Company
206	Sunrise Vistas Tract 4108G	Mohave	19 North	21 West	18	27	22-400082	Adequate		08/30/99	Sunrise Vistas Utilities Company
207	Sunrise Vistas Tract 4108H	Mohave	19 North	21 West	18	6	22-400553	Adequate		10/10/01	Sunrise Vistas Utilities Company
208	Sunrise Vistas Tract 4108I	Mohave	19 North	21 West	18	31	22-400554	Adequate		10/10/01	Sunrise Vistas Utilities Company
209	Sunrise Vistas Tract 4108J	Mohave	19 North	21 West	18	22	22-400612	Adequate		11/26/01	Sunrise Vistas Utilities Company
210	Sunrise Vistas Tract 4108K	Mohave	19 North	21 West	18	22	22-400801	Adequate		12/03/02	Sunrise Vistas Utilities Company
211	Sunrise Vistas Tract 4108L	Mohave	19 North	21 West	18	23	22-400877	Adequate		05/12/03	Sunrise Vistas Utilities
212	Sunrise Vistas Tract 4108M	Mohave	19 North	21 West	18	30	22-400999	Adequate		09/25/03	Sunrise Vistas Utilities
213	Sunrise Vistas Tract 4108N	Mohave	19 North	21 West	18	30	22-400998	Adequate		09/25/03	Sunrise Vistas Utilities
214	Sunrise Vistas Tract 4108O	Mohave	19 North	21 West	18	50	22-401347	Adequate		12/15/04	Sunrise Vista Utilities
215	Sunset Palms Tract 4183A	Mohave	19 North	22 West	26	33	22-401760	Adequate		06/06/05	Bermuda Water Co.
216	Sunset Ranchos II Tract 4156	Mohave	19 North	22 West	13	22	22-300221	Adequate		01/15/97	Bermuda Water Company, Inc.
217	Sunset Ranchos II Tract 4156 #2	Mohave	19 North	22 West	13	18	22-400445	Adequate		01/30/01	Bermuda Water Company, Inc.
218	Sunset Ranchos Tract 4046A	Mohave	19 North	22 West	13	NA		Adequate		02/20/86	Dry Lot Subdivision
219	Sunset Ranchos Tract 4046B	Mohave	19 North	22 West	13	NA		Adequate		07/28/87	Dry Lot Subdivision

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
220	Sunset Ranchos Tract 4046C	Mohave	19 North	22 West	13	284		Adequate		07/07/92	Bermuda Water Company, Inc.
221	Tangerine Terrace Tract 4142	Mohave	17 North	22 West	23	22		Adequate		07/13/92	Fort Mohave Tribal Utilities Authority
222	Terraces at Desert Foothills Estates, The	Mohave	20 North	21 West	5	123	22-300214	Adequate		11/18/96	Citizens Utilities Company-Mohave
223	Tierra del Rio Tract 4048	Mohave	19 North	22 West	25	348		Adequate		08/02/84	Bermuda Water Company, Inc.
224	Tierra Grande Tract 4023A	Mohave	20 North	21 West	19	130		Adequate		07/18/83	Citizens Utilities Company-Mohave
225	Tierra Grande Tract 4023B	Mohave	20 North	21 West	19	202		Adequate		08/03/84	Citizens Utilities Company-Mohave
				22 West	24	NA					
226	Tierra Grande Tract 4023C	Mohave	20 North	21 West	19	78		Adequate		11/16/84	Citizens Utilities Company-Mohave
227	Tierra Grande Tract 4052	Mohave	20 North	21 West	19	22		Adequate		08/28/85	Citizens Utilities Company-Mohave
228	Tierra Verde Tract 1073-B	Mohave	19 North	22 West	14	360		Adequate		04/08/74	Bermuda Water Company, Inc.
229	Tierre del Sol	Mohave	19 North	22 West	23	32		Adequate		05/09/83	Dry Lot Subdivision
230	Tierre Plaza	Mohave	19 North	22 West	14	35		Adequate		06/17/86	Bermuda Water Company, Inc.
231	Topock Lake Rancheros	Mohave	17 North	21 West	17	8		Adequate		05/01/91	Dry Lot Subdivision
232	Topock Village Estates Tract 4090	Mohave	16 North	21 West	23	205	22-402046	Adequate		09/28/06	Golden Shores Water Company
233	Twin Palms Estates Tract 4189	Mohave	19 North	22 West	36	144	22-401423	Adequate		08/05/05	Bermuda Water Company
234	Twin Palms Estates Tract 4189A	Mohave	19 North	22 West	36	97	22-402046	Adequate		08/05/05	Bermuda Water Company
235	Villa del Rio Tract 4016 A&B	Mohave	20 North	22 West	29	12		Adequate		01/22/83	Rio Verde Water Company
236	Villa del Sol Condominiums	Mohave	20 North	23 West	24	24		Adequate		02/18/82	Citizens Utilities Company-Mohave
237	Villas at Desert Horizons Tract 4162A	Mohave	19 North	22 West	23	51	22-400180	Adequate		11/05/99	Bermuda Water Company, Inc.
238	Villas At Desert Horizons Tract 4162B	Mohave	19 North	22 West	23	48	22-400496	Adequate		07/17/01	Bermuda Water Company, Inc.
239	Villas at Desert Horizons Tract 4162B	Mohave	19 North	22 West	23	33	22-401084	Adequate		01/12/04	Bermuda Water Company, Inc.
240	Vineyard at Sun Ridge Tract 5049	Mohave	21 North	21 West	30	67	22-300213	Adequate		12/18/96	North Mohave Water Company
241	Vineyard at Sun Ridge Unit 3	Mohave	21 North	21 West	30	8	22-401351	Adequate		12/20/04	North Mohave Valley Corp
242	Vista del Rio Tract 5043	Mohave	19 North	22 West	11	35	22-300139	Adequate		07/12/96	Bermuda Water Company, Inc.
243	Vista del Rio # 2 Tract 5061	Mohave	19 North	22 West	11	18	22-300411	Adequate		06/19/98	Bermuda Water Company, Inc.
244	Vista del Rio # 3 Tract 5066	Mohave	19 North	22 West	11	12	22-400052	Adequate		05/24/99	Bermuda Water Company, Inc.
245	Vista del Rio # 4 Tract 5067	Mohave	19 North	22 West	11	21	22-400053	Adequate		05/21/99	Bermuda Water Company, Inc.

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
246	Vista del Rio Condominiums	Mohave	20 North	22 West	17	18		Adequate		09/08/81	Oasis Utility Company
247	Vista Grande Condominiums	Mohave	21 North	21 West	21	32		Adequate		02/27/90	North Mohave Water Company
248	Willow Valley Estates	Mohave	18 North	22 West	21	48		Adequate		09/18/84	Willow Valley Water Company
249	Willow Valley Estates 20 Tract 4134A	Mohave	18 North	22 West	21	27	22-300085	Adequate		12/13/96	Willow Valley Water Company
250	Willow Valley Estates Tract 4134B	Mohave	18 North	22 West	21	29	22-400791	Adequate		09/25/03	Willow Valley Water Company
251	Willow Valley Mobile Homes Estates	Mohave	18 North	22 West	27	277		Adequate		12/02/81	Willow Valley Water Company
252	Willows at Cimarron Lake, The	Mohave	18 North	22 West	23	94		Adequate		12/07/90	Willow Valley Water Company
253	Willows at Cimarron Lake #2 Tract 4130A	Mohave	18 North	22 West	23	79	22-400142	Adequate		08/30/99	Willow Valley Water Company
254	Winterhaven Estates	Mohave	20 North	22 West	18	137		Adequate		02/23/88	Citizens Utilities Company-Mohave

B. Analysis of Adequate Water Supply

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section				
a	Stetson Ranch	Mohave	19 North	22 West	25	57	23-401875	05/01/06	Bermuda Water Company, Inc.
b	Valley Springs Estates Subdivision	Mohave	19 North	22 West	36	132	23-401861	02/01/06	Bermuda Water Company, Inc.

Notes:

[1] Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made. In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies.

[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.

[3] A. Physical/Continuous
nit necessary information, and/or available hydrologic data insufficient to make determination
2) Insufficient Supply (existing water supply unreliable or physically unavaible; for groundwater, depth-to-water exceeds criteria)
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)
B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)
C. Water Quality
D. Unable to locate records
NA = Data not currently available to ADWR

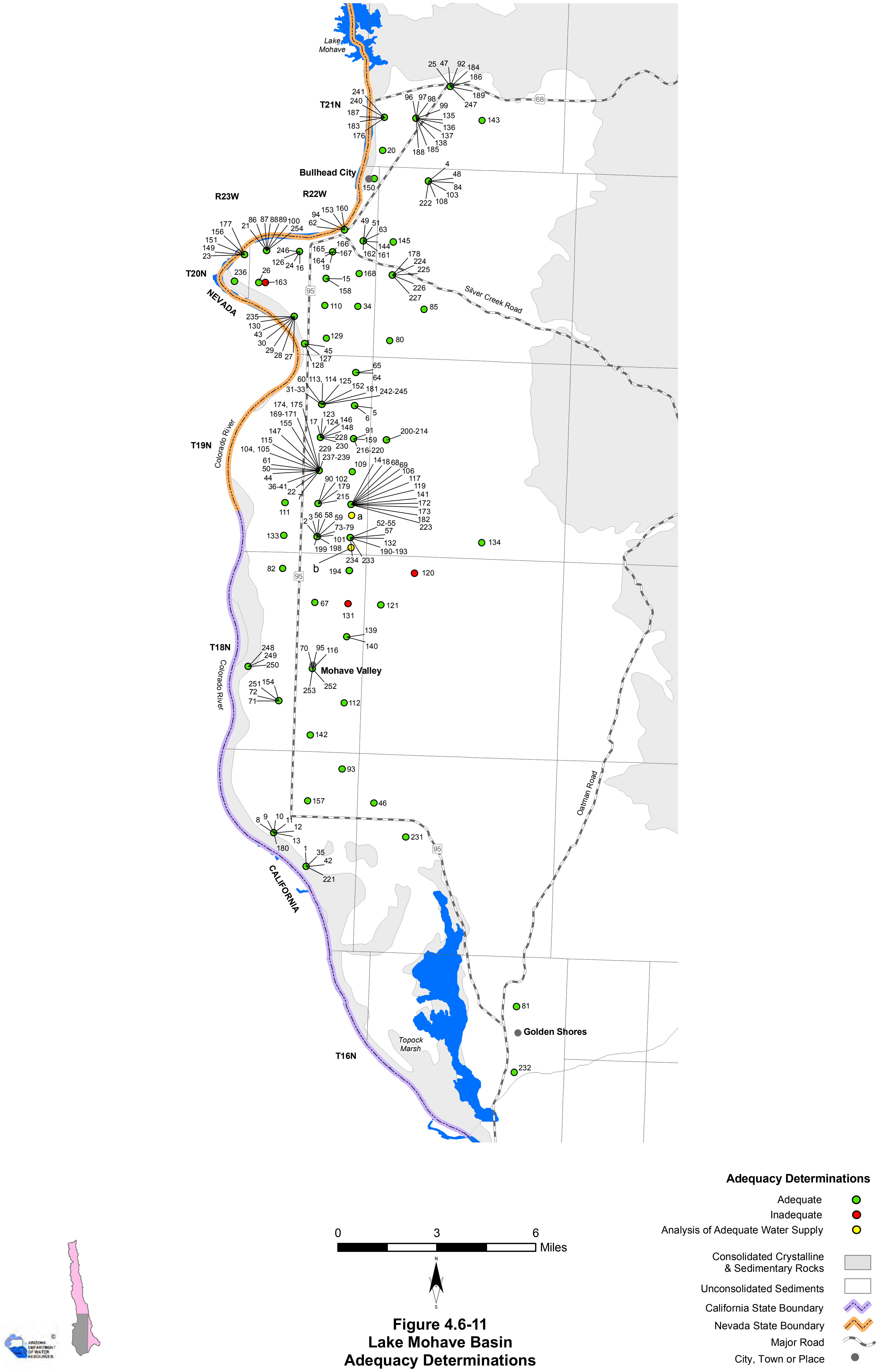


Figure 4.6-11
Lake Mohave Basin
Adequacy Determinations

Lake Mohave Basin
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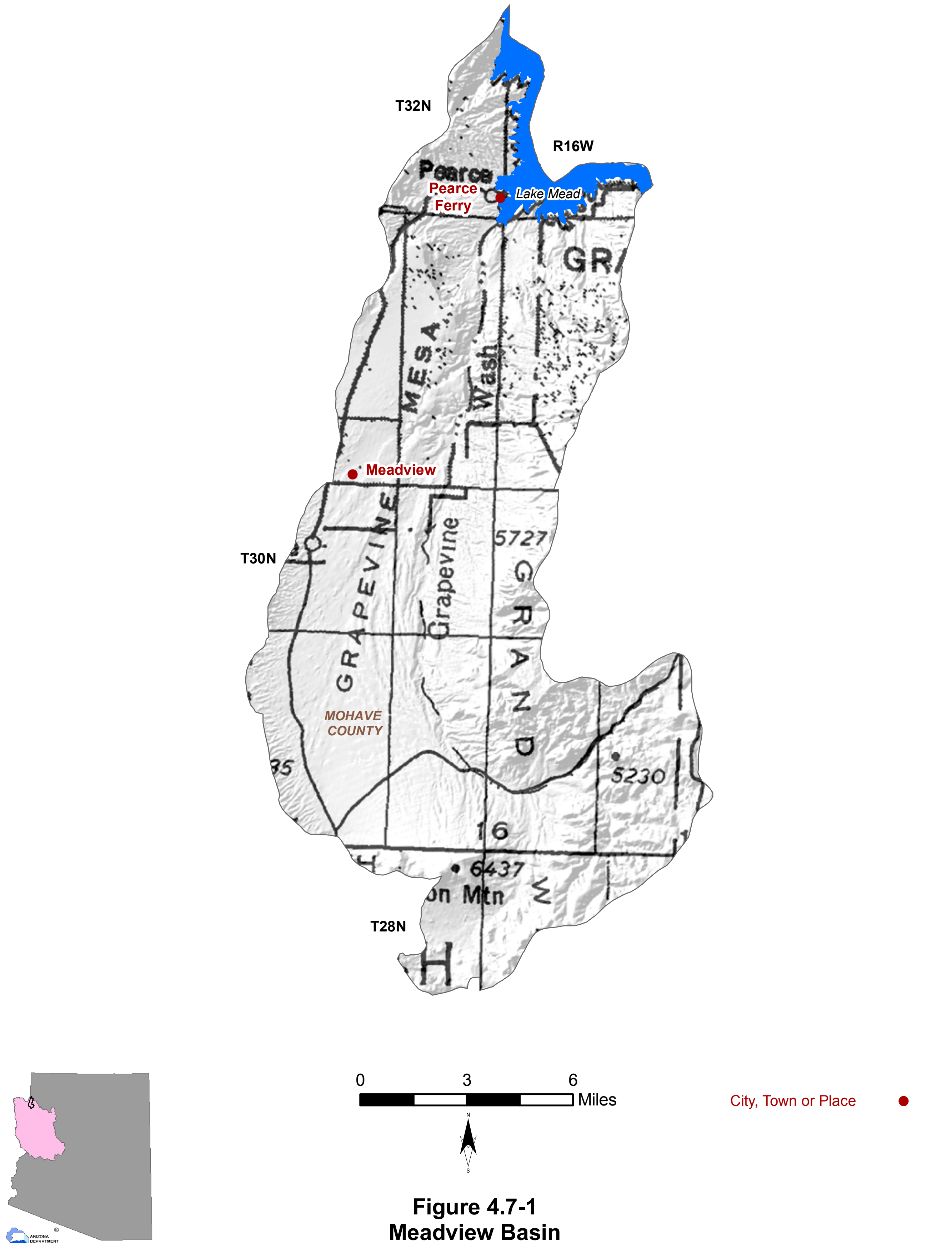
Lake Mohave Basin Index to Section 4.0

Section 4.7
Meadview Basin

4.7.1 Geography of Meadview Basin

The Meadview Basin is the smallest basin at 190 square miles, located in the north central part of the planning area. Geographic features and principal communities are shown on Figure 4.7-1. The basin is characterized by a south to north trending wash, a mesa in the western portion of the basin, cliffs along the eastern basin boundary and Lake Mead on the north. Vegetation types include Mohave desertscrub and conifer woodland.

- Principal geographic features shown on Figure 4.7-1 are:
    - The principal community of Meadview
    - The National Park Service facilities at Pearce Ferry
    - Grapevine Wash running south to north in the center of the basin
    - Lake Mead defining the northern basin boundary
    - Grapevine Mesa west of Grapevine Wash
    - The Grand Wash Cliffs in the eastern portion of the basin
    - The highest point in the basin, Iron Mountain at 6,437 feet near the southern basin boundary
    - The lowest point is about 1,100 feet at Pearce Ferry



Base Map: USGS 1:500,000, 1981

**Figure 4.7-1
Meadview Basin
Geographic Features**

4.7.2 Land Ownership in the Meadview Basin

Land ownership, including the percentage of ownership by category, for the Meadview Basin is shown in Figure 4.7-2. Principal features of land ownership in this basin are the large percentage of U.S. Bureau of Land Management and National Park Service lands. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

U.S. Bureau of Land Management (BLM)

- 46.9% of the land is federally owned and managed by the Kingman Field Office of the Bureau of Land Management.
- All BLM lands are in the southern half of the basin.
- Primary land use is grazing.

National Parks, Monuments and Recreation Areas

- 36.2% of the land is federally owned and managed by the National Park Service (NPS) as Lake Mead National Recreation Area and Grand Canyon National Park.
- All NPS lands are in the northern half of the basin.
- Primary land use is resource conservation and recreation.

Private

- 15.2% of the land is private.
- All private land is located in southern portion of the basin and is interspersed with BLM lands.
- Primary land uses are domestic and grazing.

Indian Reservation

- 1.5% of the land is under ownership of the Hualapai Tribe.
- Tribal lands are found in T29N, R15W and are interspersed with private lands.
- Primary land use is grazing.

State Trust Land

- 0.2% of the land in this basin is held in trust for the public schools under the State Trust Land system.
- The only portion of state trust land in this basin is southwest of Meadview along the basin boundary.
- Primary land use is grazing.

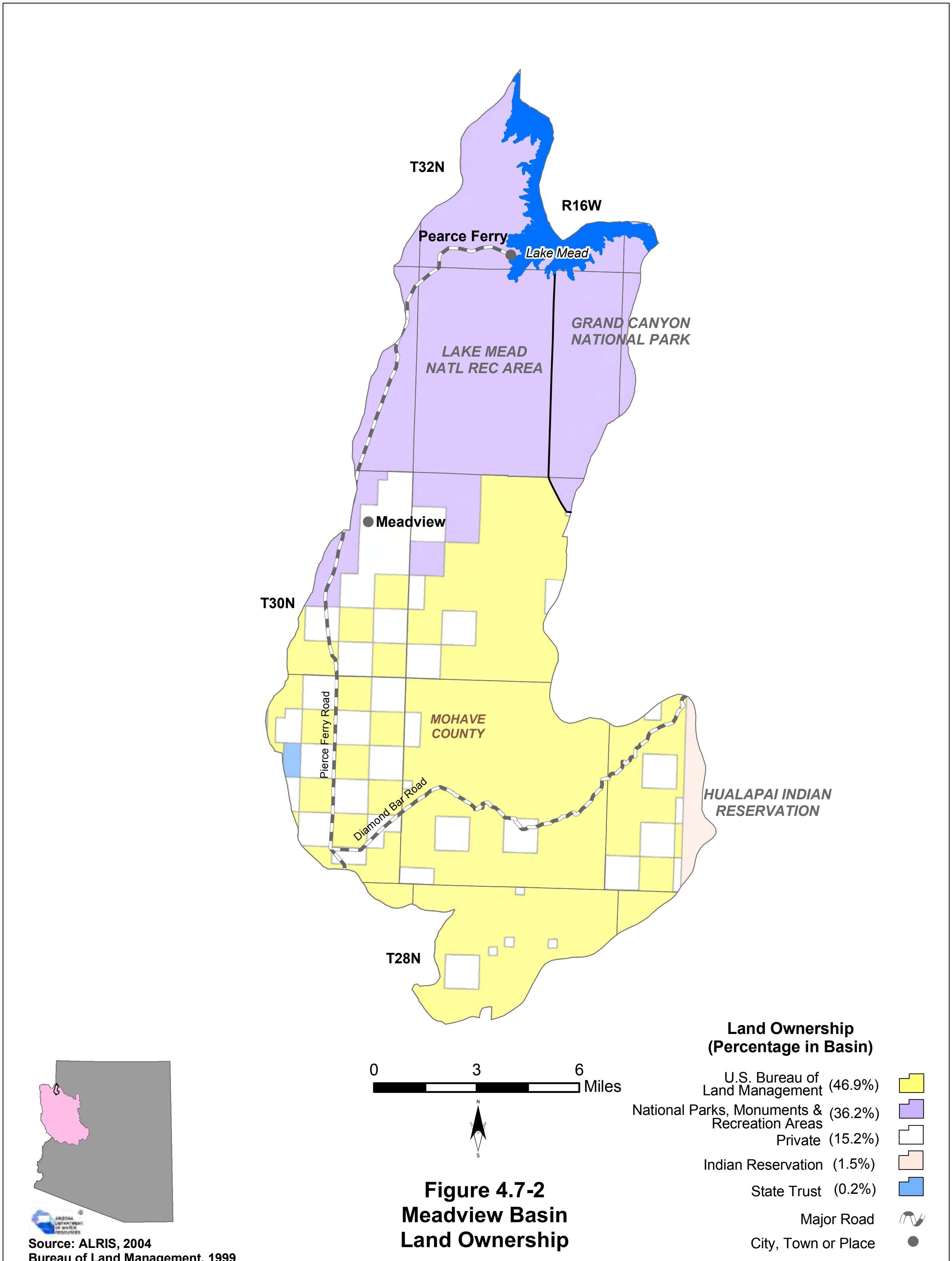


Figure 4.7-2
Meadview Basin
Land Ownership

Source: ALRIS, 2004
Bureau of Land Management, 1999

4.7.3 Climate of the Meadview Basin

Climate data from a NOAA/NWS Co-op Network station are complied in Table 4.7-1 and the location is shown on Figure 4.7-3. Figure 4.7-3 also shows precipitation data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Meadview Basin does not contain Evaporation Pan, AZMET and SNOTEL/Snowcourse stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 4.7-1A
- There is one NOAA/NWS Co-op network climate station in the basin at Pierce Ferry 14 SSW.
- The station is located at 3,860 feet.
- Average maximum temperature at the station is 83.1°F and average minimum temperature is 40.0°F.
- Annual average precipitation is 10.87 inches.
- Most precipitation, 3.52 inches on average, occurs in the winter season (January – March).
- The driest season is spring (April-June) when an average of 1.53 inches is recorded.

SCAS Precipitation Data

- See Figure 4.7-3
- Other precipitation data shows rainfall as high as 12 inches in the southern portion of the basin and as low as four inches in the northern portion of the basin.
- In general, precipitation increases as altitude increases in this basin. This basin is one of three basins in the planning area with a range of eight inches between areas of highest and lowest average annual precipitation, the lowest in the planning area.

Table 4.7-1 Climate Data for the Meadview Basin

A. NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Pierce Ferry 17 SSW	3,860	1963-1984[1]	83.1/Jul	40.0/Jan	3.52	1.53	3.41	2.42	10.87

Source: WRCC, 2003.

Notes:
[1]Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

Source: WRCC, 2003.

C. AZMET:

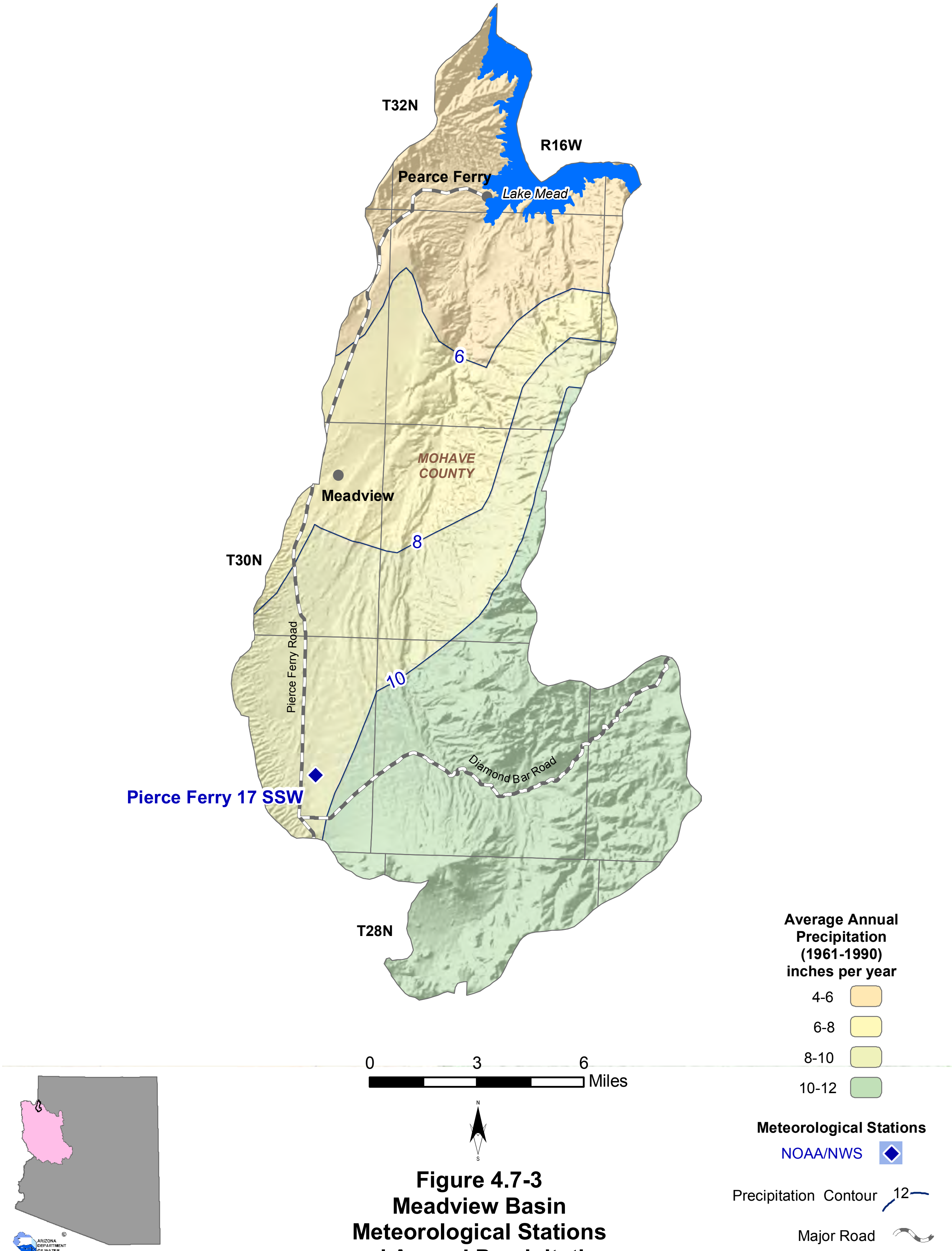
Station Name	Elevation (feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (*number of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content *(Number of measurements to calculate average)*					
			Jan	Feb	March	April	May	June
None								

Source: Natural Resources Conservation Service, 2005



Precipitation Data Source: Oregon State University, 1998

Figure 4.7-3
Meadview Basin
Meteorological Stations
and Annual Precipitation

4.7.4 Surface Water Conditions in the Meadview Basin

This basin does not contain streamflow data. Flood ALERT equipment in the basin is shown in Table 4.7-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.7-4. The location of flood ALERT gages is shown on Figure 4.7-4. There are no runoff contours in this basin. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Flood ALERT Equipment

- Refer to Table 4.7-3.
- As of October 2005 there were two stations in the basin.
- Of the two stations one is a precipitation/stage station and one is a precipitation only station.

Reservoirs and Stockponds

- Refer to Table 4.7-4.
- The basin borders one large reservoir, Lake Mead, with a maximum capacity of 29,755,000 acre-feet. The dam that creates Lake Mead, Hoover Dam, is in the Lake Mohave Basin. The reservoir is operated for hydroelectric power generation, recreation and water supply.
- There are no small reservoirs in the basin.
- There are an estimated 14 stockponds in the basin.

Table 4.7-2 Streamflow Data for the Meadview Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
None													

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Table 4.7-3 Flood ALERT Equipment in the Meadview Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
1690	Grapevine Mesa	Precipitation	5/1/2005	Mohave County FCD
7410	Lake Mead City	Precipitation/Stage	NA	Mohave County FCD

Notes:
FCD = Flood Control District
NA = Not available

Table 4.7-4 Reservoirs and Stockponds in the Meadview Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE[1]	JURISDICTION
None	Mead (Hoover Dam)[2]	Bureau of Reclamation	29,755,000[3]	C,H,I,RR,S	Federal

B. Other Large Reservoirs (50 acre surface area or greater)[4]

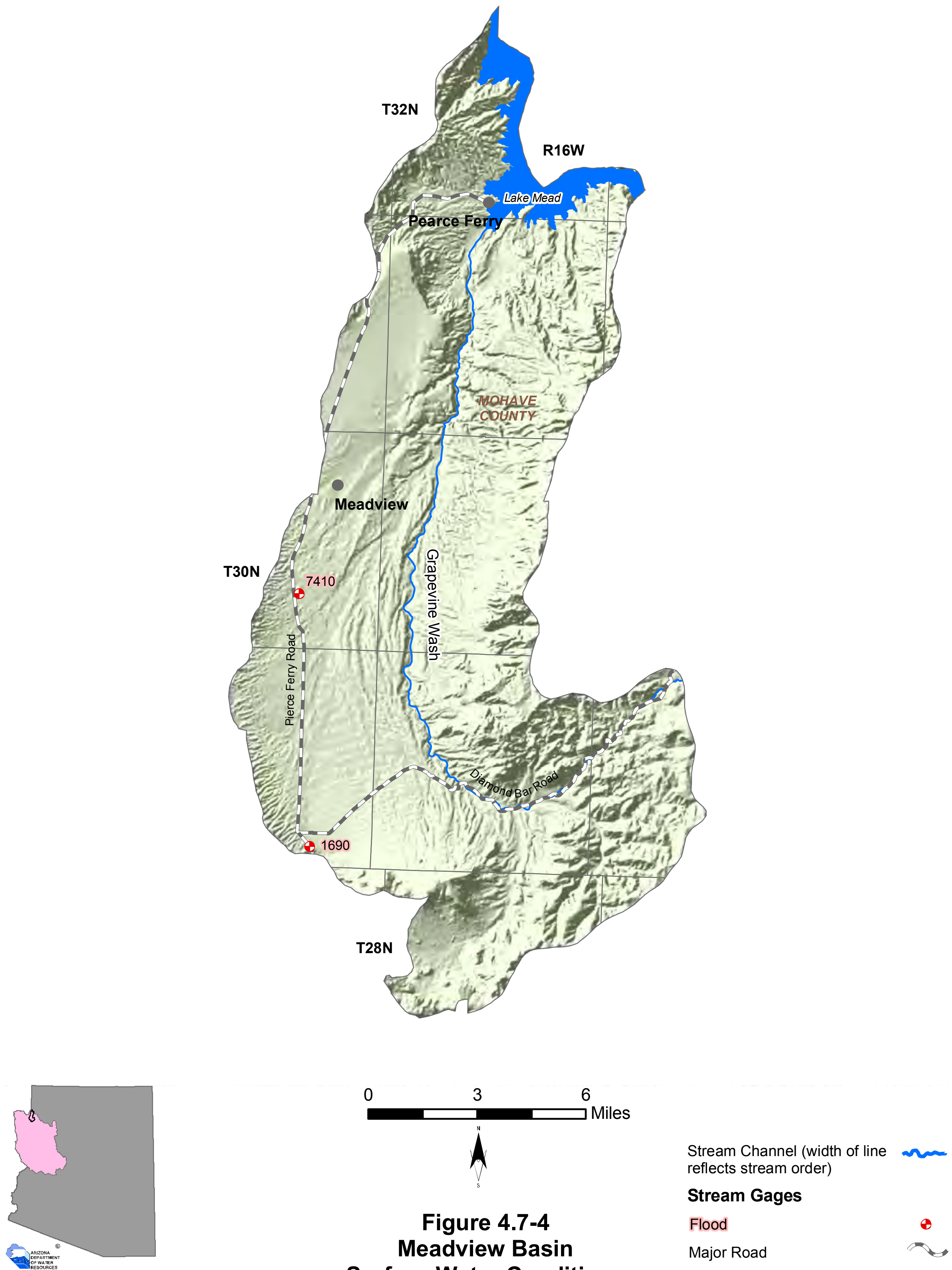
MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE	JURISDICTION
None identified by ADWR at this time					

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)
Total number: 0
Total maximum storage: 0 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)[3]
Total number: 0
Total surface area: 0 acres

E. Stockponds (up to 15 acre-feet capacity)
Total number: 14 (from water right filings)

Notes:
[1]C=flood control; H=hydroelectric; I=irrigation; RR=river regulation; S=water supply
[2] Dam is located in Lake Mohave Basin and lake storage is located in Lake Mohave, Detrital Valley, Hualapai Valley and Meadview Basins.
[3] Includes 2,378,000 acre-feet of dead storage.
[4] Capacity data not available to ADWR



Stream Data Source: ALRIS, 2005

Figure 4.7-4
Meadview Basin
Surface Water Conditions

4.7.5 Perennial/Intermittent Streams and Major Springs in the Meadview Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 4.7-5. The locations of major springs as well as perennial and intermittent streams are shown on Figure 4.7-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- There is one perennial stream, the Colorado River, located along the northern basin boundary.
- There are six major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time.
- Listed discharge rates may not be indicative of current conditions. All of the measurements were taken prior to 1995.
- All but one of the major springs are found in the southern portion of the basin. The greatest discharge rate was measured is the southern portion of the basin (Iron, 108 gpm).
- All major springs with the exception of Iron discharge less than 70 gpm.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 4.7-5B. There are two minor springs identified in this basin.
- The total number of springs identified by the USGS varies from 8 to 10, depending on the database reference.

Table 4.7-5 Springs in the Meadview Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Iron	354944	1135923	108	6/29/1994
2	Hillside	354942	1135815	69	6/9/1993
3	Grapevine	360240	1140130	43	5/1/1975
4	Adobe[2]	355229	1135911	25	9/25/1980
5	Ray's Place-left fork	354924	1140012	18	6/29/1994
6	Ray's Place-right fork	354923	1140010	16	6/29/1994

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Mud	355052	1135919	7	6/30/1994
Unnamed	360323	1140058	1	5/1975

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and USGS, 2006): 8 to 10

Notes:

[1]Most recent measurement identified by ADWR

[2]Spring is not displayed on current USGS topo maps

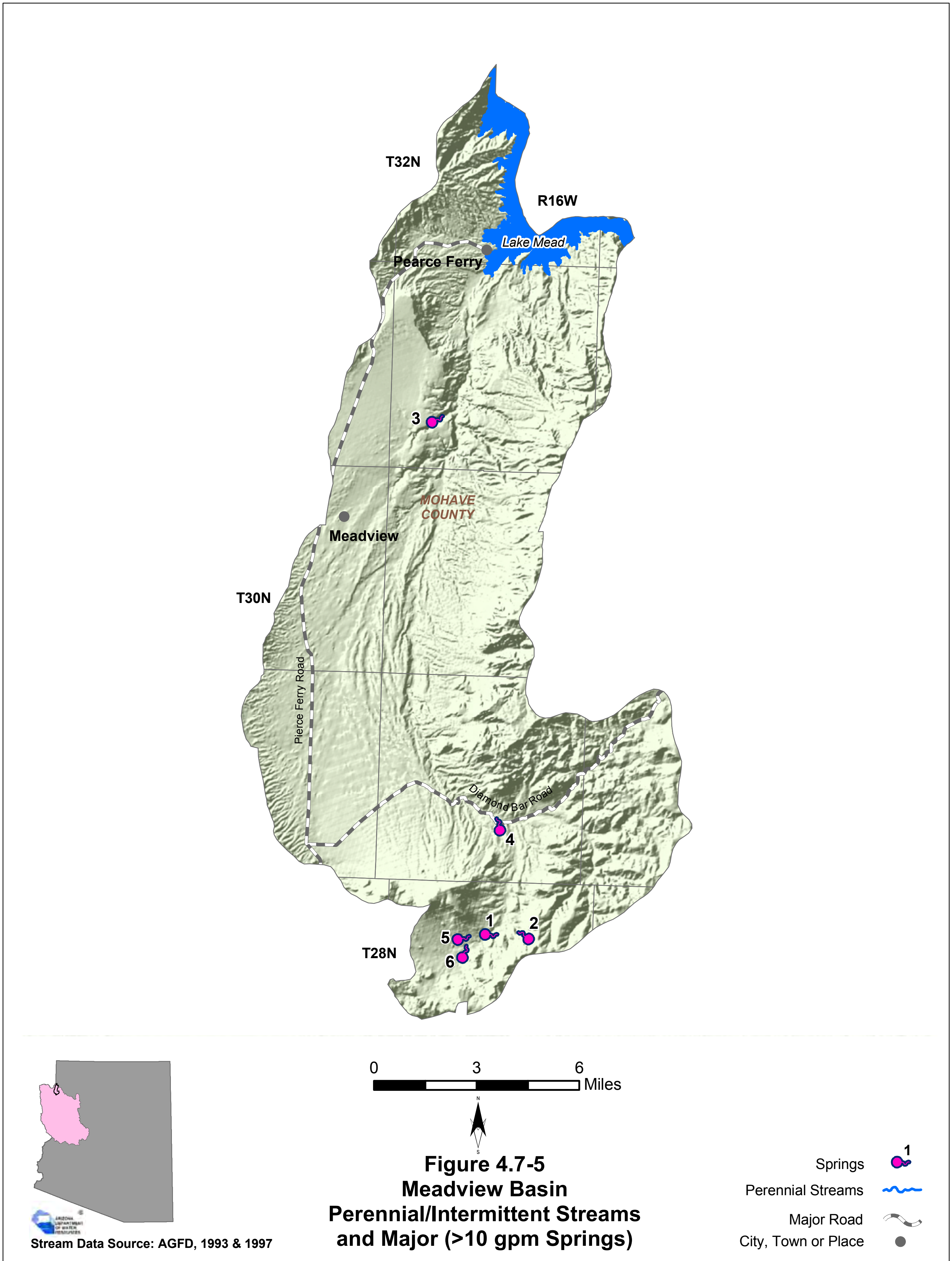


Figure 4.7-5
Meadview Basin
Perennial/Intermittent Streams
and Major (>10 gpm Springs)

4.7.6 Groundwater Conditions of the Meadview Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 4.7-6. Figure 4.7-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 4.7-7 contains a hydrograph for a selected well shown on Figure 4.7-6. Figure 4.7-8 shows well yields in one yield category. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 4.7-6 and Figure 4.7-6.
- The major aquifer in this basin is sedimentary rock, Muddy Creek Formation.
- Flow direction is from the south to the north in this basin.

Well Yields

- Refer to Table 4.7-6 and Figure 4.7-8.
- As shown on Figure 4.7-8 well yields in this basin are less than 100 gallons per minute (gpm).
- One source of well yield information, based on five reported wells, indicates that the median well yield in this basin is 33 gpm.

Natural Recharge

- Refer to Table 4.7-6.
- The estimate of natural recharge for this basin is 4,000 acre-feet per year.
- Recharge in this basin is minimal because of high evaporation rates and low rainfall. Most of the basin's recharge comes from infiltration of runoff at higher elevations surrounding the basin.

Water in Storage

- Refer to Table 4.7-6.
- There are three storage estimates for this basin, ranging from 62,440 acre-feet to a depth of 700 feet to one million acre-feet to a depth of 1,200 feet. The most recent estimate, from a 1994 ADWR study indicated that there is 62,440 acre-feet in storage to a depth of 700 feet.
- The predevelopment estimate of storage for this basin is one million acre-feet to a depth of 1,200 feet.

Water Level

- Refer to Figure 4.7-6. Water level is shown for wells measured in 2003-2004.
- The Department annually measures one index well in this basin.
- The Department measures water levels four times daily at one automated ground water monitoring site in the west-central portion of the basin.
- In 1995, the year of the last water level sweep, 18 wells were measured.

- There are only three water depths recorded in this basin in 2003-2004. The deepest is 931 feet in the southern portion of the basin along Pierce Ferry Road and the shallowest is 134 northeast of Meadview.
- A hydrograph corresponding to a selected well shown on Figure 4.7-6 but covering a longer time period is shown in Figure 4.7-7.

Table 4.7-6 Groundwater Data for the Meadview Basin

Basin Area, in square miles:	190	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Sedimentary Rock (Muddy Creek Formation)	
Well Yields, in gal/min:	Range 24-80 Median 33 (5 wells measured)	Measured by ADWR and/or USGS
	35 (1 well reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 30-100	ADWR (1990)
	Range 0-500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	4,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	62,440 (to 700 ft)	ADWR (1994)
	1,000,000[1] (to 1,200 ft)	Freethey and Anderson (1986)
	<1,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
Current Number of Index Wells:	1	
Date of Last Water-level Sweep:	1995 (18 wells measured)	

Notes:
[1] Predevelopment Estimate

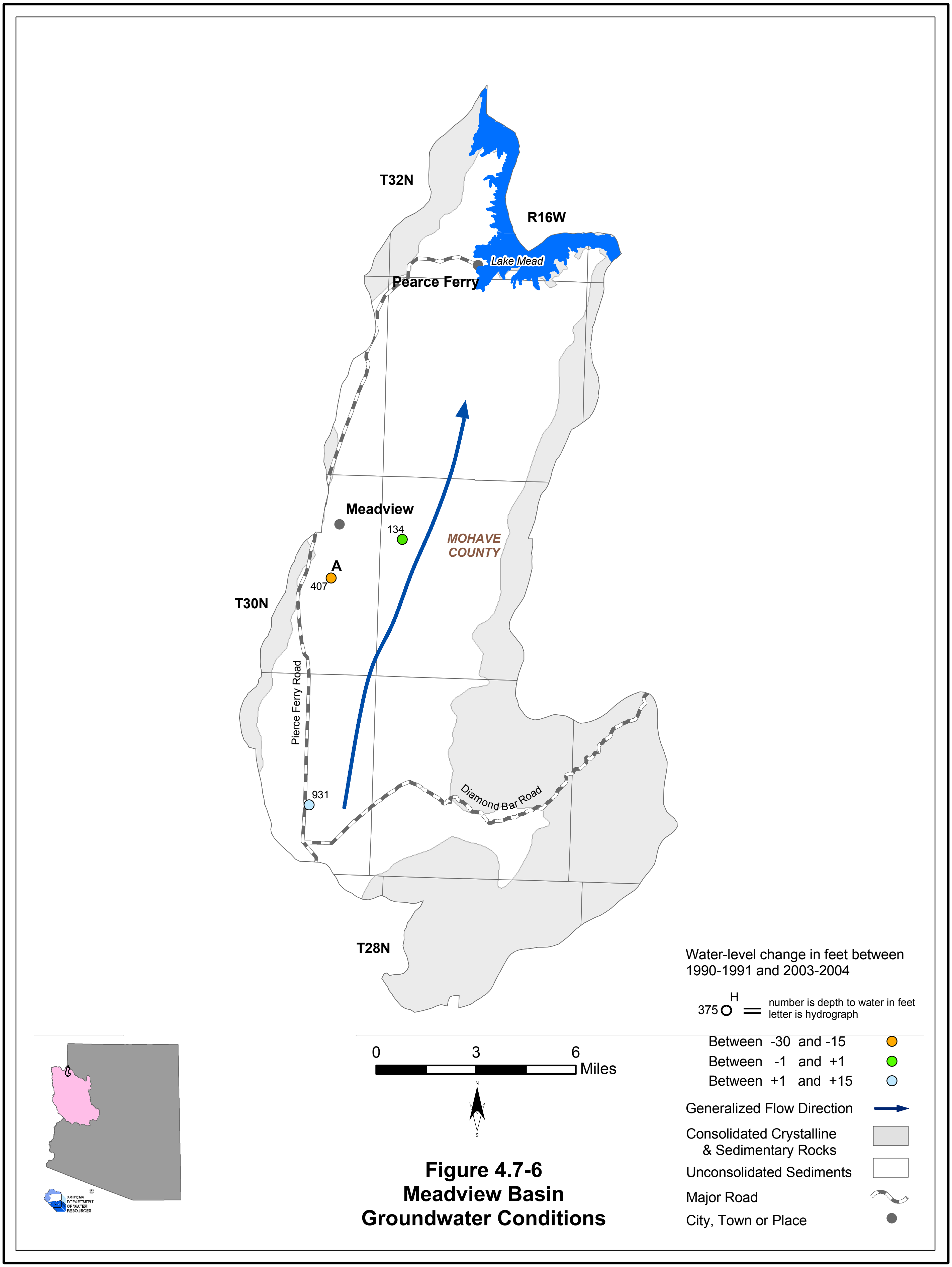
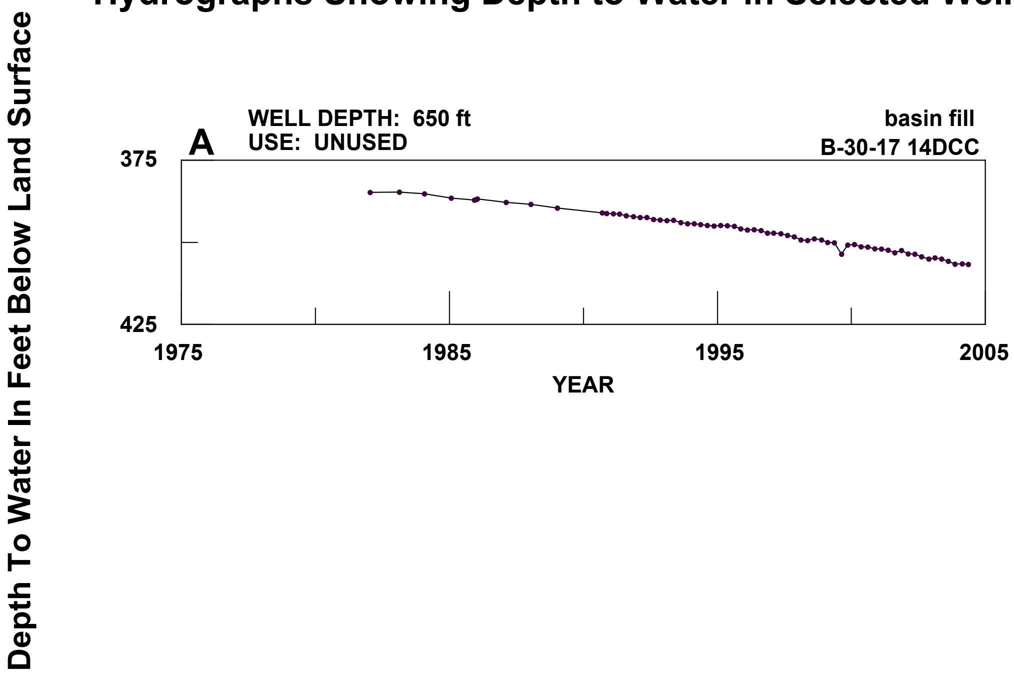


Figure 4.7-6
Meadview Basin
Groundwater Conditions

Figure 4.7-7
Meadview Basin
Hydrographs Showing Depth to Water in Selected Wells



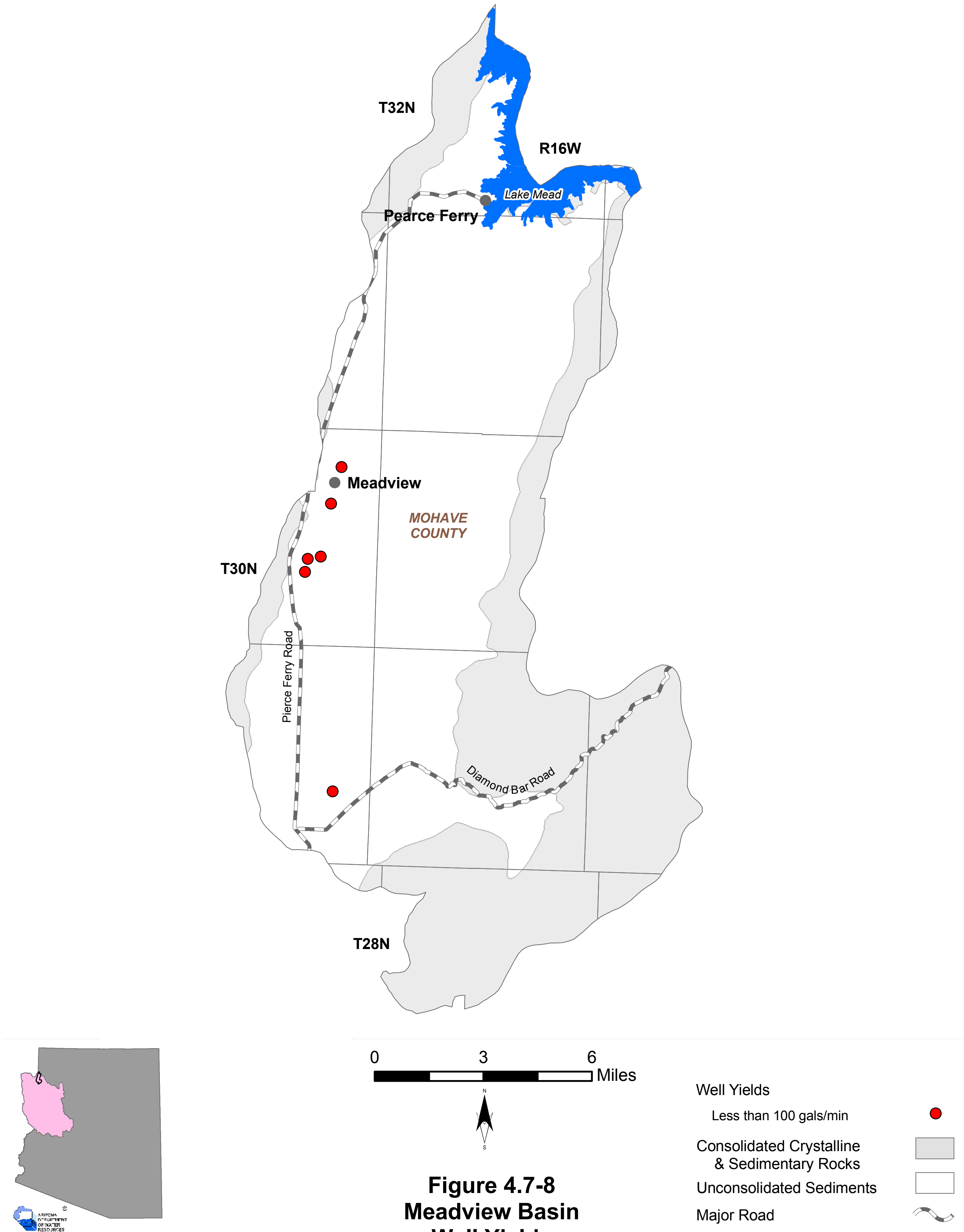


Figure 4.7-8
Meadview Basin
Well Yields

4.7.7 Water Quality of the Meadview Basin

Drinking water standard exceedences in wells, springs and mine sites including location and parameter(s) exceeded are shown in Table 4.7-7A. There are no impaired lakes or streams in this basin. Figure 4.7-9 shows the location of exceedences keyed to Table 4.7-7A. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mine Sites

- Refer to Table 4.7-7A.
- Drinking water standard exceedences in eight springs have been reported for this basin.
- The drinking water standard for radionuclides was the most frequently exceeded standard at sites in this basin.
- Other drinking water standards exceeded in this basin include arsenic, nitrate/nitrite and fluoride.

Table 4.7-7 Water Quality Exceedences in the Meadview Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Exceeding Drinking Water Standard[2]
		Township	Range	Section	
1	Spring	31 North	16 West	29	NO3, Rad
2	Spring	30 North	16 West	7	NO3
3	Spring	30 North	17 West	33	Rad
4	Spring	29 North	16 West	27	NO3, Rad
5	Spring	28 North	16 West	9	F
6	Spring	28 North	16 West	10	Rad
7	Spring	28 North	16 West	16	As
8	Spring	28 North	17 West	1	As

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard	Parameter(s) Exceeding Use Standard
None identified by ADWR at this time						

Notes:

[1] Water quality samples collected between 1973 and 2000.

[2] As = Arsenic
F = Fluoride
NO3 = Nitrate/Nitrite
Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium

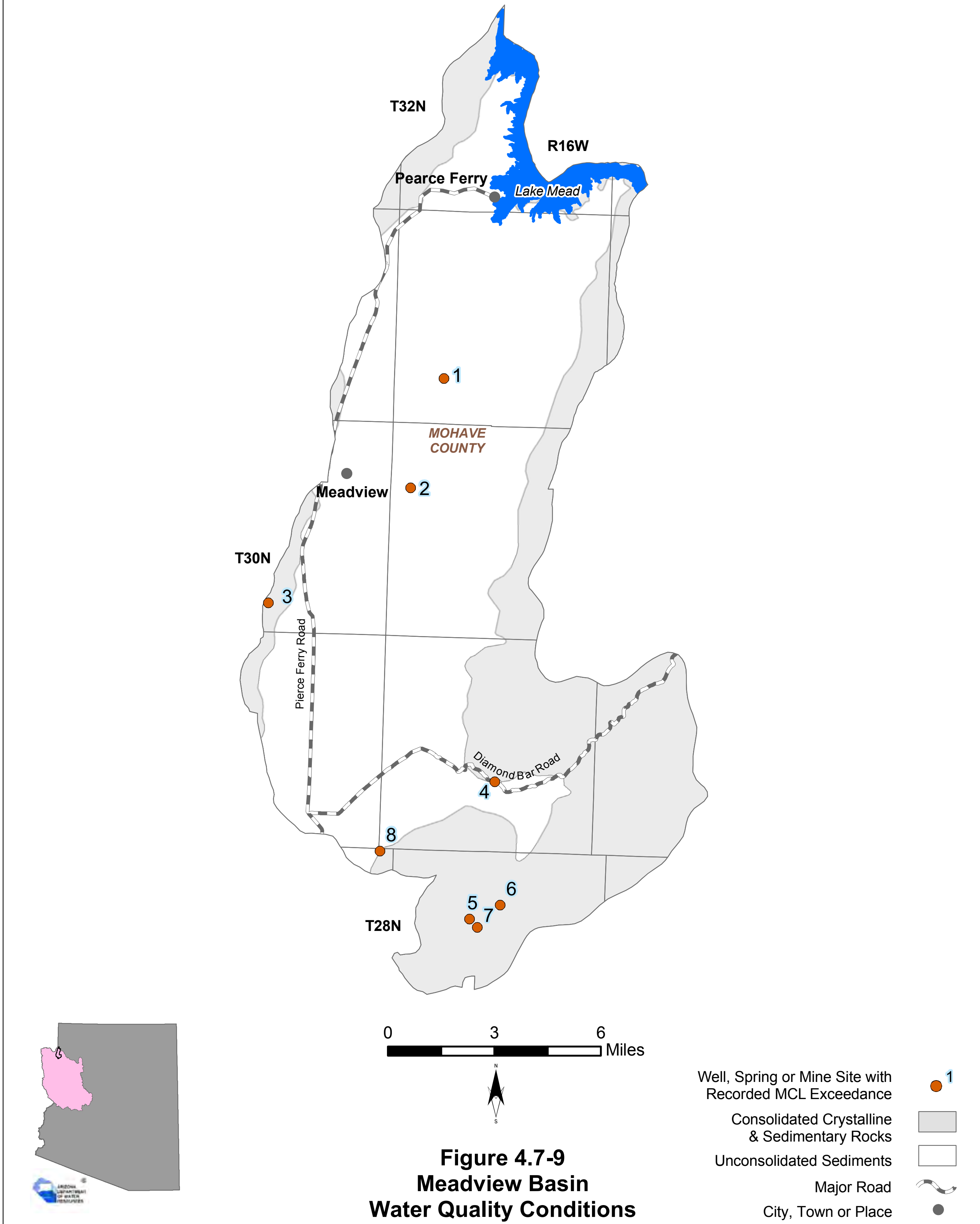


Figure 4.7-9
Meadview Basin
Water Quality Conditions

4.7.8 Cultural Water Demands in the Meadview Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 4.7-8. There are no wastewater treatment plants in this basin. Figure 4.7-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 4.0.7.

Cultural Water Demands

- Refer to Table 4.7-8 and Figure 4.7-10.
- Population in this basin is minimal but has increased since 1980, from 104 in 1980 to 822 in 2000. Projections suggest a similar rate of growth through 2050.
- Groundwater use in this basin is minimal, with current use similar to historical use. An average of less than 300 acre-feet was pumped per year from 2001-2003.
- There are no reported surface water diversions in this basin.
- The only demand center in the basin is low intensity municipal and industrial located east of Pierce Ferry Road.
- As of 2003 there were 29 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and one well with a pumping capacity of more than 35 gallons per minute.

Table 4.7-8 Cultural Water Demands in the Meadview Basin[1]

<table>
<tr><th rowspan="3">Year</th><th rowspan="3">Recent (Census) and Projected (DES) Population</th><th colspan="2" rowspan="2">Number of Registered Water Supply Wells Drilled</th><th colspan="7">Average Annual Demand (in acre-feet)</th></tr>
<tr><th colspan="3">Well Pumpage</th><th colspan="3">Surface-Water Diversions</th><th rowspan="2">Data Source</th></tr>
<tr><th>Q ≤ 35 gpm</th><th>Q > 35 gpm</th><th>Municipal</th><th>Industrial</th><th>Irrigation</th><th>Municipal</th><th>Industrial</th><th>Irrigation</th></tr>
<tr><td>**1971**</td><td></td><td rowspan="10">19[2]</td><td rowspan="10">1[2]</td><td colspan="3" rowspan="5"><300</td><td colspan="3" rowspan="5">NR</td><td rowspan="20">ADWR (1994)</td></tr>
<tr><td>**1972**</td><td></td></tr>
<tr><td>**1973**</td><td></td></tr>
<tr><td>**1974**</td><td></td></tr>
<tr><td>**1975**</td><td></td></tr>
<tr><td>**1976**</td><td></td><td colspan="3" rowspan="5"><300</td><td colspan="3" rowspan="5">NR</td></tr>
<tr><td>**1977**</td><td></td></tr>
<tr><td>**1978**</td><td></td></tr>
<tr><td>**1979**</td><td></td></tr>
<tr><td>**1980**</td><td>104</td></tr>
<tr><td>**1981**</td><td>139</td><td rowspan="5">0</td><td rowspan="5">0</td><td colspan="3" rowspan="5"><300</td><td colspan="3" rowspan="5">NR</td></tr>
<tr><td>**1982**</td><td>174</td></tr>
<tr><td>**1983**</td><td>209</td></tr>
<tr><td>**1984**</td><td>243</td></tr>
<tr><td>**1985**</td><td>278</td></tr>
<tr><td>**1986**</td><td>313</td><td rowspan="5">2</td><td rowspan="5">0</td><td colspan="3" rowspan="5"><300</td><td colspan="3" rowspan="5">NR</td></tr>
<tr><td>**1987**</td><td>348</td></tr>
<tr><td>**1988**</td><td>383</td></tr>
<tr><td>**1989**</td><td>418</td></tr>
<tr><td>**1990**</td><td>453</td></tr>
<tr><td>**1991**</td><td>490</td><td rowspan="5">0</td><td rowspan="5">0</td><td rowspan="5"><300</td><td rowspan="5">NR</td><td rowspan="5">NR</td><td colspan="3" rowspan="5">NR</td><td rowspan="13">USGS (2005)</td></tr>
<tr><td>**1992**</td><td>527</td></tr>
<tr><td>**1993**</td><td>563</td></tr>
<tr><td>**1994**</td><td>600</td></tr>
<tr><td>**1995**</td><td>637</td></tr>
<tr><td>**1996**</td><td>674</td><td rowspan="5">1</td><td rowspan="5">0</td><td rowspan="5"><300</td><td rowspan="5">NR</td><td rowspan="5">NR</td><td colspan="3" rowspan="5">NR</td></tr>
<tr><td>**1997**</td><td>711</td></tr>
<tr><td>**1998**</td><td>748</td></tr>
<tr><td>**1999**</td><td>785</td></tr>
<tr><td>**2000**</td><td>822</td></tr>
<tr><td>**2001**</td><td>889</td><td rowspan="3">5</td><td rowspan="3">0</td><td rowspan="3"><300</td><td rowspan="3">NR</td><td rowspan="3">NR</td><td colspan="3" rowspan="3">NR</td></tr>
<tr><td>**2002**</td><td>957</td></tr>
<tr><td>**2003**</td><td>1,024</td></tr>
<tr><td>**2010**</td><td>1,494</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**2020**</td><td>1,900</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**2030**</td><td>2,231</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**2040**</td><td>2,519</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>**2050**</td><td>2,753</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">***ADDITIONAL WELLS:[3]***</td><td>**2**</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">***WELL TOTALS:***</td><td>**29**</td><td>**1**</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Notes:
NR = Not reported
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] Includes all wells through 1980.
[3] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 4.7-9 Effluent Generation in the Meadview Basin

<table>
<tr><th rowspan="2">Facility Name</th><th rowspan="2">Ownership</th><th rowspan="2">City/Location Served</th><th rowspan="2">Population Served</th><th rowspan="2">Volume Treated/Generated (acre-feet)</th><th colspan="7">Disposal Method</th><th rowspan="2">Current Treatment Level</th><th rowspan="2">Population Not Served</th><th rowspan="2">Year of Record</th></tr>
<tr><th>Water-course</th><th>Evaporation Pond</th><th>Irrigation</th><th>Golf Course/Turf Irrigation</th><th>Wildlife Area</th><th>Discharged to Another Facility</th><th>Infiltration Basins</th></tr>
<tr><td colspan="15">No Wastewater Treatment Facilities Identified by ADWR in this Basin</td></tr>
</table>

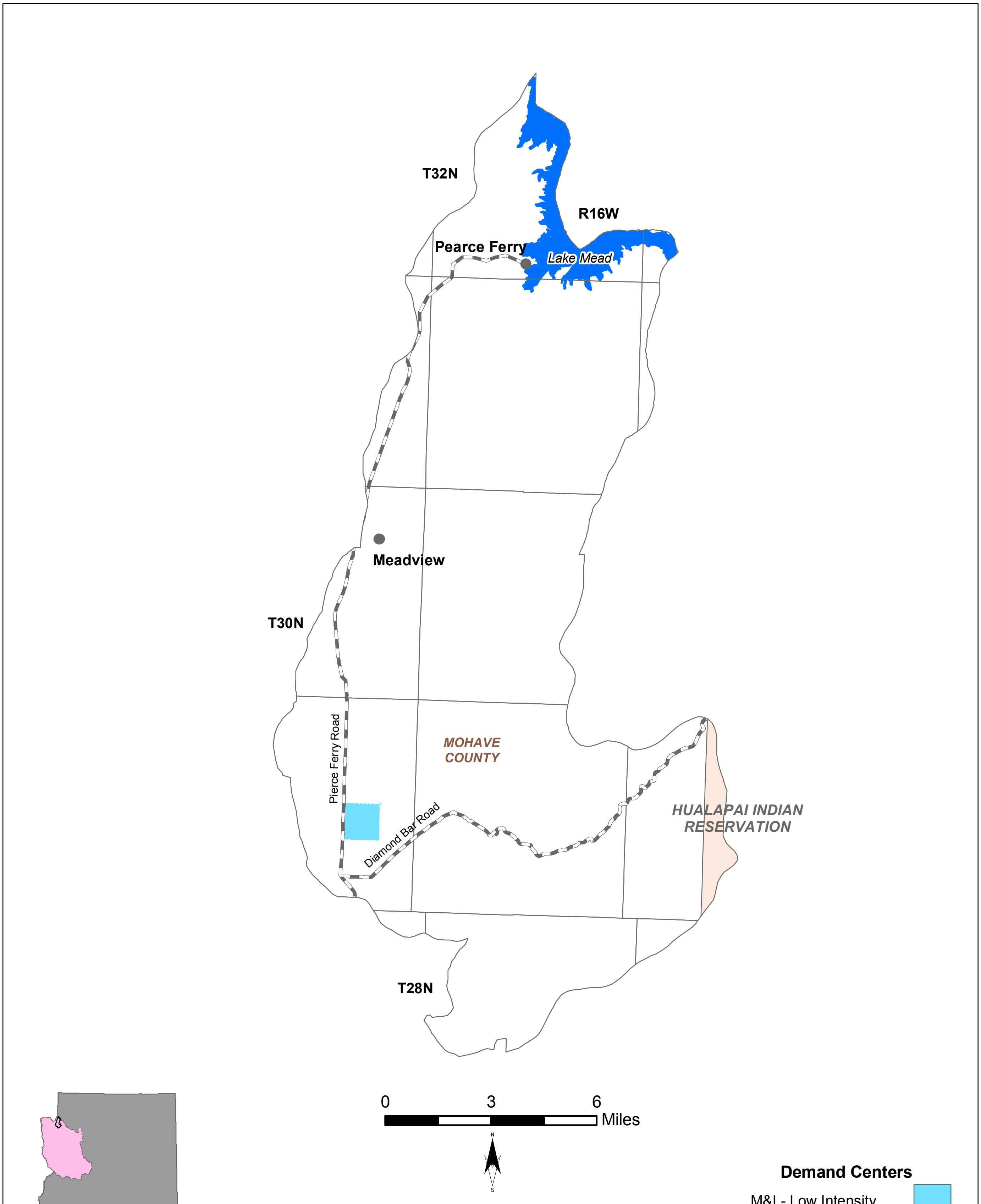


Figure 4.7-10
Meadview Basin
Cultural Water Demand

Primary Data Source: USGS National Gap Analysis Program, 2004

4.7.9 Water Adequacy Determinations in the Meadview Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 4.7-10. Figure 4.7-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

- A total of five water adequacy determinations have been made in this basin through December, 2006.
- Five determinations of inadequacy have been made; all determinations are in the western portion of the basin.
- The determinations of inadequacy were based on the applicant's decision not to submit the necessary information and/or available hydrologic data were insufficient to make a determination, insufficient supply and insufficient infrastructure.
- All lots receiving an adequacy determination are in Mohave County. Of the 2,989 lots in five subdivisions, no lots were determined to be adequate.

Table 4.7-10 Adequacy Determinations in the Meadview Basin[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Lake Mead City Unit No. 15-29-1	Mohave	29 North	17 West	15	25	22-402136	Inadequate	A1	05/08/06	NA
2	Meadview	Mohave	30 North	17 West	1, 12	2441		Inadequate	A1	08/27/73	Joshua Valley Utility Company
3	Meadview B	Mohave	30 North	17 West	35	138		Inadequate	A1, A2, A3	02/17/84	Dry Lot Subdivision
4	Meadview Highlands	Mohave	30 North	17 West	1	135		Inadequate	A2, A3	06/30/93	Joshua Valley Utility Company
5	Meadview Unit # 5	Mohave	29 North	17 West	11, 13, 15	250		Inadequate	A2, A3	10/22/85	Dry Lot Subdivision

Notes:

[1]Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies

[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.

[3] A. Physical/Continuous
- 1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
- 2) Insufficient Supply (existing water supply unreliable or physically unavaible;for groundwater, depth-to-water exceeds criteria)
- 3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)

B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)

C. Water Quality

D. Unable to locate records

NA = Data not currently available to ADWR

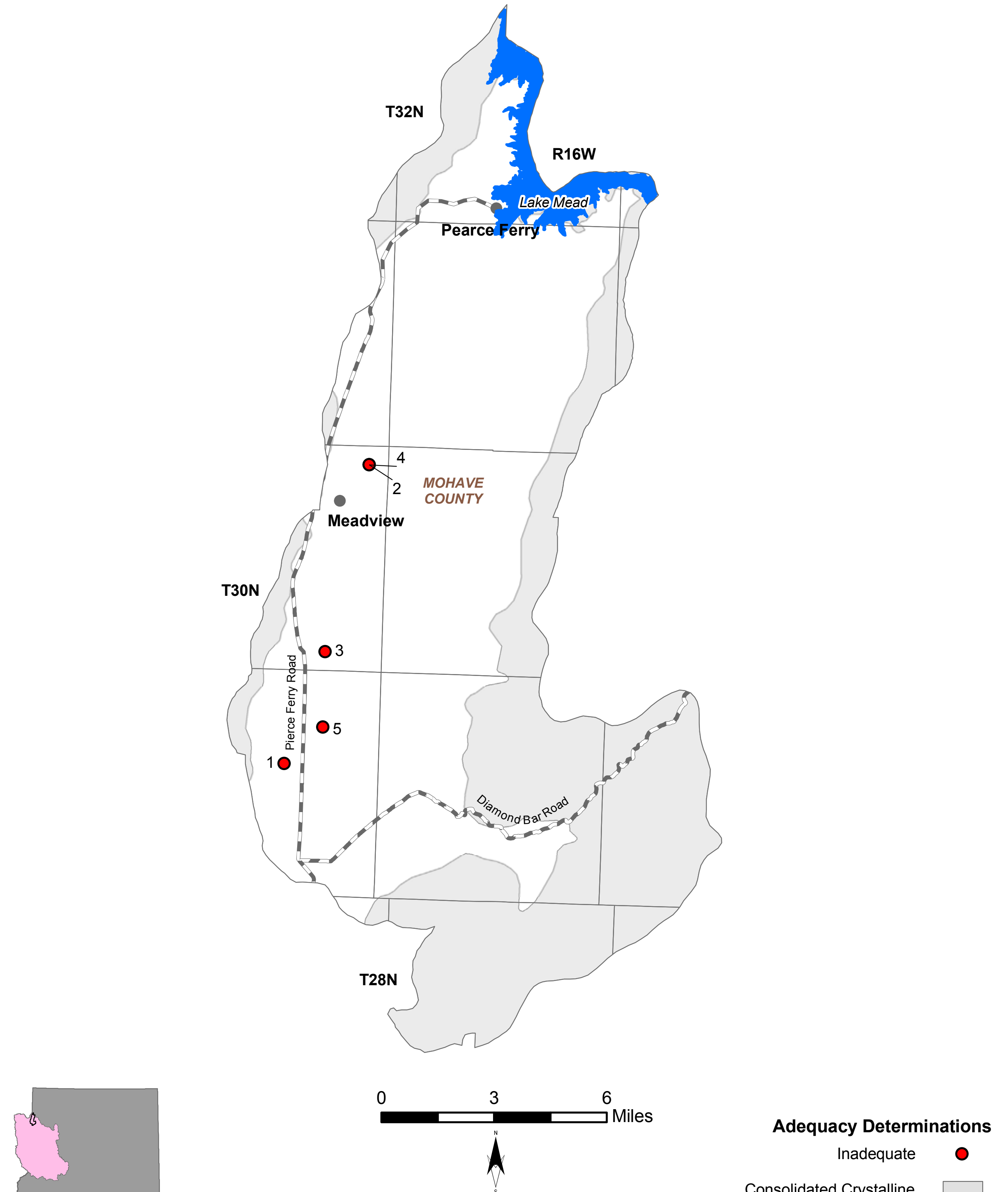


Figure 4.7-11
Meadview Basin
Adequacy Determinations

Meadview Basin
References and Supplemental Reading

References

A

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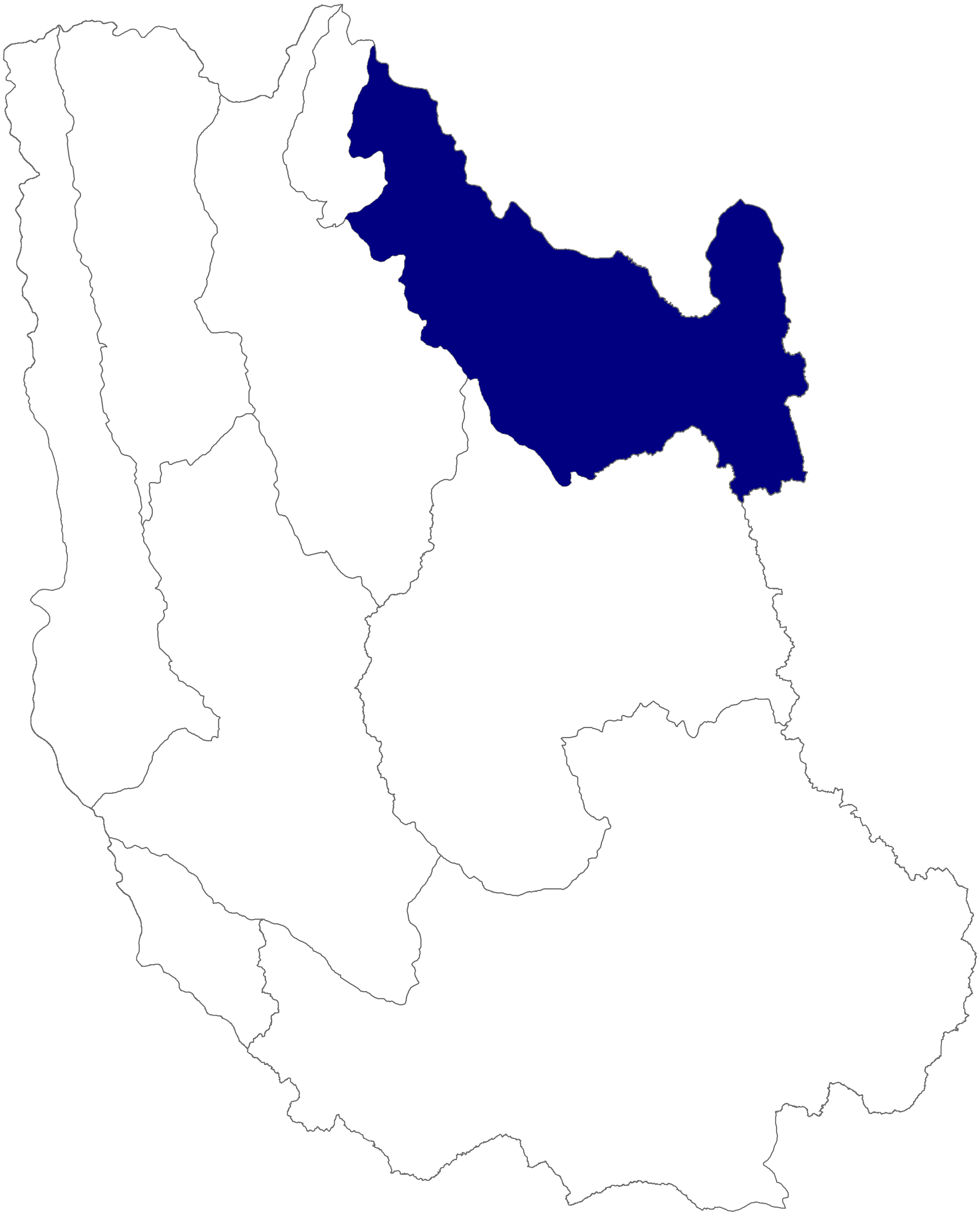
Meadview Basin Index to Section 4.0

Section 4.8
Peach Springs Basin

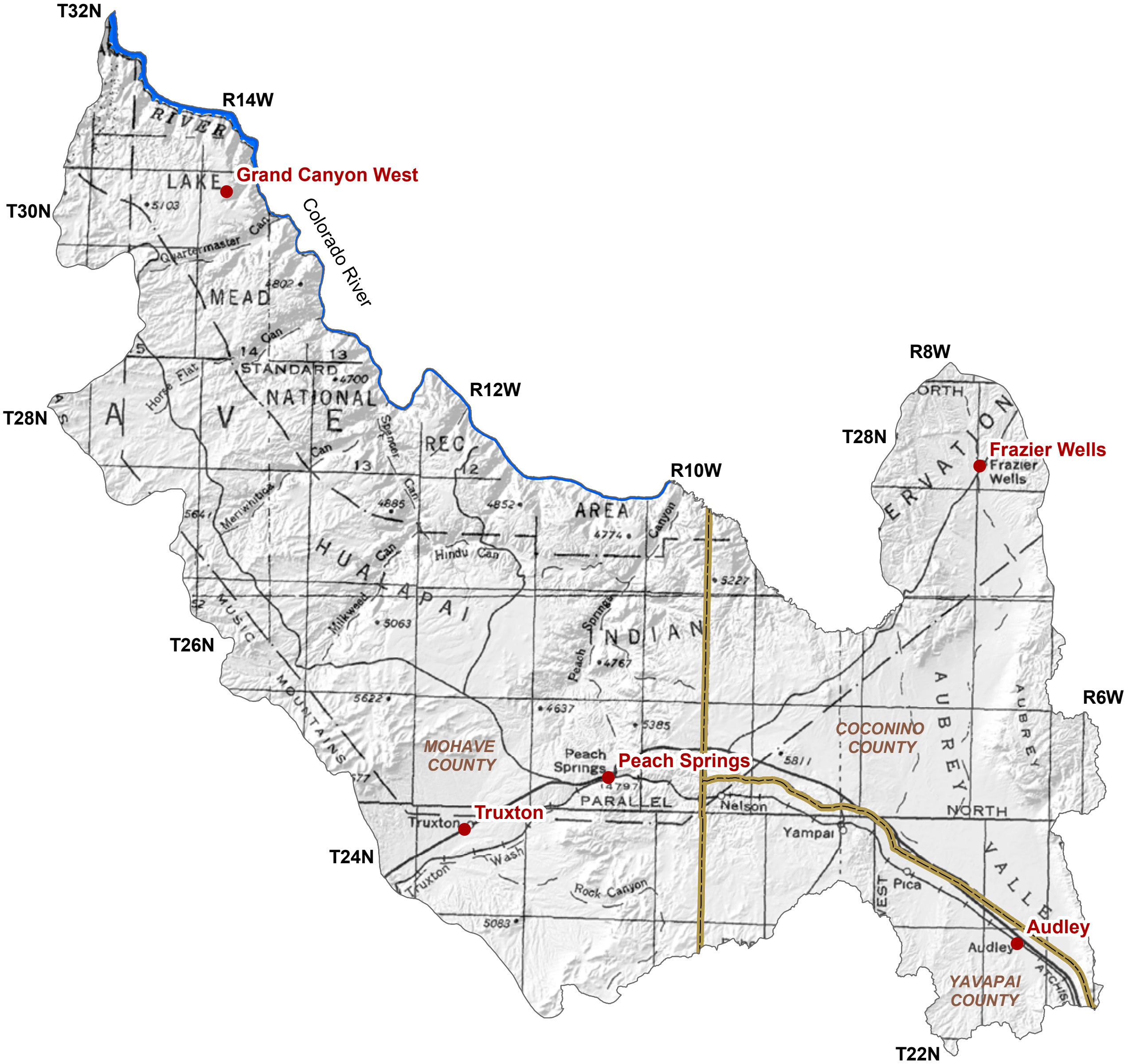


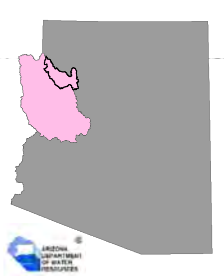
4.8.1 Geography of Peach Springs Basin

The Peach Springs Basin is a medium-size 1,409 square mile basin in the northeastern portion of the planning area. Geographic features and principal communities are shown on Figure 4.8-1. The basin is characterized by a relatively high elevation plateau area, steep canyons and small valleys. The Colorado River defines the northwestern basin boundary. Vegetation types include semidesert grassland and conifer woodland.

- Principal geographic features shown on Figure 4.8-1 are:
    - The principal community of Peach Springs
    - The smaller communities of Truxton, Frazier Wells, Audley and Grand Canyon West
    - The Grand Wash Cliffs on the north west basin boundary
    - The Music Mountains on the west basin boundary with the highest point in the basin, an unnamed point at approximately 6,760 feet.
    - The lowest point in the basin, approximately 1,100 feet at the Colorado River north of Quartermaster Canyon
    - Aubrey Valley north of Audley
    - Aubrey Cliffs on the east basin boundary
    - Peach Springs Canyon, with access to the Colorado River

- Not well shown is the Hualapai Plateau comprising most of the basin north of Peach Springs





0 3 6 Miles

COUNTY
City, Town or Place

Base Map: USGS 1:500,000, 1981

Figure 4.8-1
Peach Springs Basin
Geographic Features

4.8.2 Land Ownership in the Peach Springs Basin

Land ownership, including the percentage of ownership by category, for the Peach Springs Basin is shown in Figure 4.8-2. The principal feature of land ownership in this basin is the large amount of tribal land. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

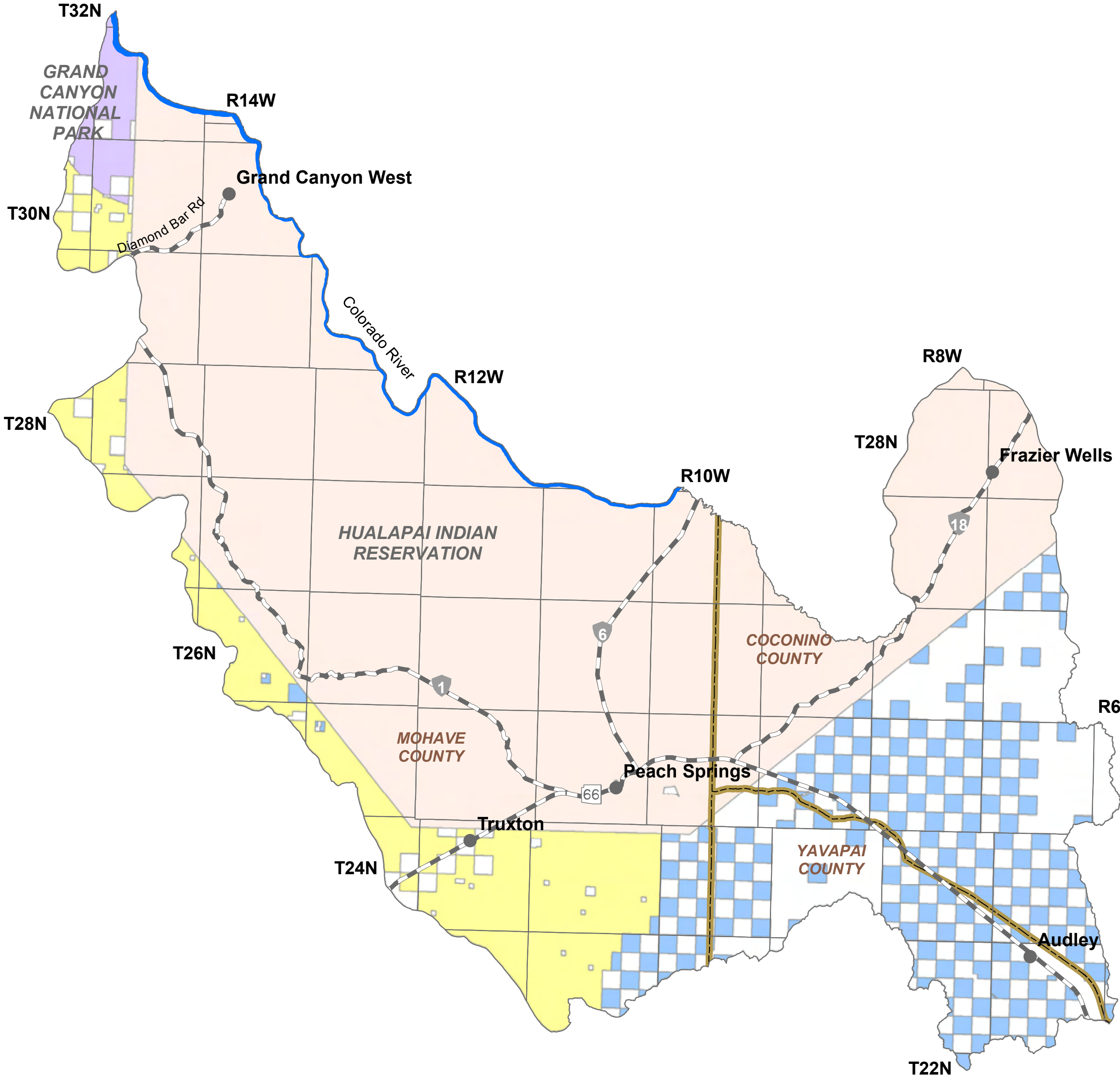
Indian Reservation
- 59.9% of the land is under ownership of the Hualapai Tribe.
- Tribal lands encompass most of the basin and are contiguous.
- This basin contains the largest percentage of tribal lands in the planning area.
- Land uses include domestic, commercial, recreation and ranching.

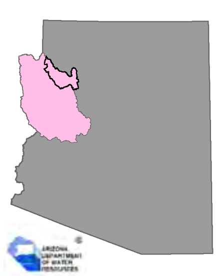
Private
- 17.8% of the land is private.
- Most private land is located in the southeastern portion of the basin in a checkerboard pattern with state trust lands.
- Primary land uses are domestic and ranching.

U.S. Bureau of Land Management (BLM)
- 11.2% of the land is federally owned and managed by the Kingman Field Office of the Bureau of Land Management.
- All BLM lands are located along the western basin boundary.
- This basin contains the smallest percentage off BLM lands in the planning area.
- Primary land use is grazing.

State Trust Land
- 9.7% of the land in this basin is held in trust for the public schools and five other beneficiaries under the State Trust Land system.
- Most state trust lands are found interspersed with private lands in the southeastern portion of the basin.
- Primary land use is grazing.

National Parks, Monuments and Recreation Areas
- 1.4% of the land is federally owned and operated by the National Park Service (NPS) as Grand Canyon National Park.
- All NPS lands are along the northwestern basin boundary.
- Primary land uses are resource conservation and recreation.





0 3 6 Miles

Land Ownership (Percentage in Basin)

- Indian Reservation (59.9%)
- Private (17.8%)
- U.S. Bureau of Land Management (11.2%)
- State Trust (9.7%)
- National Parks, Monuments & Recreation Areas (1.4%)
- COUNTY
- Major Road
- City, Town or Place

Figure 4.8-2
Peach Springs Basin
Land Ownership

Source: ALRIS, 2004
Bureau of Land Management, 1999

4.8.3 Climate of the Peach Springs Basin

The Peach Springs Basin does not contain any NOAA/NWS Co-op Network, Evaporation Pan, AZMET or SNOTEL/Snowcourse stations. The precipitation figures shown in Figure 4.8-3 are from the Spatial Climatic Analysis Service (SCAS) at Oregon State University. A description of this and other climate data sources and methods is found in Volume 1, Section 1.3.3.

SCAS Precipitation Data

- See Figure 4.8-3
- Average annual precipitation is as high as 18 inches in the eastern portion of the basin in the Aubrey Cliffs.
- Average annual precipitation is as low as four inches in the northernmost tip of the basin.
- In general, precipitation increases as the elevation increases in this basin. The range of 14 inches between areas of highest and lowest precipitation is high for the planning area.

Table 4.8-1 Climate Data for the Peach Springs Basin

A.NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
None									

Source: WRCC, 2003.

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

Source: WRCC, 2003.

C. AZMET:

Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (*number of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content *(Number of measurements to calculate average)*					
			Jan	Feb	March	April	May	June
None								

Source: Natural Resources Conservation Service, 2005

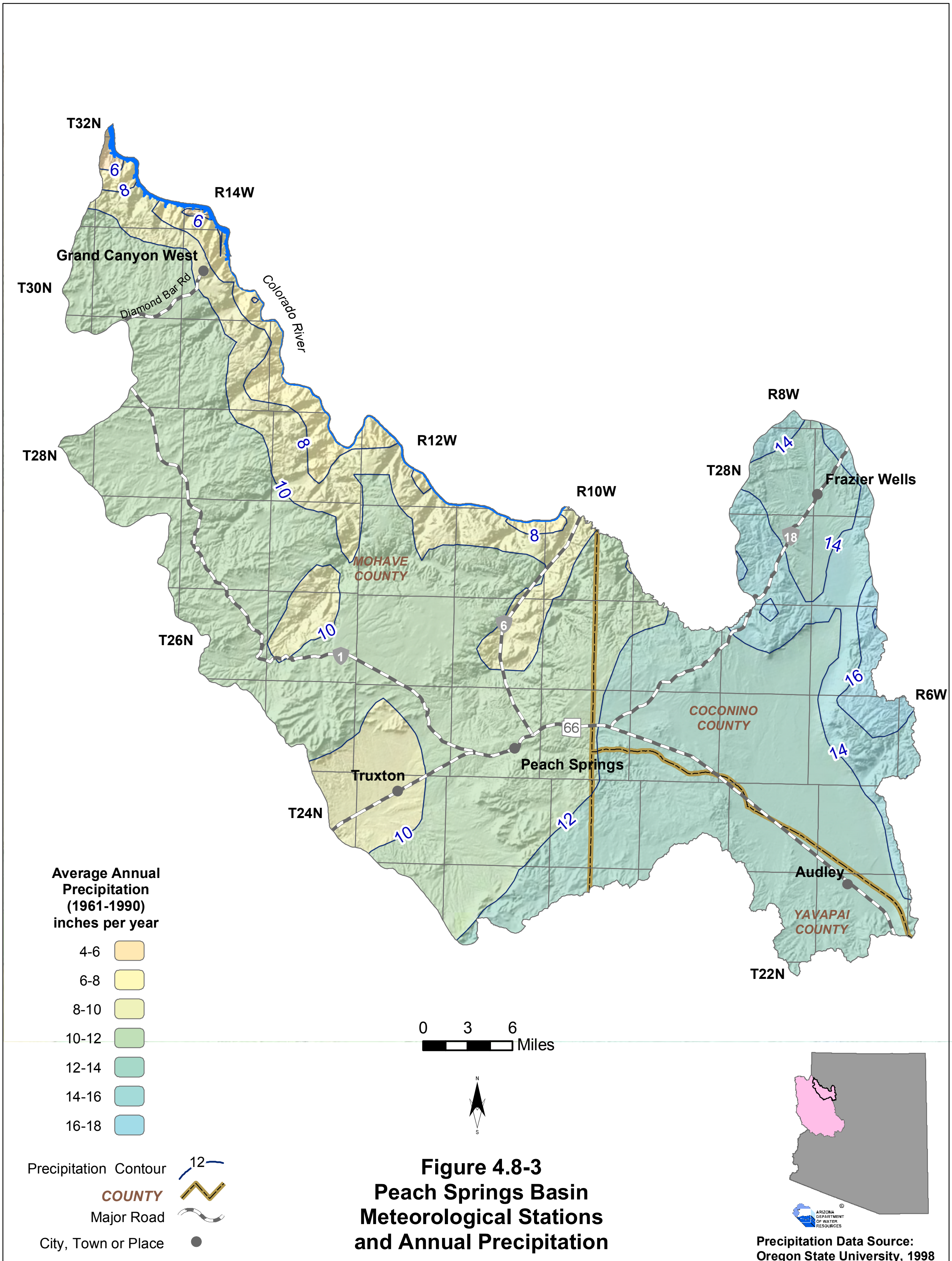


Figure 4.8-3
Peach Springs Basin
Meteorological Stations
and Annual Precipitation

4.8.4 Surface Water Conditions in the Peach Springs Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 4.8-2. Flood ALERT equipment in the basin is shown in Table 4.8-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.8-4. The location of streamflow gages, using the USGS number, is shown on Figure 4.8-4. The location of large reservoirs and flood ALERT equipment as well as USGS runoff contours are also shown on Figure 4.8-4. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Streamflow Data

- Refer to Table 4.8-2.
- Data from one station located at Spencer Creek is shown on the table and on Figure 4.8-4.
- The average seasonal flow for the station is highest in the summer (July-September) when 32% of the average annual flow occurs and lowest in the spring (April-June) when 19% of the average annual flow occurs.
- Maximum annual flow was 2,267 acre-feet in 1993 and minimum annual flow was 760 acre-feet in 2002.

Flood ALERT Equipment

- Refer to Table 4.8-3.
- As of October 2005 there were three stations in the basin.
- Of the three stations one is a precipitation/stage station and two are repeater/precipitation stations.

Reservoirs and Stockponds

- Refer to Table 4.8-4.
- Surface water is stored or could be stored in 10 small reservoirs in the basin.
- Total maximum storage for the two small reservoirs with greater than 15 acre-feet and less than 500 acre-feet storage capacity is 451 acre-feet. The remaining eight reservoirs have a total surface area of 93 acres.
- There are an estimated 135 stockponds in this basin.

Runoff Contour

- Refer to Figure 4.8-4.
- Average annual runoff is 0.1 inch per year in the in the eastern portion of the basin.

Table 4.8-2 Streamflow Data for the Peach Springs Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9404222	Spencer Creek near Peach Springs	NA	NA	3/1998-current	19	27	32	21	760 (2002)	1,456	1,485	2,267 (1993)	4

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Notes:
Statistics based on Calendar Year
Annual Flow statistics based on monthly values
Summation of Average Annual Flows may not equal 100 due to rounding.
Period of record may not equal Year of Record used for annual Flow/Year statistics due to only using years with a 12 month record

Table 4.8-3 Flood ALERT Equipment in the Peach Springs Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
7450	Crozier Canyon	Precipitation/Stage	NA	Mohave County FCD
7480	Grand Canyon West Repeater	Repeater/Precipitation	NA	Mohave County FCD
7500	Grey Mountain Repeater	Repeater/Precipitation	NA	Mohave County FCD

Notes:
FCD = Flood Control District
NA = Not available

Table 4.8-4 Reservoirs and Stockponds in the Peach Springs Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE	JURISDICTION
None identified by ADWR at this time					

B. Other Large Reservoirs (50 acre surface area or greater)[1]

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE	JURISDICTION
None identified by ADWR at this time					

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 2
Total maximum storage: 451 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)[1]

Total number: 8
Total surface area: 93 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 135 (from water right filings)

Notes:
[1]Capacity data not available to ADWR

USGS Annual Runoff Contour for 1951-1980 (in inches) — 2

Stream Channel (width of line reflects stream order)

Stream Gages

USGS

Flood

COUNTY

Major Road

City, Town or Place

0 3 6 Miles

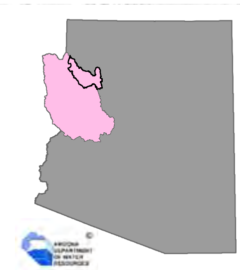


Figure 4.8-4
Peach Springs Basin
Surface Water Conditions

Stream Data Source: ALRIS, 2005

4.8.5 Perennial/Intermittent Streams and Major Springs in the Peach Springs Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 4.8-5. The locations of major springs as well as perennial and intermittent streams are shown on Figure 4.8-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- There is one perennial stream, the Colorado River, located along the northern basin boundary. Based on USGS stream gage data from 1998 to present, there is likely an additional perennial/intermittent stream not identified by Arizona Game and Fish in 1997. This stream, Spencer Canyon, is not shown on Figure 4.8-5 but can be found on Figure 4.8-4.
- There are 14 major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time.
- Listed discharge rates may not be indicative of current conditions; however, all spring measurements in the basin are relatively recent. All measurements were taken between 1991 and 1995.
- Most of the springs are located near or along the Colorado River. The greatest discharge rate was measured south of the Colorado River (Spencer, 1,730 gpm).
- Two springs in this basin are highly variable. One spring, Eagle, measured 1,023 gpm in 1993 and the most recent measurement was less that 10 gpm.
- More than one half of the major spring discharge measurements reported were greater than 100 gpm.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 4.8-5B. There are five minor springs identified in this basin.
- The total number of springs identified by the USGS varies from 28 to 29, depending on the database reference.

Table 4.8-5 Springs in the Peach Springs Basin

A. Major Springs (10 gpm or greater):

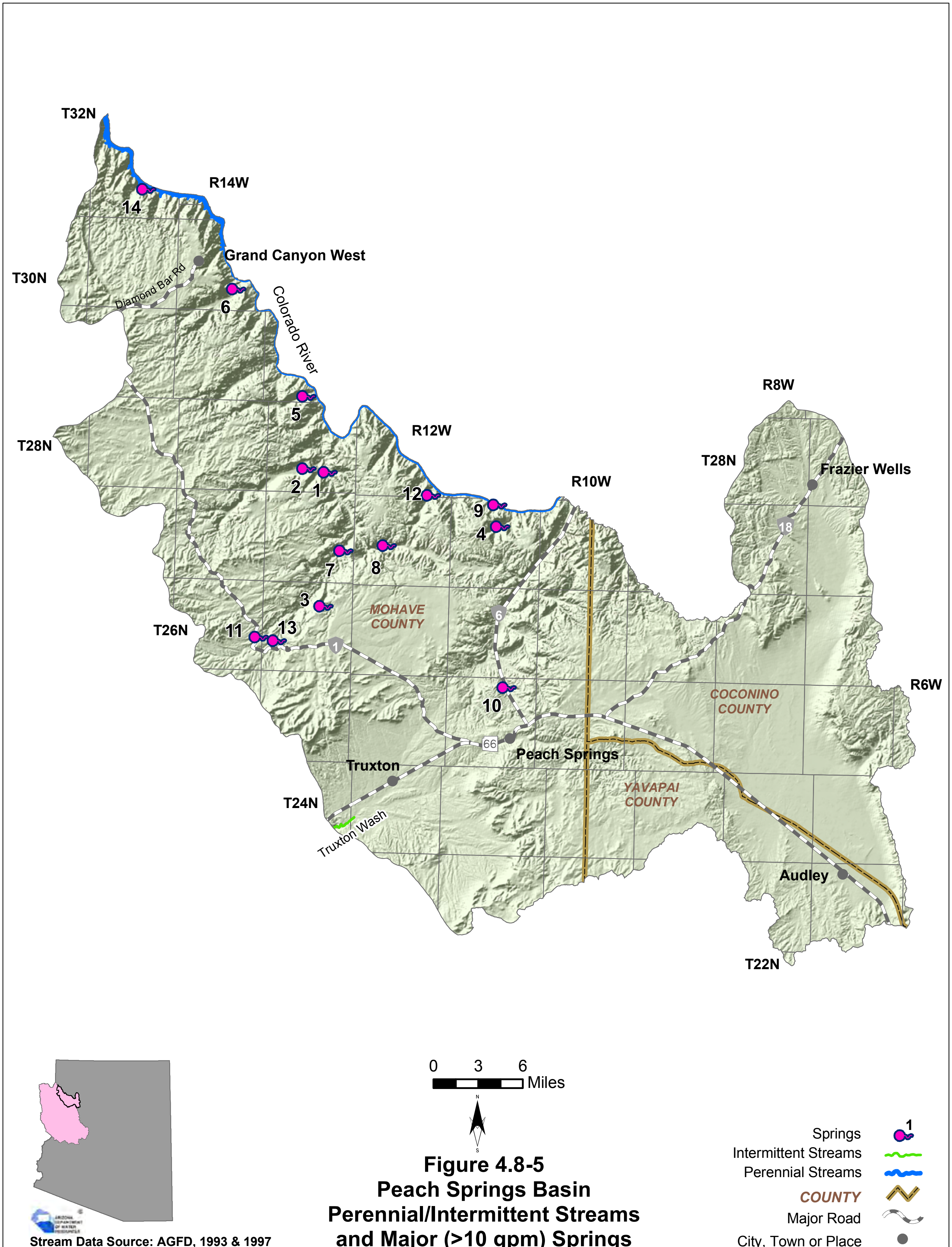
Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Spencer (multiple)	354659	1133900	1,730	6/8/1994
2	Meriwhitica	354711	1134032	1,233	6/7/1994
3	Eagle[2]	353912	1133902	1,023[3]	5/18/1993
4	Travertine Canyon	354406	1132634	898	6/6/1994
5	Clay Tank Canyon[2]	355124	1134040	261	6/7/1994
6	Quartermaster (multiple)	355732	1134555	189	8/25/1991
7	Lower Milkweed Canyon[2]	354228	1133743	159	6/8/1994
8	Hindu	354250	1133438	127[3]	5/16/1993
9	Travertine Falls	354522	1132648	54	6/5/1994
10	Peach	353445	1132550	49	3/31/1995
11	Westwater	353710	1134332	49	3/30/1995
12	Bridge Canyon[2]	354550	1133134	27	6/9/1994
13	Milkweed	353707	1134220	23	6/4/1994
14	Boundary[2]	360312	1135234	12	6/5/1994

B. Minor Springs (1 to 10 gpm):

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Upper Blue Mountain Canyon	354151	1131736	9	12/9/1994
Horse Flat Canyon	355111	1134623	5[4]	5/17/1993
Surprise	353208	1132404	4[4]	8/6/1992
Metuck	353848	1132257	3	6/6/1994
New Water	355807	1135618	1	6/11/1993

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and USGS, 2006): 28 to 29

Notes:
[1]Most recent measurement identified by ADWR
[2]Spring is not displayed on current USGS topo maps
[3]Most recent measurement < 10gpm
[4]Most recent measurement < 1gpm



Stream Data Source: AGFD, 1993 & 1997

Figure 4.8-5
Peach Springs Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

4.8.6 Groundwater Conditions of the Peach Springs Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 4.8-6. Figure 4.8-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 4.8-7 contains hydrographs for selected wells shown on Figure 4.8-6. Figure 4.8-8 shows well yields in three yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 4.8-6 and Figure 4.8-6.
- The major aquifers in this basin are basin fill and sedimentary rock, R (Redwall) Aquifer.
- Flow direction is generally from south to north in this basin.

Well Yields

- Refer to Table 4.8-6 and Figure 4.8-8.
- As shown on Figure 4.8-8 well yields in this basin range from less than 100 gallons per minute (gpm) to 1,000 gpm.
- One source of well yield information, based on seven reported wells, indicates that the median well yield in this basin is 250 gpm.

Natural Recharge

- Refer to Table 4.8-6.
- There is no estimate of natural recharge for this basin.

Water in Storage

- Refer to Table 4.8-6.
- There are three storage estimates for this basin, ranging from one million acre-feet in the Truxton Valley alone to more than four million acre-feet. The most recent estimate, from a 1994 ADWR study indicated that there is one million acre-feet in storage to a depth of 1,200 feet in the Truxton Valley.
- The predevelopment estimate of storage for this basin is more than one million acre-feet to a depth of 1,200 feet.

Water Level

- Refer to Figure 4.8-6. Water level is shown for wells measured in 2003-2004.
- The Department annually measures four index wells in this basin.
- In 1995, the year of the last water level sweep, 34 wells were measured.
- The deepest recorded water level in the basin is 1,341 feet near the Yavapai/Coconino County boundary, this is the deepest recorded water level in the planning area. The shallowest recorded water level is 60 feet east of Truxton.
- Hydrographs corresponding to selected wells shown on Figure 4.8-6 but covering a longer time period are shown in Figure 4.8-7.

Table 4.8-6 Groundwater Data for the Peach Springs Basin

Basin Area, in square miles:	1,409	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Basin Fill	
	Sedimentary Rock (R Aquifer)	
Well Yields, in gal/min:	119 (1 well measured)	Measured by ADWR and/or USGS
	Range 45-650 Median 250 (7 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 5-146	ADWR (1994)
	Range 0-500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	N/A	
Estimated Water Currently in Storage, in acre-feet:	1,000,000 (Truxton Valley, to 1,200 ft)	ADWR (1994)
	>1,000,000[1] (to 1,200 ft)	Freethey and Anderson (1986)
	>4,000,000	Arizona Water Commission (1975)
Current Number of Index Wells:	4	
Date of Last Well Sweep:	1995 (34 wells measured)	

Notes:
NA = Not Available
[1]Predevelopment Estimate

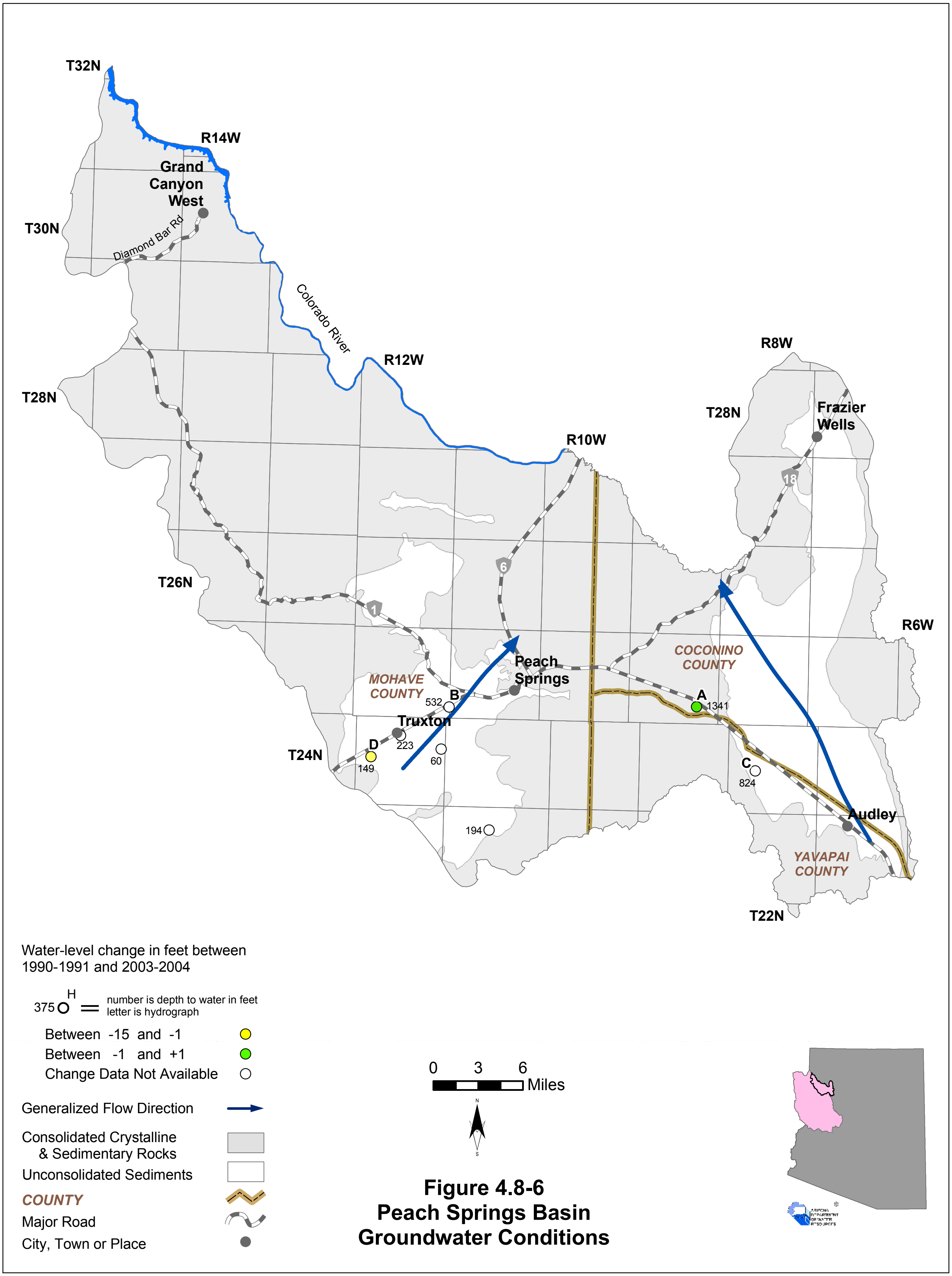
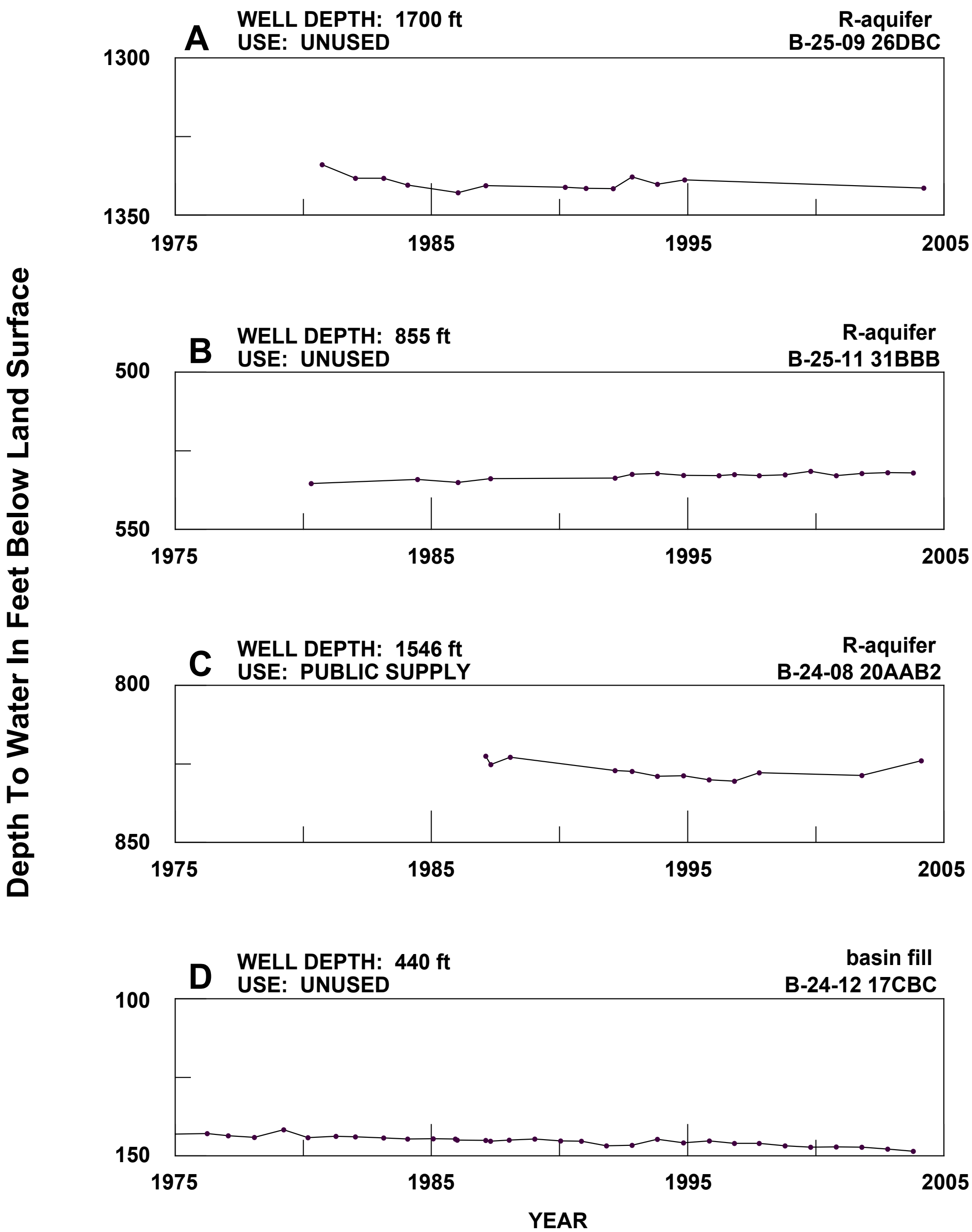


Figure 4.8-6
Peach Springs Basin
Groundwater Conditions

Figure 4.8-7
Peach Springs Basin
Hydrographs Showing Depth to Water in Selected Wells



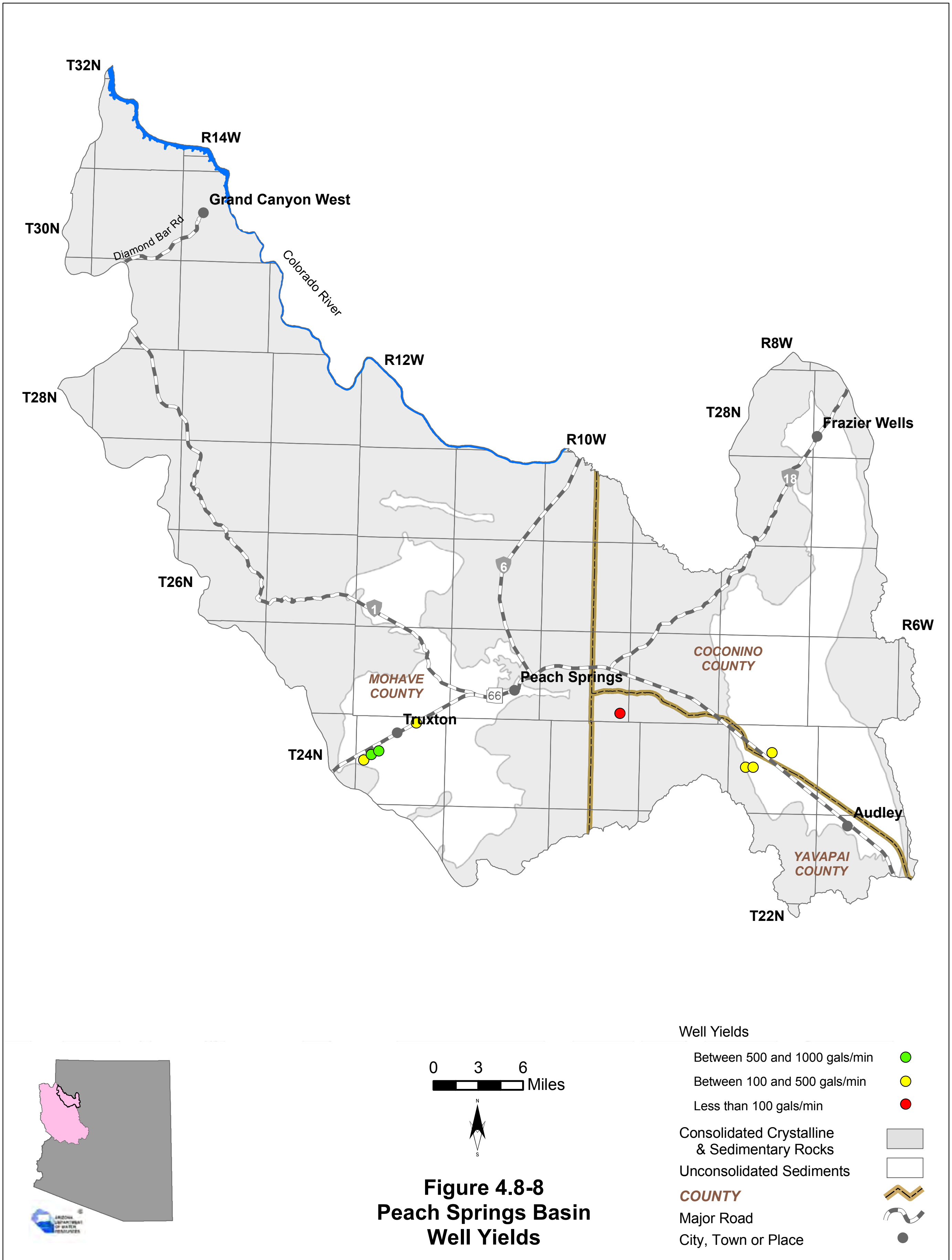


**Figure 4.8-8
Peach Springs Basin
Well Yields**

4.8.7 Water Quality of the Peach Springs Basin

Drinking water standard exceedences in wells, springs and mine sites including location and parameter(s) exceeded are shown in Table 4.8-7A. Impaired lakes and streams with site type, name, length of impaired stream reach, area of impaired lake, designated use standard and parameter(s) exceeded is shown in Table 4.8-7B. Figure 4.8-9 shows the location of exceedences and impairment keyed to Table 4.8-7. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mine Sites

- Refer to Table 4.8-7A.
- Drinking water standard exceedences in wells and springs have been reported for 29 sites in the basin.
- The drinking water standard for arsenic was the most frequently exceeded standard at sites in this basin.
- Only four of the 29 sites did not have arsenic exceedences. The arsenic exceedences were found at measured sites throughout the basin.
- Other drinking water standards exceeded in this basin include cadmium, fluoride, lead, nitrate/nitrite and mercury.

Lakes and Streams

- Refer to Table 4.2-7B.
- Water quality standards were exceeded in one reach of the Colorado River between Parashant Canyon and Diamond Creek.
- Only a very small portion of a 28-mile impaired reach of the Colorado River is in this basin. The majority of the impaired reach is in the Coconino Plateau Basin in the Western Plateau Planning Area.
- The drinking water standards exceeded were selenium and suspended sediment.
- The Colorado River between Parashant Canyon and Diamond Creek is not part of the ADEQ water quality improvement effort called the Total Maximum Daily Load (TMDL) program at this time.

Table 4.8-7 Water Quality Exceedences in the Peach Springs Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Exceeding Drinking Water Standard[2]
		Township	Range	Section	
1	Well	28 North	7 West	17	Pb
2	Spring	28 North	8 West	2	As
3	Spring	28 North	8 West	12	As
4	Well	28 North	8 West	12	As
5	Spring	28 North	12 West	21	As
6	Spring	28 North	12 West	21	As
7	Spring	28 North	12 West	35	As
8	Spring	28 North	12 West	35	As
9	Spring	27 North	10 West	5	As
10	Spring	27 North	11 West	2	As
11	Spring	27 North	11 West	3	As
12	Spring	27 North	11 West	3	As
13	Spring	27 North	11 West	6	As
14	Spring	27 North	11 West	10	As
15	Spring	27 North	13 West	24	As
16	Spring	27 North	13 West	24	As
17	Spring	27 North	13 West	34	As, Cd
18	Spring	27 North	13 West	34	As
19	Spring	26 North	10 West	7	As
20	Spring	26 North	11 West	2	As
21	Spring	26 North	11 West	25	As
22	Spring	26 North	13 West	4	As
23	Spring	26 North	13 West	9	As
24	Spring	26 North	13 West	17	As
25	Spring	26 North	13 West	20	Hg
26	Well	25 North	11 West	2	As, NO3
27	Spring	25 North	11 West	14	As
28	Well	24 North	8 West	17	As
29	Well	24 North	8 West	17	F

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard	Parameter(s) Exceeding Use Standard
a	Stream	Colorado River (Parashant Canyon to Diamond Creek)	28		A&W	Se, Suspended Sediment

Notes:

[1] Water quality samples collected between 1967 and 2001.

[2] As = Arsenic
Cd = Cadmium
F = Fluoride
Pb = Lead
NO3 = Nitrate/Nitrite
Hg = Mercury
Se = Selenium

[3] A&W = Aquatic and Wildlife

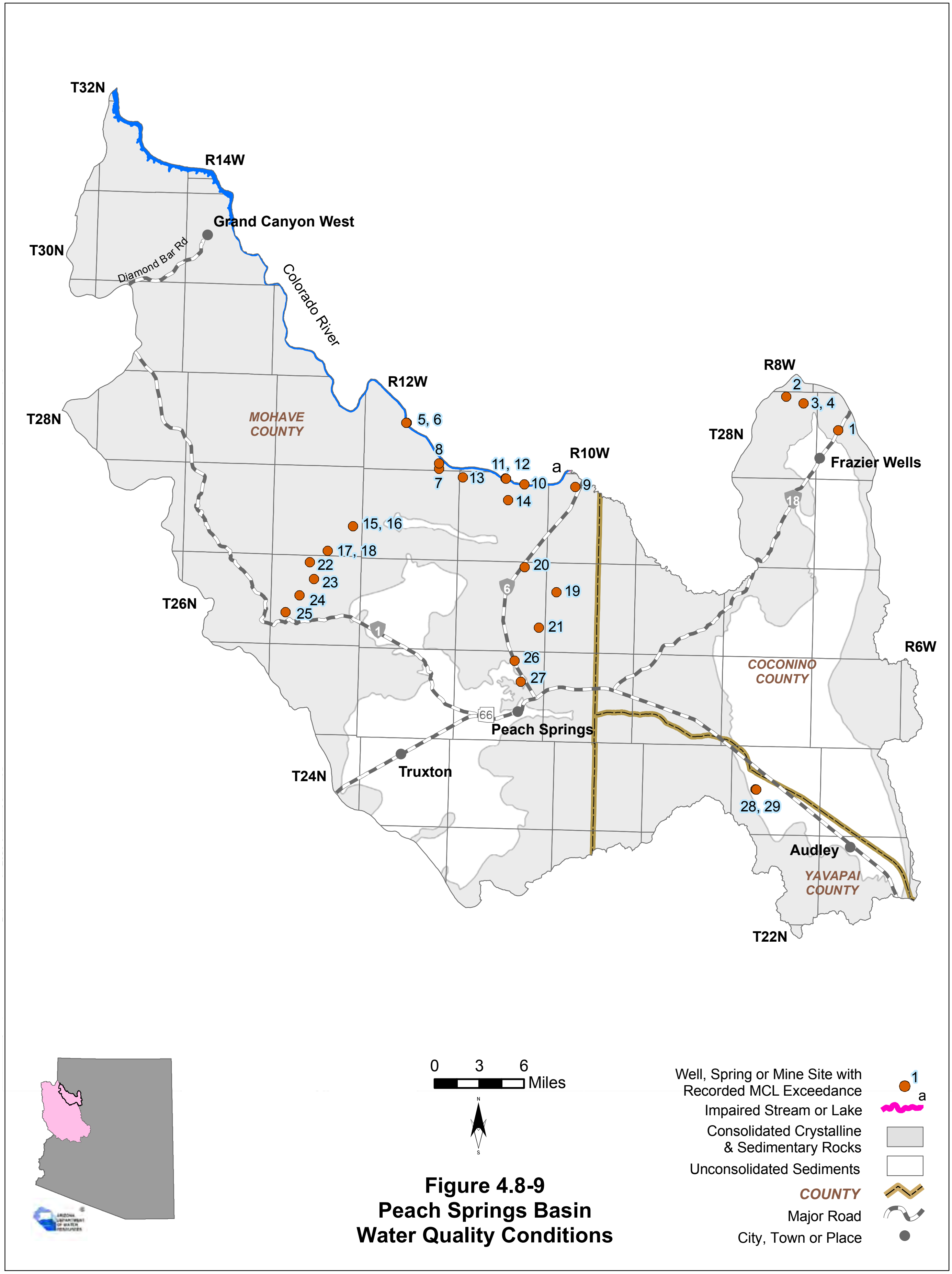


Figure 4.8-9
Peach Springs Basin
Water Quality Conditions

4.8.8 Cultural Water Demands in the Peach Springs Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 4.8-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 4.8-9. Figure 4.8-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 4.0.7.

Cultural Water Demands

- Refer to Table 4.8-8 and Figure 4.8-10.
- Population in this basin declined in the 1980s and increased minimally between 1990 and 2000. Overall, the population is virtually unchanged between 1980 and 2000, with a population of 1,804 in 1980 and 1,780 in 2000. Projections suggest a minimal rate of growth through 2050.
- Groundwater use has remained relatively constant from the 1970s to the present, with an average of less than 600 acre-feet of water pumped per year from 2001-2003 and less than 300 acre-feet each pumped for municipal and industrial use.
- There are no surface water diversions in this basin.
- The majority of the land in this basin is within the Hualapai Indian Reservation. The only demand centers are municipal and industrial and are located in the vicinity of Peach Springs.
- As of 2003 there were 286 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 32 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 4.8-9.
- There is one wastewater treatment facility, Peach Spring Sewer System, which serves Peach Springs.
- Over 1,500 people are served by this facility which generates 112 acre-feet of effluent per year.
- The facility discharges to an evaporation pond and to unlined infiltration basins.

Table 4.8-8 Cultural Water Demands in the Peach Springs Basin [1]

Year	Recent (Census) and Projected (DES) Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)						
				Well Pumpage			Surface-Water Diversions			Data Source
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial	Irrigation	Municipal	Industrial	Irrigation	
1971										
1972										
1973					<500			NR		
1974										
1975		278[2]	32[2]							
1976										
1977										
1978					<500			NR		
1979										
1980	1,804									ADWR (1994)
1981	1,720									
1982	1,636									
1983	1,552	1	0		<500			NR		
1984	1,468									
1985	1,384									
1986	1,301									
1987	1,217									
1988	1,133	0	0		<500			NR		
1989	1,049									
1990	965									
1991	1,046									
1992	1,128									
1993	1,209	0	0	<300	<300	NR		NR		
1994	1,291									
1995	1,372									
1996	1,454									USGS (2005)
1997	1,535									
1998	1,617	4	0	<300	<300	NR		NR		
1999	1,698									
2000	1,780									
2001	1,826									
2002	1,872	3	0	<300	<300	NR		NR		
2003	1,918									
2010	2,242									
2020	2,711									
2030	3,063									
2040	3,284									
2050	3,461									
ADDITIONAL WELLS: [3]		**2**								
WELL TOTALS:		**286**	**32**							

Notes:
NR - Not reported
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] Includes all wells through 1980.
[3] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 4.8-9 Effluent Generation in the Peach Springs Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf Irrigation	Wildlife Area	Discharged to Another Facility	Infiltration Basins			
Peach Spring Sewer System	Hualapai Tribal Authority	Peach Springs	1,530	112		X					X	Secondary	NA	2000

Notes:
WWTP: Waste Water Treatment Plant
NA: Data not currently available to ADWR

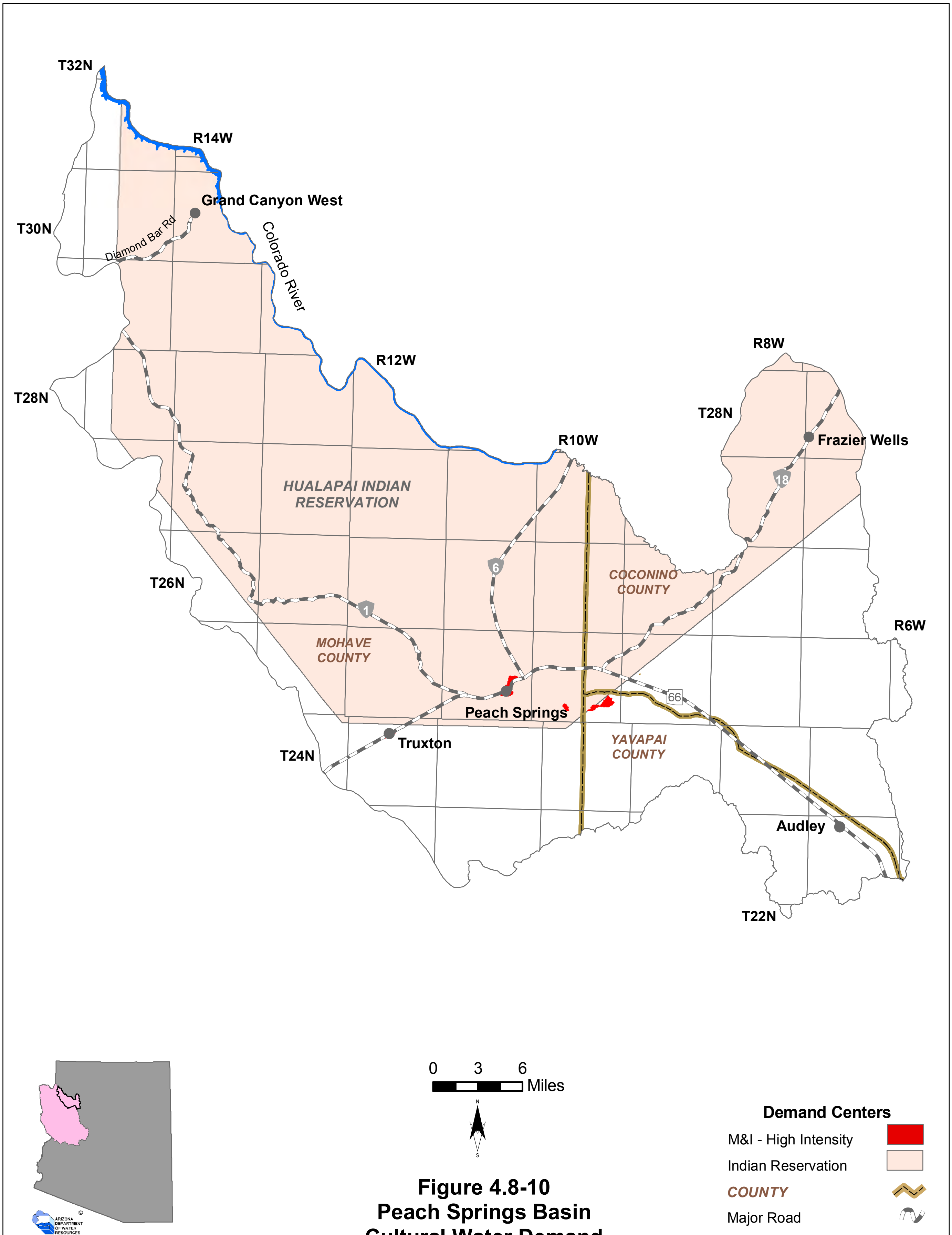


Figure 4.8-10
Peach Springs Basin
Cultural Water Demand

Primary Data Source: USGS National Gap Analysis Program, 2004

4.8.9 Water Adequacy Determinations in the Peach Springs Basin

There are no water adequacy applications on file with the Department as of December, 2006 for the Peach Springs Basin. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, 1.3.1.

Table 4.8-10 Adequacy Determinations in the Peach Springs Basin

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
No subdivisions on file with ADWR at this time											

Peach Springs Basin
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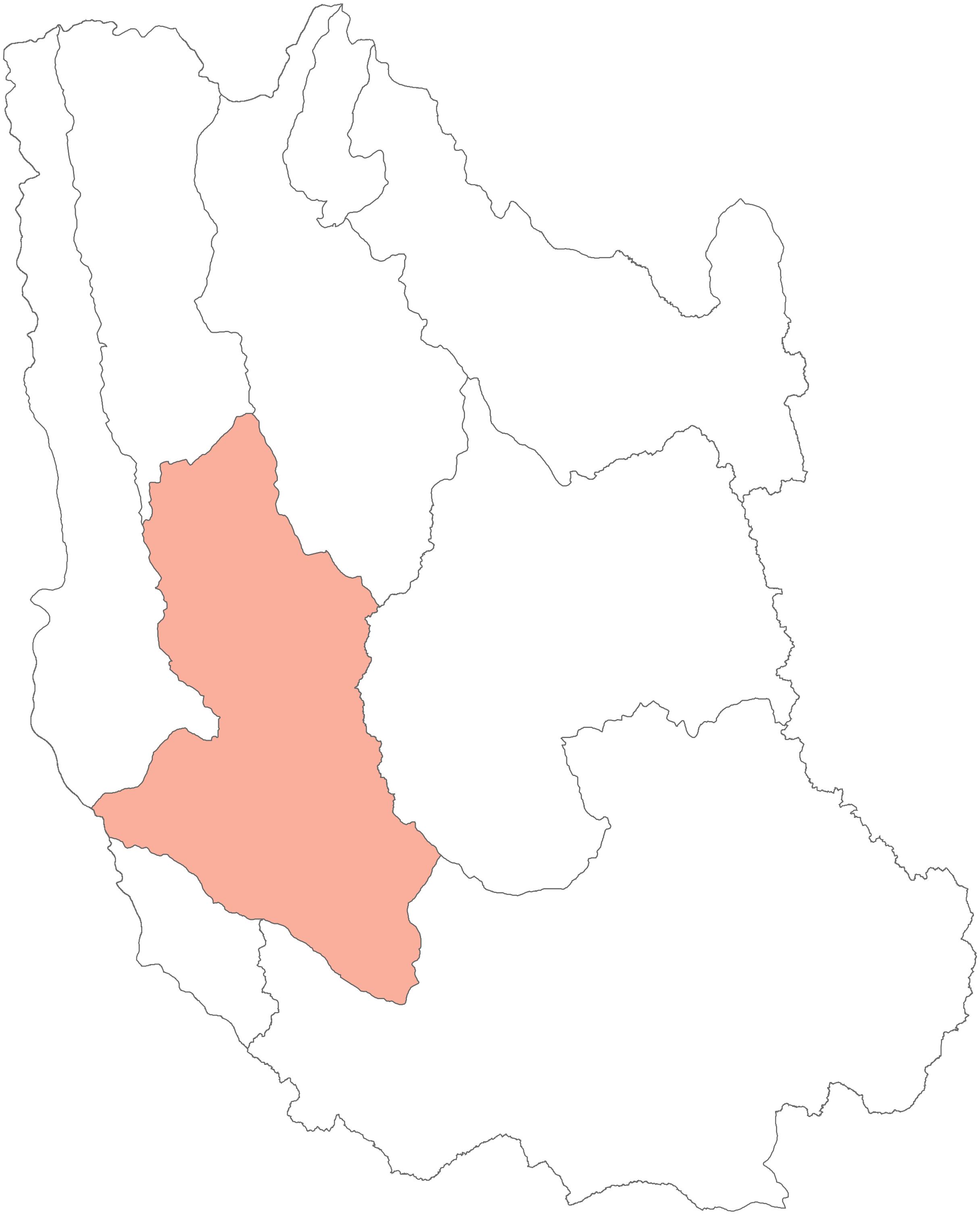
Peach Springs Basin Index to Section 4.0

Section 4.9
Sacramento Valley Basin



4.9.1 Geography of Sacramento Valley Basin

The Sacramento Valley Basin is the third largest basin in the planning area at 1,587 square miles and is located in the western portion of the planning area. Geographic features and principal communities are shown on Figure 4.9-1. The basin is characterized by broad valleys and mountains along the eastern and western basin boundaries. A small segment of the Colorado River defines the westernmost basin boundary. Vegetation type varies widely including Sonoran and Mohave desertscrub, chaparral, conifer woodlands and conifer forest. A small riparian area consisting of marsh and mesquite occurs along the Colorado River.

- Principal geographic features shown on Figure 4.9-1 are:
  - The principal community of Kingman
  - The smaller communities of Chloride, Topock and Yucca
  - Places of Franconia and Griffith
  - The north-south trending Sacramento Valley and Dutch Flat in the center of the basin
  - Sacramento Wash running north to south to Yucca and then running east to west to the Colorado River
  - The lowest point in the basin, about 500 feet near Topock
  - Buck Mountain Wash running north to The Sacramento Wash in the southern part of the basin
  - The Cerbat Mountains on the north east basin boundary
  - The Hualapai Mountains on the east central basin boundary with the highest point in the basin, Wabayuma Peak, at 7,601 feet

- Not well shown are the Black Mountains on the western basin boundary north of Yucca and the Mohave Mountains on the southwestern basin boundary

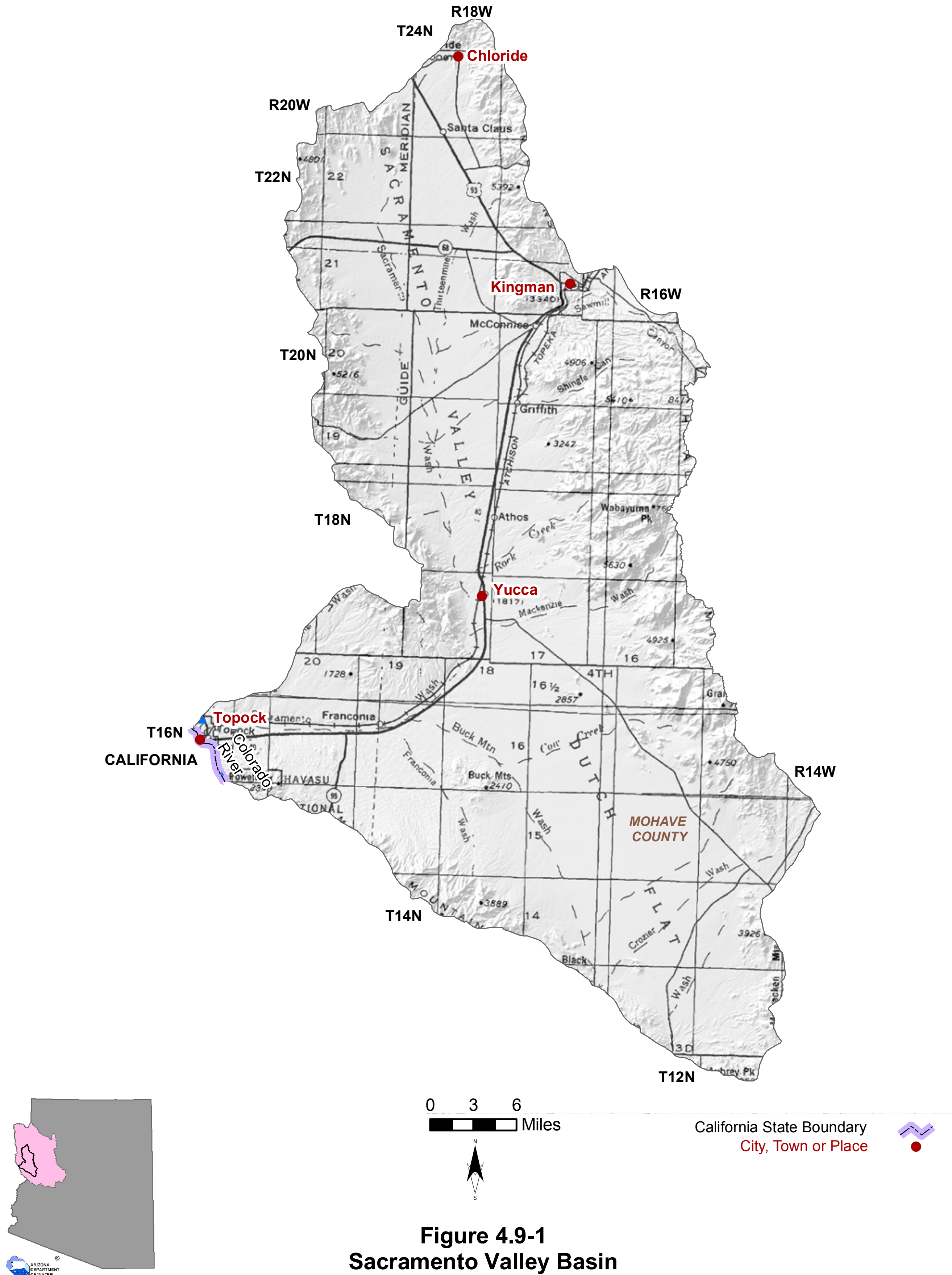


Figure 4.9-1
Sacramento Valley Basin
Geographic Features

Base Map: USGS 1:500,000, 1981

4.9.2 Land Ownership in the Sacramento Valley Basin

Land ownership, including the percentage of ownership by category, for the Sacramento Valley Basin is shown in Figure 4.9-2. Principal features of land ownership in this basin are the large amount of U.S Bureau of Land Management and private lands. A description of land ownership data sources and methods is found in Volume 1, Section 1.3.8. Land ownership categories are discussed below in the order of percentage from largest to smallest in the basin.

U.S. Bureau of Land Management (BLM)

- 58.2% of the land is federally owned and managed by the Kingman Field Office of the Bureau of Land Management.
- The basin contains two wilderness areas, a portion of the 112,400 acre Warm Springs Wilderness west of Yucca and the entire 40,000 acre Wabayuma Peak Wilderness located in T18N and T19N, R16W and T19N, R15W.
- BLM lands are located throughout the basin.
- Primary land uses are recreation and grazing.

Private

- 38.0% of the land is private.
- Private land is located throughout the basin, with larger contiguous parcels of land in the center of the basin and numerous fragmented lands along the basin edges.
- Land uses include domestic, commercial and grazing.

State Trust Land

- 2.8% of the land in this basin is held in trust for the public schools under the State Trust Land system.
- State trust lands are found interspersed with private lands throughout the basin.
- Primary land use is grazing.

Wildlife Refuge

- 0.6% of the land is federally owned and managed by the U.S. Fish and Wildlife Service.
- All wildlife refuge lands are part of the Havasu National Wildlife Refuge and are located along the western basin boundary south of Topock.
- Primary land uses are wildlife conservation and recreation.

Other (Game and Fish, County and Bureau of Reclamation)

- 0.4% of the land is owned and managed by Arizona Game and Fish Department and the Mohave County Parks and Recreation Department.
- Lands in the “other” category located in T20N, R18W are managed by Arizona Game and Fish and lands located in T20N, R15W are managed by the Mohave County Parks and Recreation Department as the Hualapai Mountain Park.
- Primary land use is recreation.

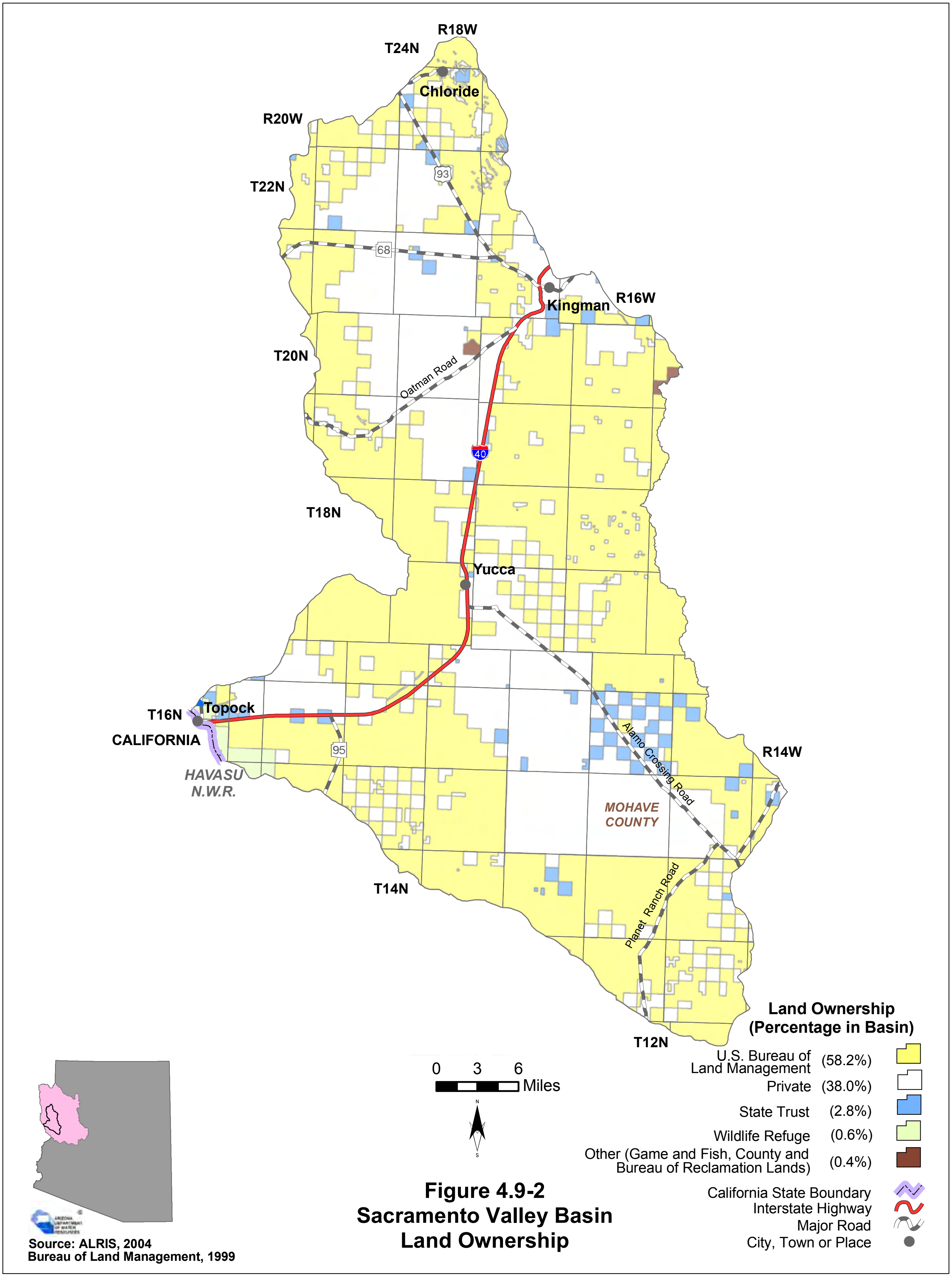


Figure 4.9-2
Sacramento Valley Basin
Land Ownership

Source: ALRIS, 2004
Bureau of Land Management, 1999

4.9.3 Climate of the Sacramento Valley Basin

Climate data from NOAA/NWS Co-op Network stations are complied in Table 4.9-1 and the location is shown on Figure 4.9-3. Figure 4.9-3 also shows precipitation data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Sacramento Valley Basin does not contain Evaporation Pan, AZMET and SNOTEL/Snowcourse stations. A description of the climate data sources and methods is found in Volume 1, Section 1.3.3.

NOAA/NWS Co-op Network

- Refer to Table 4.9-1A
- There are three NOAA/NWS Co-op network climate stations in the basin.
- Of the three stations, data from different periods of record may be used as shown. The variety of periods may be due to discontinued measurements, date of installation or other availability issues.
- Station elevation ranges from 1,950 feet at Yucca to 3,540 feet at Kingman 2.
- Maximum average temperatures range from 82.4°F at Kingman to 90.9°F at Yucca.
- Minimum average temperatures range from 42.9°F at Kingman 2 to 49.9°F at Yucca.
- Average annual station precipitation is 8.13 inches per year at Yucca and approximately 10 inches per year at the other two stations, with the highest precipitation at the Kingman station, 10.36 inches per year.
- All stations report highest seasonal rainfall in the winter season (January – March).
- The driest season for all stations is spring (April – June).

SCAS Precipitation Data

- See Figure 4.9-3
- Additional precipitation data shows rainfall as high as 16 inches in the Hualapai Mountains on the southeastern boundary of the basin and as low as four inches in the western portion of the basin near Topock.
- Altitude is a factor in precipitation with the highest precipitation in the Hualapai Mountain range and the lowest near the Colorado River. The range of annual precipitation within the basin is 12 inches, which is typical of other basin in the planning area.

Table 4.9-1 Climate Data for the Sacramento Basin

A.NOAA/NWS Co-op Network:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Temperature Range (in F)		Average Total Precipitation (in inches)				
			Max/Month	Min/Month	Winter	Spring	Summer	Fall	Annual
Kingman	3,360	1901-1967	82.4/Jul	43.4/Jan	3.47	1.06	3.30	2.54	10.36
Kingman 2	3,540	1971-2000	82.5/Jul	42.9/Jan	3.64	0.97	3.05	2.34	10.00
Yucca	1,950	1971-2000	90.9/Jul	49.9/Dec, Jan	3.46	0.63	2.40	1.64	8.13

Source: WRCC, 2003.

B. Evaporation Pan:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

Source: WRCC, 2003.

C. AZMET:

Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, in inches (*number of years to calculate averages*)
None			

Source: Arizona Meteorological Network, 2005

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record Used for Averages	Average Snowpack, at Beginning of the Month, as Inches Snow Water Content					
			Jan	Feb	March	April	May	June
None								

Source: Natural Resources Conservation Service, 2005

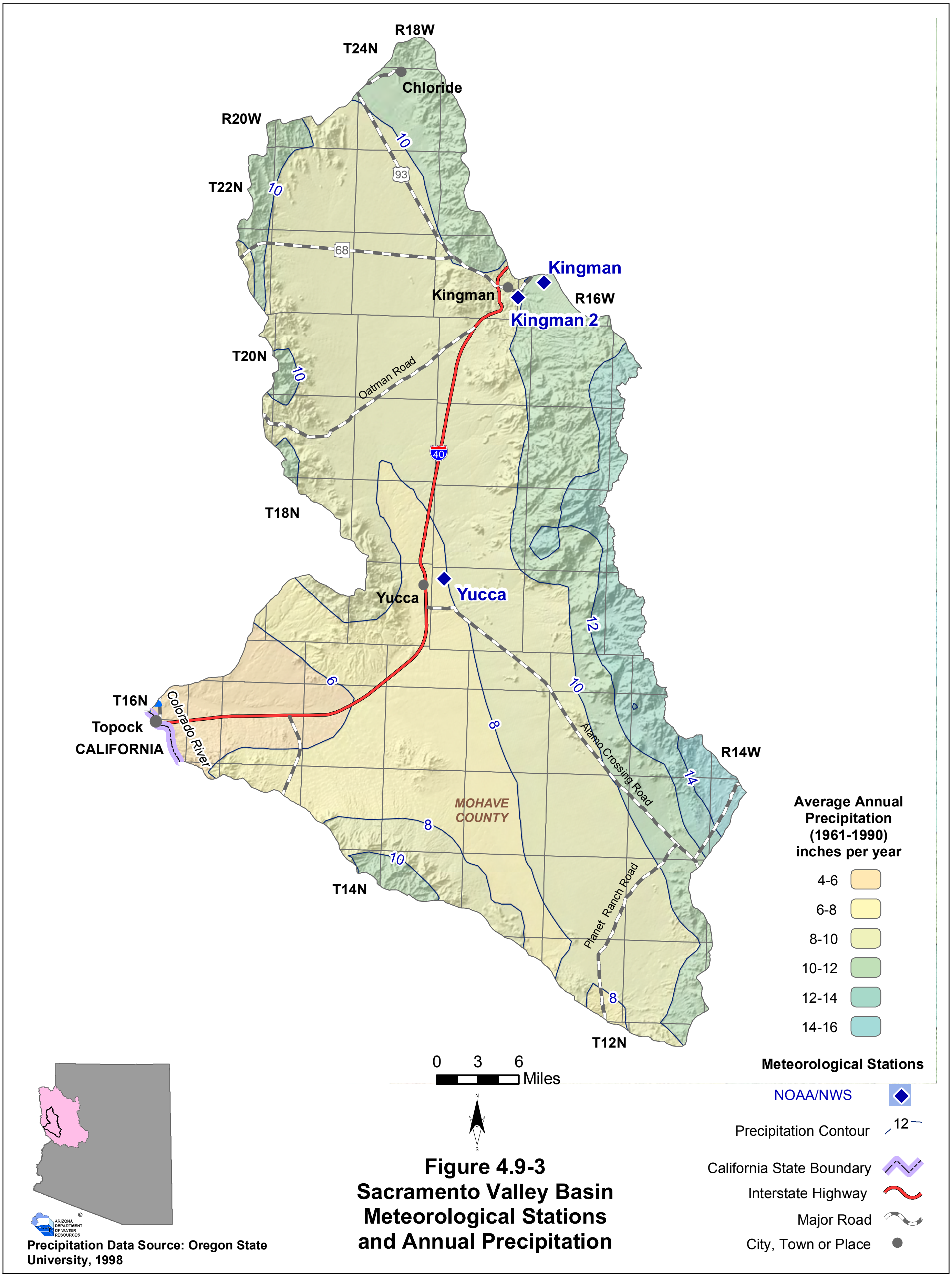


Figure 4.9-3
Sacramento Valley Basin
Meteorological Stations
and Annual Precipitation

4.9.4 Surface Water Conditions in the Sacramento Valley Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 4.9-2. Flood ALERT equipment in the basin is shown in Table 4.9-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.9-4. The location of streamflow gages, using the USGS number, is shown on Figure 4.9-4. The location of large reservoirs and flood ALERT equipment as well as USGS runoff contours are also shown on Figure 4.9-4. A description of stream data sources and methods is found in Volume 1, Section 1.3.16. A description of reservoir data sources and methods is found in Volume 1, Section 1.3.11. A description of stockpond data sources and methods is found in Volume 1, Section 1.3.15.

Streamflow Data

- Refer to Table 4.9-2.
- Data from one station located at the Colorado River near Topock is shown in the table and on Figure 4.9-4. The period of record is from 1917 to 1982.
- The average seasonal flow is highest in the summer (July-September) when 38% of the annual average seasonal flow occurs. The average seasonal flow is lowest in the fall (October-December).
- Maximum annual flow at this station was 21,827,922 acre-feet in 1921 and minimum annual flow was 4,316,354 acre-feet in 1934.

Flood ALERT Equipment

- Refer to Table 4.9-3.
- As of October 2005 there were 12 stations in the basin.
- Of the 12 stations one is a weather station, five are precipitation only stations and six are precipitation/stage stations.

Reservoirs and Stockponds

- Refer to Table 4.9-4.
- The basin contains 5 small reservoirs.
- Total maximum storage for the three small reservoirs with greater than 15 acre-feet and less than 500 acre-feet storage capacity is 110 acre-feet. The remaining two small reservoirs have a total surface area of 16 acres.
- There are an estimated 44 stockponds in this basin.

Runoff Contour

- Refer to Figure 4.3-4.
- Average annual runoff is 0.5 inches per year in the northeastern portion of the basin and decreases to 0.1 in the vicinity of Sacramento Wash and Cow Creek.

Table 4.9-2 Streamflow Data for the Sacramento Valley Basin

Station Number	USGS Station Name	Drainage Area (in mi^2)	Mean Basin Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9424000	Colorado River near Topock	172,300	NA	2/1917-9/1982	19	38	26	17	4,316,354 (1934)	8,926,643	10,636,610	21,827,922 (1921)	64

Sources: USGS NWIS, USGS 1998 and USGS 2003.

Notes:
NA = Not available

Table 4.9-3 Flood ALERT Equipment in the Sacramento Valley Basin

Station ID	Station Name	Station Type	Install Date	Responsibility
1500	Cherum Peak near Chloride	Precipitation	12/3/2001	Mohave County FCD
1510	Upper Sacramento Wash West	Precipitation/Stage	12/4/2001	Mohave County FCD
1520	Upper Sacramento Wash East	Precipitation/Stage	12/3/2001	Mohave County FCD
1530	Willow Spring	Precipitation	12/4/2001	Mohave County FCD
1540	Santa Claus	Precipitation	12/3/2001	Mohave County FCD
1550	Lower Sacramento Wash	Precipitation/Stage	12/5/2001	Mohave County FCD
1650	Holy Moses Wash	Precipitation/Stage	12/4/2001	Mohave County FCD
7520	Hualapai Foothills	Precipitation	NA	Mohave County FCD
7600	Union Pass	Precipitation	NA	Mohave County FCD
7620	Thirteenmile Wash	Precipitation/Stage	NA	Mohave County FCD
7670	Pinion Pines	Weather Station	4/22/2005	Mohave County FCD
7680	MacKenzie Wash	Precipitation/Stage	NA	Mohave County FCD

Notes:
FCD = Flood Control District
NA = Not available

Table 4.9-4 Reservoirs and Stockponds in the Sacramento Valley Basin

A. Large Reservoirs (500 acre-feet capacity and greater)

MAP KEY	RESERVOIR/LAKE NAME (Name of dam, if different)	OWNER/OPERATOR	MAXIMUM STORAGE (AF)	USE[1]	JURISDICTION
None	Havasu (Parker Dam)[2]	Bureau of Reclamation	651,000[3]	H,I,S	Federal

Source: US Army Corps of Engineers 2005, BOR 2006

B. Other Large Reservoirs (50 acre surface area or greater)[3]

MAP KEY	RESERVOIR/LAKE NAME (name of dam, if different)	OWNER/OPERATOR	MAXIMUM SURFACE AREA (acres)	USE	JURISDICTION
None identified by ADWR at this time					

C. Small Reservoirs (greater than 15 acre-feet and less than 500 acre-feet capacity)

Total number: 3
Total maximum storage: 110 acre-feet

D. Other Small Reservoirs (between 5 and 50 acres surface area)[1]

Total number: 2
Total surface area: 16 acres

E. Stockponds (up to 15 acre-feet capacity)

Total number: 44 (from water right filings)

Notes:
[1]H=hydroelectric; I=irrigation; S=water supply
[2]Dam is located in Parker Basin but lake storage is in Lake Havasu and Sacramento Valley Basins
[3] Includes 28,600 acre-feet of dead storage
[4] Capacity data not available to ADWR

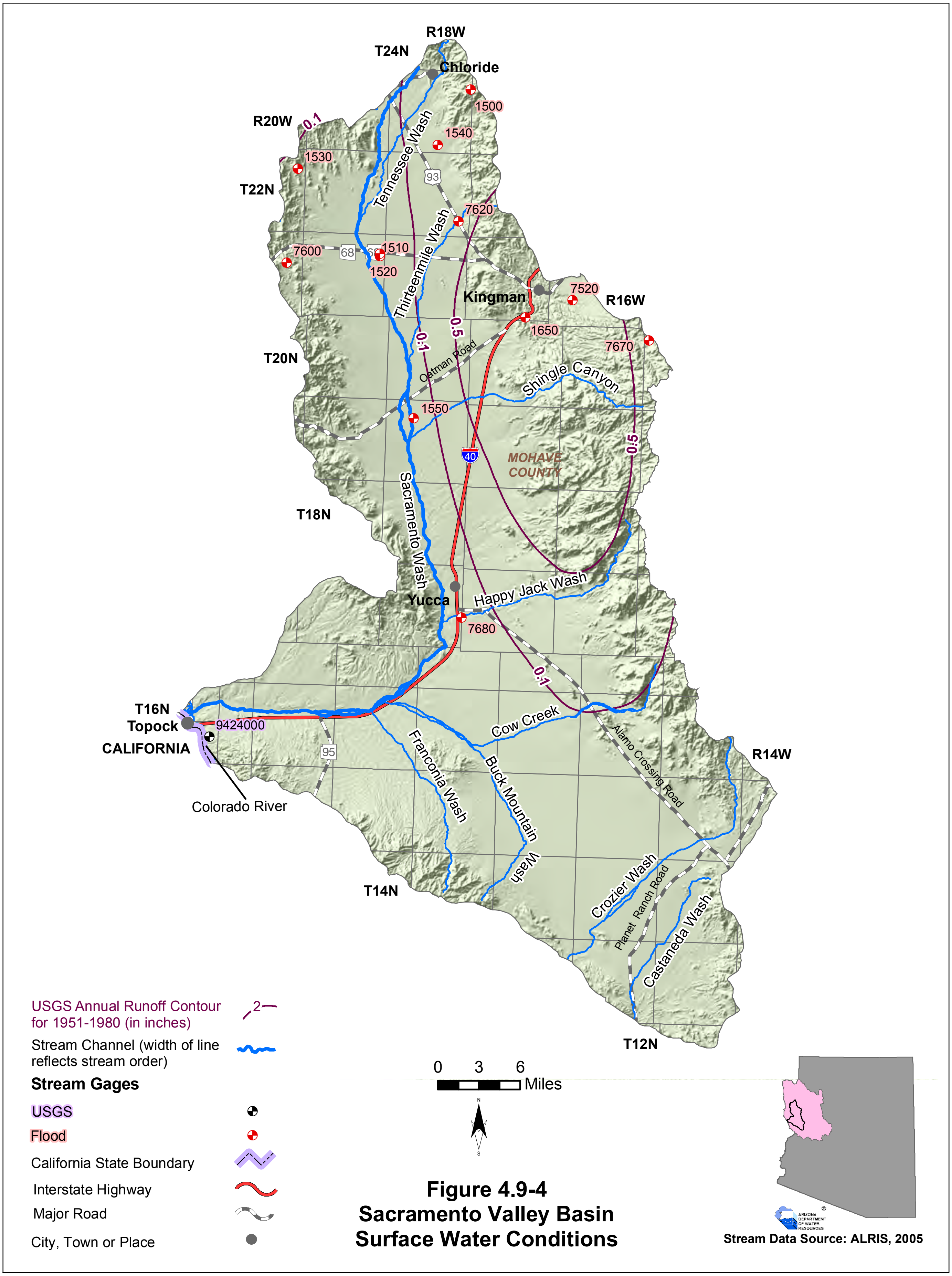


Figure 4.9-4
Sacramento Valley Basin
Surface Water Conditions

4.9.5 Perennial/Intermittent Streams and Major Springs in the Sacramento Valley Basin

Major and minor springs with discharge rates and date of measurement, and the total number of springs in the basin are shown in Table 4.9-5. The locations of major springs are shown on Figure 4.9-5. A description of data sources and methods for intermittent and perennial reaches is found in Volume 1, 1.3.16. A description of spring data sources and methods is found in Volume 1, Section 1.3.14.

- There is one perennial stream, the Colorado River, located along the basin boundary with California.
- There is one intermittent stream, Sawmill Canyon, located along the northeastern basin boundary.
- There are 15 major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time.
- Listed discharge rates may not be indicative of current conditions. All measurements were taken during or prior to 1965 and a number of measurements were taken in 1943.
- All springs are located in the northern half of the basin. The greatest discharge rate was measured north of Kingman (Johnston, 100 gpm) although the latest discharge measurement at this spring was less than 10 gpm.
- All springs discharge 100 gpm or less.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 4.9-5B. There are 42 minor springs identified in this basin.
- The total number of springs identified by the USGS varies from 90 to 100, depending on the database reference.

Table 4.9-5 Springs in the Sacramento Valley Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Johnston	351353	1140424	100[3]	4/1/1943
2	Beale	351348	1142258	90[3]	4/15/1943
3	Unnamed[2]	351231	1140357	50	4/15/1943
4	Cottonwood	351728	1142201	50	1/1965
5	Grapevine	351233	1140535	35	5/13/1943
6	Unnamed[2]	350657	1135918	25	During or Prior to 1965
7	Willow	350243	1135917	20	10/25/1979
8	Gross	352124	1140904	15	During or Prior to 1965
9	Unnamed	351938	1140825	12	1/1/1965
10	Cottonwood	350617	1135858	12	10/25/1979
11	Unnamed[2]	350403	1135500	10	During or Prior to 1965
12	Unnamed	351314	1142258	10	10/12/1979
13	Twin	350210	1141902	10	3/1/1965
14	C	351348	1142258	10[3]	1/1/1965
15	Unnamed	351356	1142320	10	5/1965

B. Minor Springs (1 to 10 gpm):

Name[1]	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Dripping	350349	1141820	8	1/1/1965
Lookout	350704	1140304	7	10/24/1979
Unnamed	351830	1142053	7	10/1943
Willow	351751	1142235	7	1/1965
Burro	351556	1142239	7	1/1965
Cave	350438	1141845	5	10/11/1979
Unnamed	352021	1140718	5	During or Prior to 1965
Unnamed	352009	1140717	5	During or Prior to 1965
Unnamed	351955	1140719	5	During or Prior to 1965
Unnamed	351521	1142153	4	1/1965
Unnamed	350717	1140130	4	1/1965
Unnamed	352206	1140940	4	1/1965
Unnamed	350621	1135352	3	1/1965
Unnamed	345639	1135729	3	12/1964
Unnamed	350030	1135923	3	1/1965
Unnamed	350031	1135905	3	1/1965
Unnamed	345926	1135701	3	1/1965
Unnamed	350616	1135530	3	1/1965
Hackberry	351553	1140605	3	During or Prior to 1949
Little Hberry	345600	1140118	2	12/1964
Unnamed	350336	1135500	2	1/1965
Unnamed	350233	1135731	2	1/1965
Unnamed	350245	1135622	2	1/1965
Unnamed	350621	1135543	2	1/1965
Unnamed	351439	1142154	2	1/1965
Unnamed	352447	1140855	2	During or Prior to 1965

Table 4.9-5 Springs in the Sacramento Valley Basin (con't)

B. Minor Springs (1 to 10 gpm): (con't)

Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Unnamed	352417	1140952	2	During or Prior to 1965
Unnamed	352507	1140940	2	During or Prior to 1964
Caliche	345531	1141313	2[4]	10/24/1979
Unnamed	345852	1140014	1	1/1965
Unnamed	350705	1135315	1	2/1965
Unnamed	350701	1135350	1	2/1965
Unnamed	350454	1135548	1	1/1965
Unnamed	350436	1135530	1	1/1965
Unnamed	350827	1140314	1	1/1965
Unnamed	352127	1140707	1	During or Prior to 1965
Unnamed	352009	1140717	1	During or Prior to 1965
Indian	350856	1140332	1	1/1965
Fig	350424	1141825	1	10/11/1979
Van Martyr	351306	1140437	1	4/27/1978
Jone's Seep	351155	1140428	1	2/27/1979
Unnamed	352000	1140841	1	1/1965

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005 and USGS, 2006): 90 to 100

Notes:
[1]Most recent measurement identified by ADWR
[2]Spring is not displayed on current USGS topo maps
[3]Most recent measurement < 10gpm
[4]Most recent measurement < 1gpm

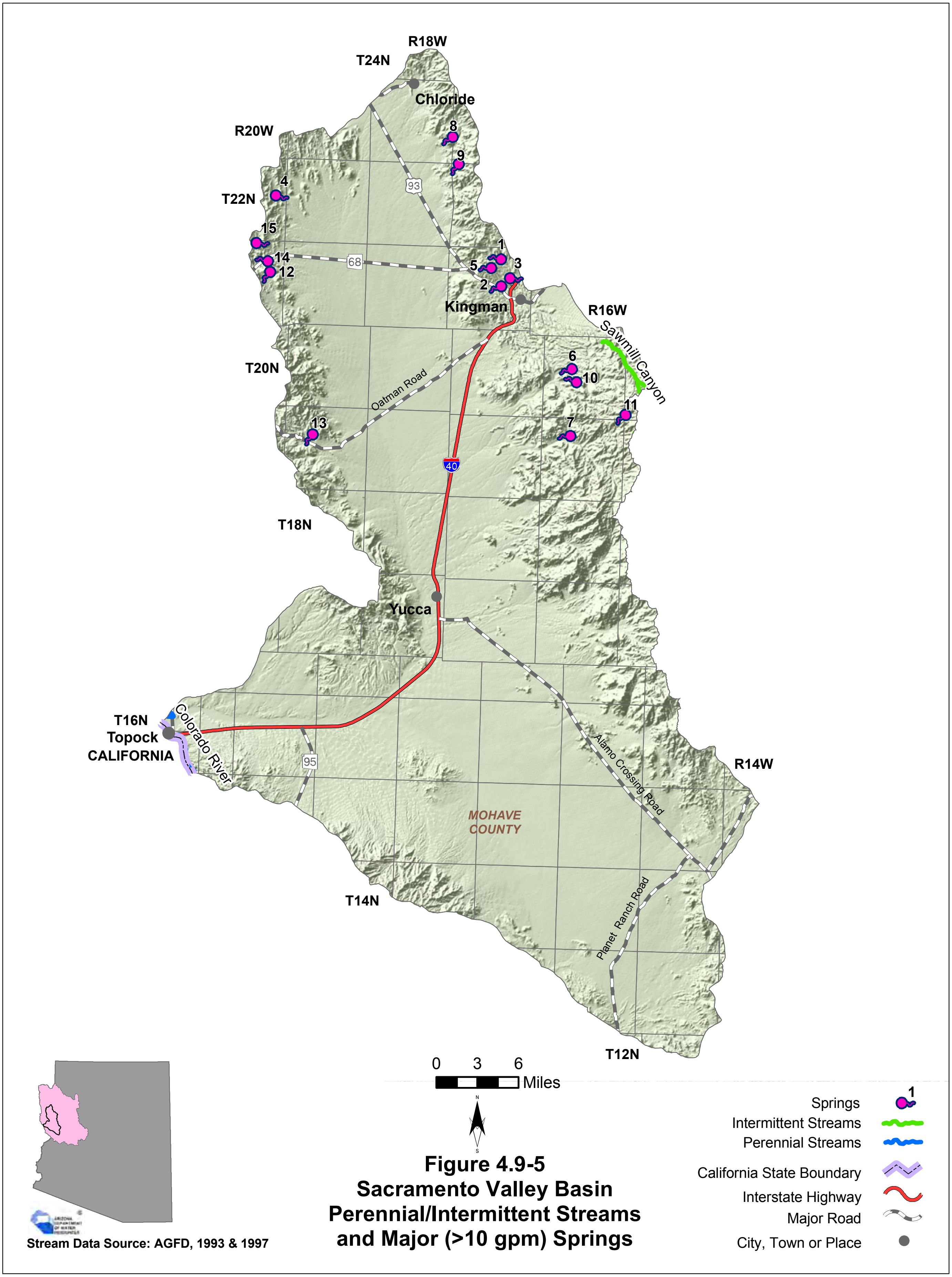


Figure 4.9-5
Sacramento Valley Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

4.9.6 Groundwater Conditions of the Sacramento Valley Basin

Major aquifers, well yields, estimated natural recharge, estimated water in storage, number of index wells and date of last water-level sweep are shown in Table 4.9-6. Figure 4.9-6 shows aquifer flow direction and water-level change between 1990-1991 and 2003-2004. Figure 4.9-7 contains hydrographs for selected wells shown on Figure 4.9-6. Figure 4.9-8 shows well yields in four yield categories. A description of aquifer data sources and methods is found in Volume 1, Section 1.3.2. A description of well data sources and methods, including water-level changes and well yields is found in Volume 1, Section 1.3.19.

Major Aquifers

- Refer to Table 4.9-6 and Figure 4.9-6.
- The major aquifer in this basin is basin fill.
- Flow direction is from the north to the south in the northern portion of the basin and east to west in the southern portion of the basin.

Well Yields

- Refer to Table 4.9-6 and Figure 4.9-8.
- As shown on Figure 4.9-8 well yields in this basin range from less than 100 gallons per minute (gpm) to 2,000 gpm.
- One source of well yield information, based on 36 reported wells, indicates that the median well yield in this basin is 100 gpm.

Natural Recharge

- Refer to Table 4.8-6.
- There are two estimates of natural recharge for this basin ranging from 1,000 acre-feet per year to 4,000 acre-feet per year.
- Most of the recharge in this basin comes from infiltration along the mountain fronts.

Water in Storage

- Refer to Table 4.9-6.
- There are four storage estimates for this basin, ranging from 6.5 million acre-feet (to 1,500 feet) to 14 million acre-feet (to 1,200 feet). The most recent estimate, from a 1994 ADWR study indicated that the basin has between 7 and 8.3 million acre-feet in storage to a depth of 1,200 feet.
- The predevelopment estimate of storage for this basin is 11 million acre-feet to a depth of 1,200 feet.

Water Level

- Refer to Figure 4.9-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures 11 index wells in this basin.
- The Department measures water levels four times daily at one automated groundwater monitoring site in the north-central portion of the basin.
- In 1995, the year of the last water level sweep, 60 wells were measured.

- The deepest recorded water level in the basin is 1,062 feet near Highway 68 and the shallowest is 38 feet east of Topock.
- Hydrographs corresponding to selected wells shown on Figure 4.9-6 but covering a longer time period are shown in Figure 4.9-7.

Table 4.9-6 Groundwater Data for the Sacramento Valley Basin

Basin Area, in square miles:	1,587	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Basin Fill	
	Volcanic Rock	
Well Yields, in gal/min:	Range 94-753 Median 167 (9 wells measured)	Measured by ADWR and/or USGS
	Range 5-1,000 Median 100 (36 wells reported)	Reported on registration forms for large (> 10-inch) diameter wells
	Range 30-100	ADWR (1990)
	Range 0-2,500	USGS (1994)
Estimated Natural Recharge, in acre-feet/year:	1,000	ADWR (1991) (HMS 21)
	4,000	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	7,000,000 - 8,300,000 (to 1,200 ft)	ADWR (1990 and 1994)
	11,000,000[1] (to 1,200 ft)	Freethey and Anderson (1986)
	14,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
	6,500,000 - 13,000,000 (to 1,500 ft)	USGS (1971)
Current Number of Index Wells:	11	
Date of Last Water-level Sweep:	1995 (60 wells measured)	

Notes:
[1]Predevelopment Estimate

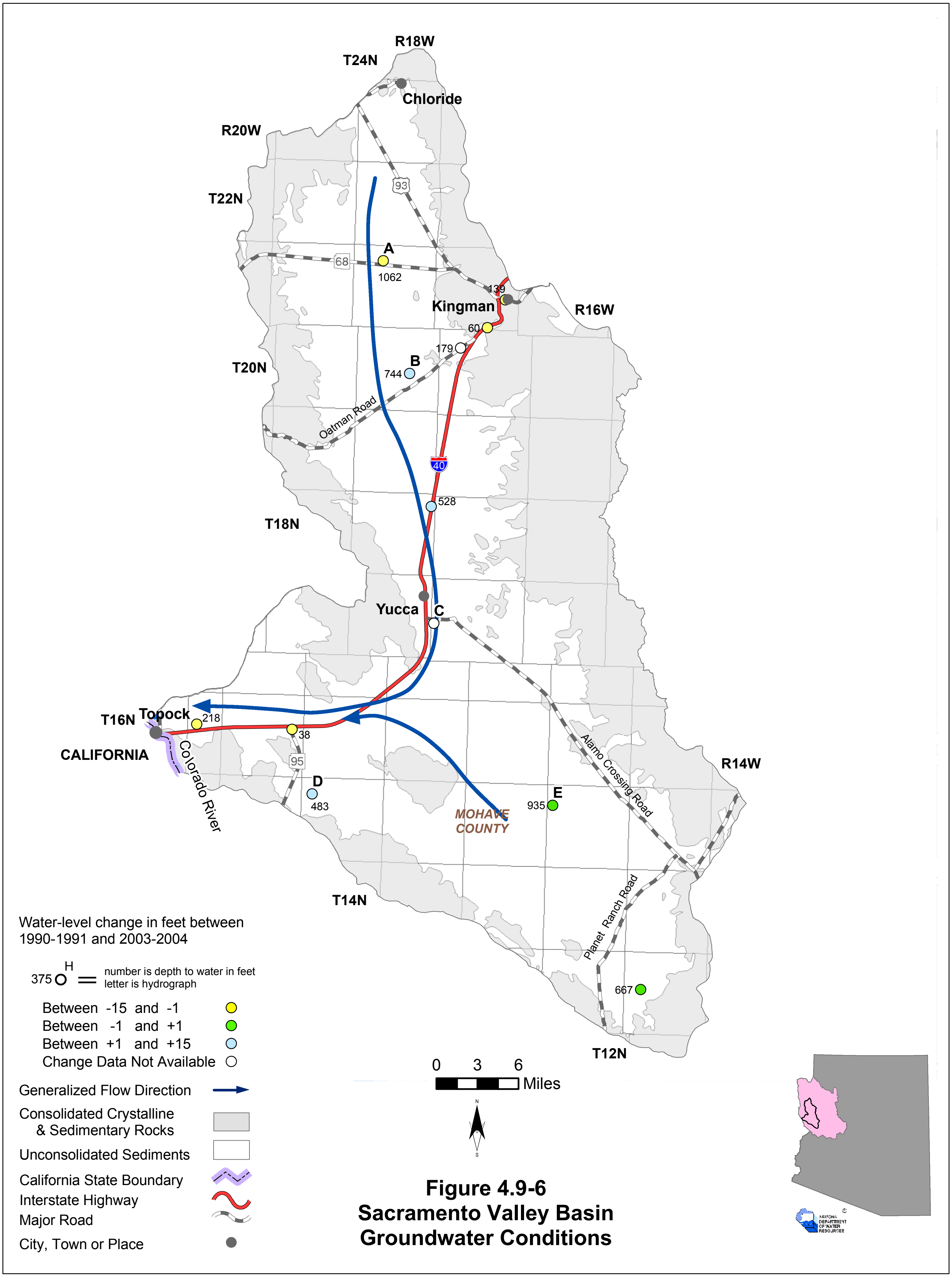
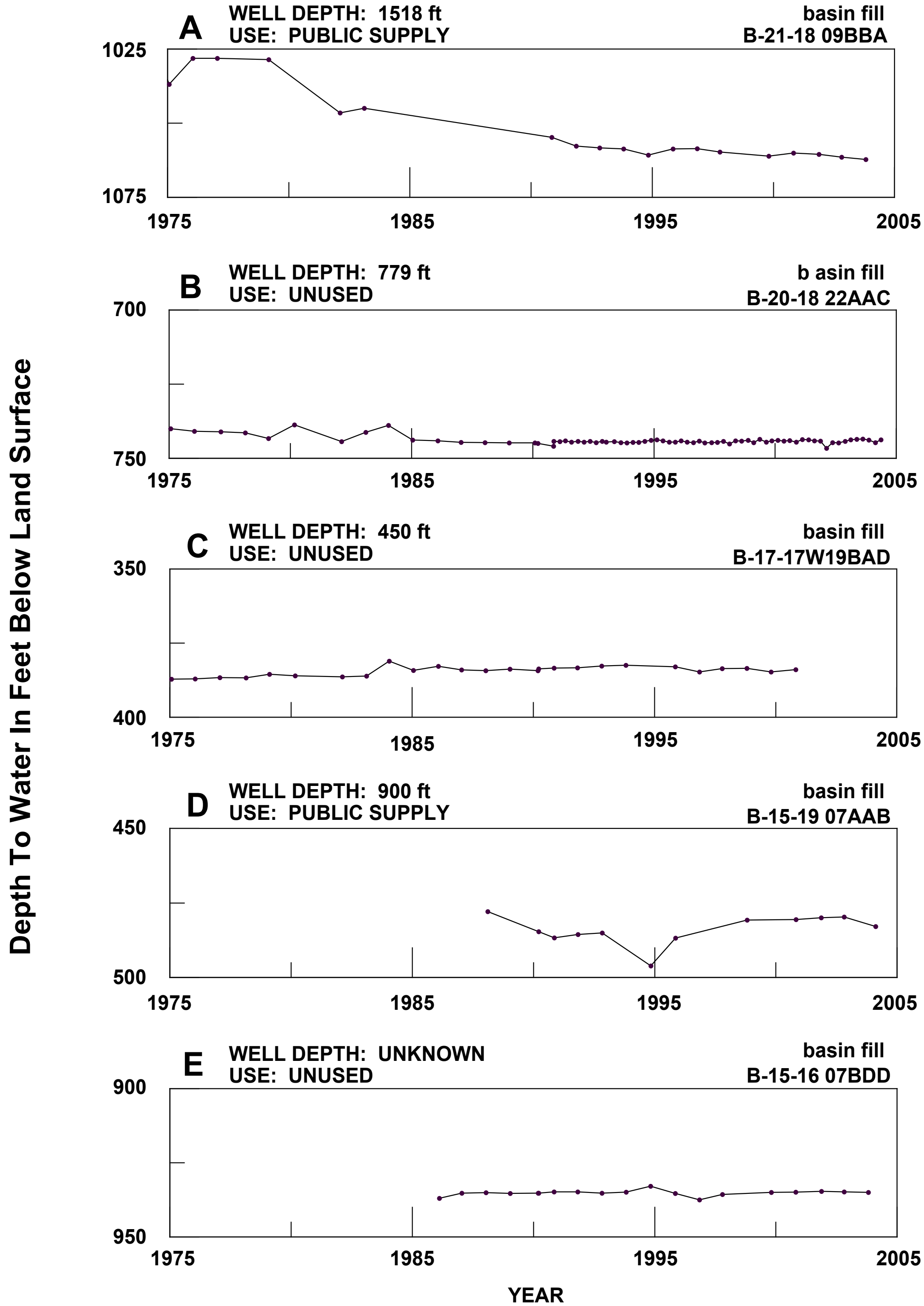


Figure 4.9-6
Sacramento Valley Basin
Groundwater Conditions

Figure 4.9-7
Sacramento Valley Basin
Hydrographs Showing Depth to Water in Selected Wells



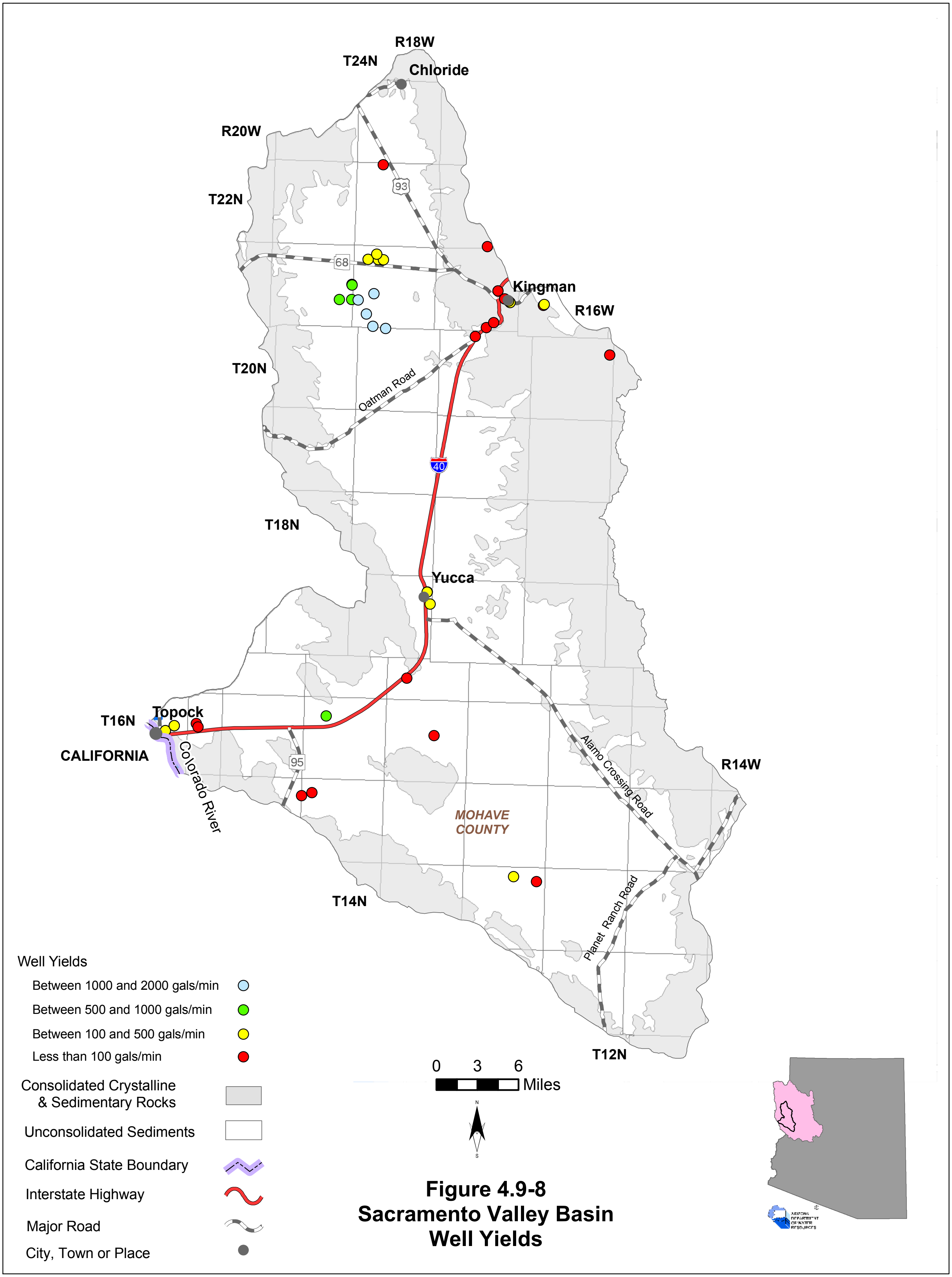


Figure 4.9-8
Sacramento Valley Basin
Well Yields

4.9.7 Water Quality of the Sacramento Valley Basin

Drinking water standard exceedences in wells, springs and mine sites including location and parameter(s) exceeded are shown in Table 4.9-7A. Figure 4.9-9 shows the location of exceedences keyed to Table 4.9-7A as well as the location of an effluent dependent stream reach within the basin. A description of water quality data sources and methods is found in Volume 1, Section 1.3.18. Not all parameters were measured at all sites; selective sampling for particular constituents is common.

Wells, Springs and Mine Sites

- Refer to Table 4.9-7A.
- Drinking water standard exceedences in wells, springs and mine sites have been reported for 62 sites in the basin.
- The drinking water standards for arsenic, fluoride and radionuclides were the most frequently exceeded standards at sites in this basin.
- Arsenic and radionuclide exceedences are found throughout the basin and fluoride exceedences are found in the central and southern portions of the basin.
- Other drinking water standards exceeded in this basin include beryllium, cadmium, copper, chromium, lead, nitrate/nitrite and total dissolved solids.

Effluent Dependent Reaches

- There is one effluent dependent reach in this basin, Holy Moses Wash, south of Kingman.

Table 4.9-7 Water Quality Exceedences in the Sacramento Valley Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Exceeding Drinking Water Standard[2]
		Township	Range	Section	
1	Well	24 North	18 West	33	Rad
2	Well	24 North	18 West	33	Rad
3	Well	24 North	18 West	34	Pb
4	Well	23 North	18 West	3	As, NO3, Rad
5	Well	23 North	18 West	3	As, Rad
6	Well	23 North	18 West	3	NO3, Rad
7	Well	23 North	18 West	3	NO3, Rad
8	Well	23 North	18 West	3	Rad
9	Well	23 North	18 West	3	As
10	Mine	23 North	18 West	3	As, Cd, Pb, TDS
11	Well	23 North	18 West	3	As, NO3
12	Well	23 North	18 West	3	NO3
13	Mine	23 North	18 West	14	Cd, Cu
14	Spring	22 North	17 West	6	As, Rad
15	Mine	22 North	17 West	6	As
16	Well	22 North	17 West	7	Cd, Be, Pb
17	Spring	22 North	17 West	17	As, Rad
18	Well	22 North	17 West	30	NO3
19	Well	22 North	19 West	11	NO3
20	Well	22 North	20 West	35	NO3
21	Well	21 North	17 West	11	NO3
22	Well	21 North	18 West	5	As
23	Well	21 North	18 West	5	Cr
24	Well	21 North	18 West	9	As
25	Well	21 North	18 West	30	As
26	Well	21 North	18 West	32	Pb
27	Well	21 North	19 West	25	As
28	Spring	20 North	17 West	2	As
29	Spring	20 North	19 West	7	Cd
30	Well	20 North	19 West	9	As
31	Well	19 North	16 West	7	F, Rad
32	Well	19 North	17 West	16	F, NO3, Rad
33	Spring	18 North	16 West	25	As, Rad
34	Well	18 North	16 West	26	F, Rad
35	Well	18 North	17 West	11	F, Rad
36	Spring	17 North	15 West	32	As, Rad
37	Well	17 North	16 West	2	F, Rad
38	Well	17 North	18 West	12	As
39	Well	17 North	18 West	25	As
40	Spring	16 North	15 West	20	Rad
41	Well	16 North	15 West	33	F
42	Well	16 North	15 West	36	As
43	Well	16 North	15 West	36	F, Rad
44	Well	16 North	15 West	36	F
45	Well	16 North	16 West	11	As, Rad
46	Well	16 North	16 West	14	F
47	Well	16 North	16 West	14	F, Rad
48	Well	16 North	20 West	14	F
49	Well	16 North	20.5 West	14	F
50	Well	16 North	21West	35	As, Cd, F
51	Well	16 North	21West	35	As, Cd, F
52	Well	16 North	21West	36	As, F
53	Well	15 North	14 west	8	F

Table 4.9-7 Water Quality Exceedences in the Sacramento Valley Basin (cont'd)[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Exceeding Drinking Water Standard[2]
		Township	Range	Section	
54	Well	15 North	15 West	15	As, F, Rad, TDS
55	Well	15 North	15 West	15	Rad
56	Well	15 North	16 West	1	F, Rad
57	Well	14 North	15 West	2	F, Rad
58	Well	14 North	17 West	2	F
59	Well	14 North	17 West	12	F
60	Well	13 North	15 West	12	NO3, Rad
61	Well	13 North	15 West	14	As
62	Well	13 North	15 West	33	Rad

B. Lakes and Streams

Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard	Parameter(s) Exceeding Use Standard
None identified by ADWR at this time						

Notes:

[1] Water quality samples collected between 1978 and 2004.

[2] As = Arsenic
Be = Beryllium
Cd = Cadmium
Cu = Copper
Cr = Chromium
F = Fluoride
Pb = Lead
NO3 = Nitrate/Nitrite
TDS = Total Dissolved Solids
Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium

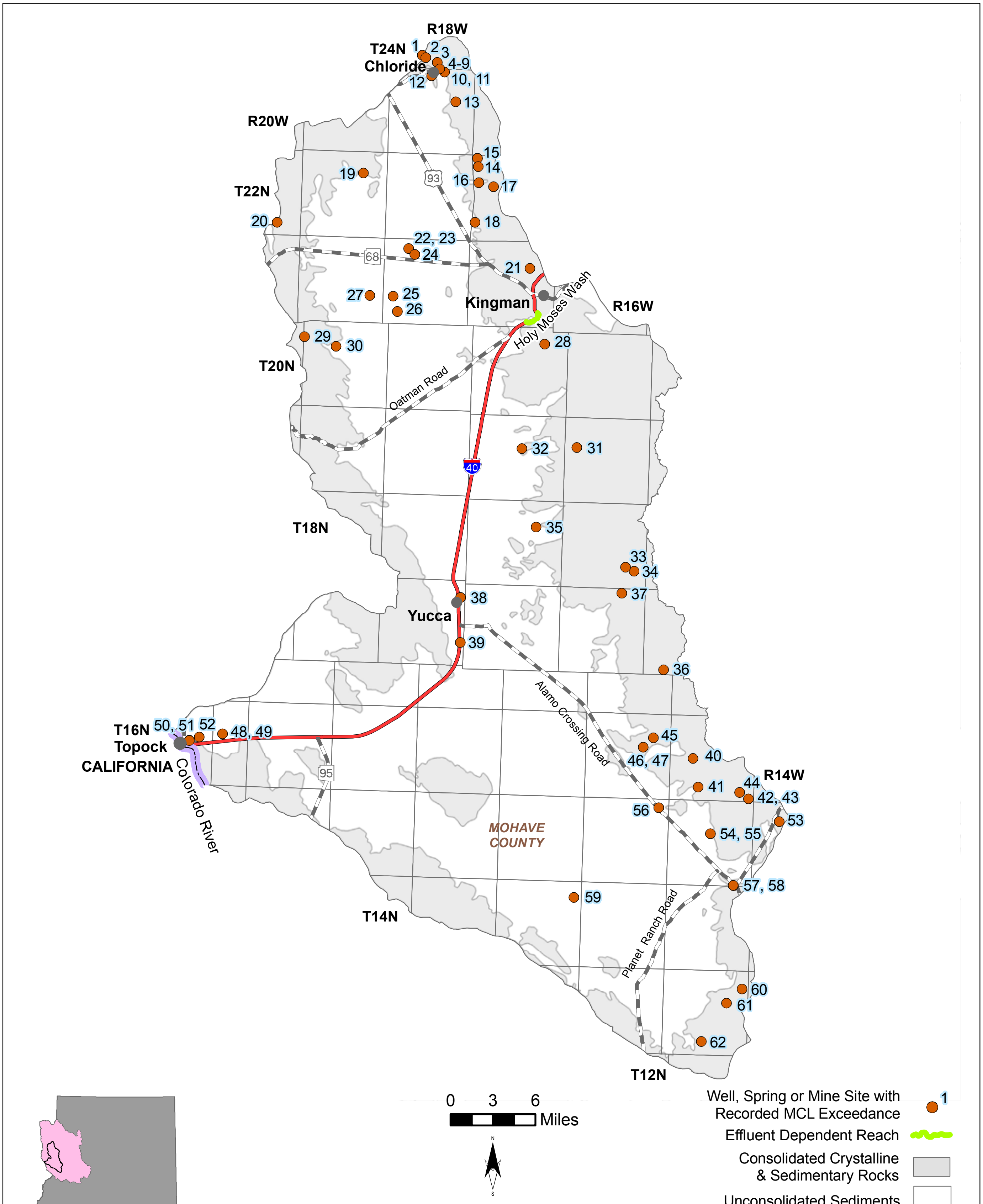


Figure 4.9-9
Sacramento Valley Basin
Water Quality Conditions

4.9.8 Cultural Water Demands in the Sacramento Valley Basin

Cultural water demand data including population, number of wells and the average well pumpage and surface water diversions by the municipal, industrial and agricultural sectors are shown in Table 4.9-8. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 4.9-9. Figure 4.9-10 shows the location of demand centers. A description of cultural water demand data sources and methods is found in Volume 1, Section 1.3.5. More detailed information on cultural water demands is found in Section 4.0.7.

Cultural Water Demands

- Refer to Table 4.9-8 and Figure 4.9-10.
- Population in this basin has more than doubled since 1980, increasing from 7,245 in 1980 to 16,276 in 2000. Projections suggest a similar rate of growth through 2050.
- Groundwater use in this basin decreased from 1971-1990. Between 1991-2003 groundwater demand has increased, with an average of 3,700 acre-feet pumped per year from 2001-2003.
- Most municipal and industrial demand in this basin is in the vicinity of Kingman and around Highway 68 west of Kingman in the Golden Valley unincorporated area.
- Although the City of Kingman is located in this basin, the majority of the water for the City comes from well fields located in the Hualapai Valley Basin. Municipal groundwater demand in this basin has, however, increased from an average of 1,500 acre-feet a year in 1991 to an average of 2,000 acre-feet per year in 2003.
- Groundwater use declines in the 1970's and 1980's can be attributed to the declining use of water by the Mineral Park Mine located south of Chloride.
- Industrial groundwater use has increased in recent years from an average of less than 300 acre-feet per year in 1991 to an average of 1,700 acre-feet per year in 2003.
- There is one power plant, Griffith, located in this basin. The Griffith plant opened in 2002 and is located south of Kingman west of Interstate 40.
- There are no reported surface water diversions for cultural demand in this basin, however, water is diverted for environmental purposes at Topock Marsh in Havasu National Wildlife Refuge.
- As of 2003 there were 905 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 61 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 4.9-9.
- There are four wastewater treatment facilities in this basin.
- Information on population served was available for only one facility and information on effluent generation was available for two facilities. More than 3,500 people are served by these facilities which generate almost 400 acre-feet of effluent per year.
- Of the two facilities with information on the effluent disposal method, one discharges to a watercourse and one discharges to an evaporation pond.

Table 4.9-8 Cultural Water Demands in the Sacramento Valley Basin[1]

<table>
<tr><th rowspan="3">Year</th><th rowspan="3">Recent (Census) and Projected (DES) Population</th><th colspan="2" rowspan="2">Number of Registered Water Supply Wells Drilled</th><th colspan="6">Average Annual Demand (in acre-feet)[2]</th><th rowspan="3">Data Source</th></tr>
<tr><th colspan="3">Well Pumpage</th><th colspan="3">Surface-Water Diversions</th></tr>
<tr><th>Q ≤ 35 gpm</th><th>Q > 35 gpm</th><th>Municipal[3]</th><th>Industrial</th><th>Irrigation</th><th>Municipal</th><th>Industrial</th><th>Irrigation</th></tr>
<tr><td>1971</td><td></td><td rowspan="10">332[4]</td><td rowspan="10">37[4]</td><td colspan="3" rowspan="5">6,000</td><td colspan="3" rowspan="5">NR[5]</td><td rowspan="20">ADWR (1994)</td></tr>
<tr><td>1972</td><td></td></tr>
<tr><td>1973</td><td></td></tr>
<tr><td>1974</td><td></td></tr>
<tr><td>1975</td><td></td></tr>
<tr><td>1976</td><td></td><td colspan="3" rowspan="5">7,000</td><td colspan="3" rowspan="5">NR</td></tr>
<tr><td>1977</td><td></td></tr>
<tr><td>1978</td><td></td></tr>
<tr><td>1979</td><td></td></tr>
<tr><td>1980</td><td>7,245</td></tr>
<tr><td>1981</td><td>7,578</td><td rowspan="5">63</td><td rowspan="5">2</td><td colspan="3" rowspan="5">3,000</td><td colspan="3" rowspan="5">NR</td></tr>
<tr><td>1982</td><td>7,911</td></tr>
<tr><td>1983</td><td>8,244</td></tr>
<tr><td>1984</td><td>8,577</td></tr>
<tr><td>1985</td><td>8,910</td></tr>
<tr><td>1986</td><td>9,243</td><td rowspan="5">61</td><td rowspan="5">4</td><td colspan="3" rowspan="5">2,000</td><td colspan="3" rowspan="5">NR</td></tr>
<tr><td>1987</td><td>9,576</td></tr>
<tr><td>1988</td><td>9,909</td></tr>
<tr><td>1989</td><td>10,242</td></tr>
<tr><td>1990</td><td>10,575</td></tr>
<tr><td>1991</td><td>11,145</td><td rowspan="5">133</td><td rowspan="5">11</td><td rowspan="5">1,500</td><td rowspan="5"><300</td><td rowspan="5">NR</td><td colspan="3" rowspan="5">NR</td><td rowspan="13">USGS (2005)</td></tr>
<tr><td>1992</td><td>11,715</td></tr>
<tr><td>1993</td><td>12,285</td></tr>
<tr><td>1994</td><td>12,855</td></tr>
<tr><td>1995</td><td>13,425</td></tr>
<tr><td>1996</td><td>13,995</td><td rowspan="5">168</td><td rowspan="5">5</td><td rowspan="5">1,800</td><td rowspan="5">200</td><td rowspan="5">NR</td><td colspan="3" rowspan="5">NR</td></tr>
<tr><td>1997</td><td>14,565</td></tr>
<tr><td>1998</td><td>15,136</td></tr>
<tr><td>1999</td><td>15,706</td></tr>
<tr><td>2000</td><td>16,276</td></tr>
<tr><td>2001</td><td>16,598</td><td rowspan="3">66</td><td rowspan="3">0</td><td rowspan="3">2,000</td><td rowspan="3">1,700</td><td rowspan="3">NR</td><td colspan="3" rowspan="3">NR</td></tr>
<tr><td>2002</td><td>16,920</td></tr>
<tr><td>2003</td><td>17,243</td></tr>
<tr><td>2010</td><td>19,498</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2020</td><td>22,774</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2030</td><td>25,234</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2040</td><td>26,798</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>2050</td><td>28,031</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">***ADDITIONAL WELLS:[6]***</td><td>**82**</td><td>**2**</td><td colspan="7"></td></tr>
<tr><td colspan="2">***WELL TOTALS:***</td><td>**905**</td><td>**61**</td><td colspan="7"></td></tr>
</table>

Notes:
NR = Not reported
[1] Does not include evaporation losses from stockponds and reservoirs.
[2] Includes pumpage and diversion of Colorado River Contract Water.
[3] The majority of the water for the City of Kingman comes from well fields in the Hualapai Valley Basin
[4] Includes all wells through 1980.
[5] The 1994 ADWR Arizona Water Resources Assessment included surface water diversions for this basin for the Havasu National Wildlife Refuge.
[6] Other water-supply wells are listed in the ADWR Well Registry for this basin, but they do not have completion dates. These wells are summed here.

Table 4.9-9 Effluent Generation in the Sacramento Valley Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water - course	Evaporation Pond	Irrigation	Golf Course/Turf Irrigation	Wildlife Area	Discharged to Another Facility	Infiltration Basins			
Arizona Gateway WWTP	AZ American Water	Franconia	NA	125		X						Primary	NA	2004
Kingman - Downtown WWTP	City of Kingman	Kingman	3,590	258	X							Secondary	5,335	2004
Pilot Travel Center #221	Private	Franconia	NA											
Sacramento Rd WWTP	Private	Griffith Power Plant	NA											
Total			3,590	383										

Notes:
NA: Data not currently available to ADWR
WWTP: Waste Water Treatment Plant
Adv. Tr. 1: Advanced treatment level 1

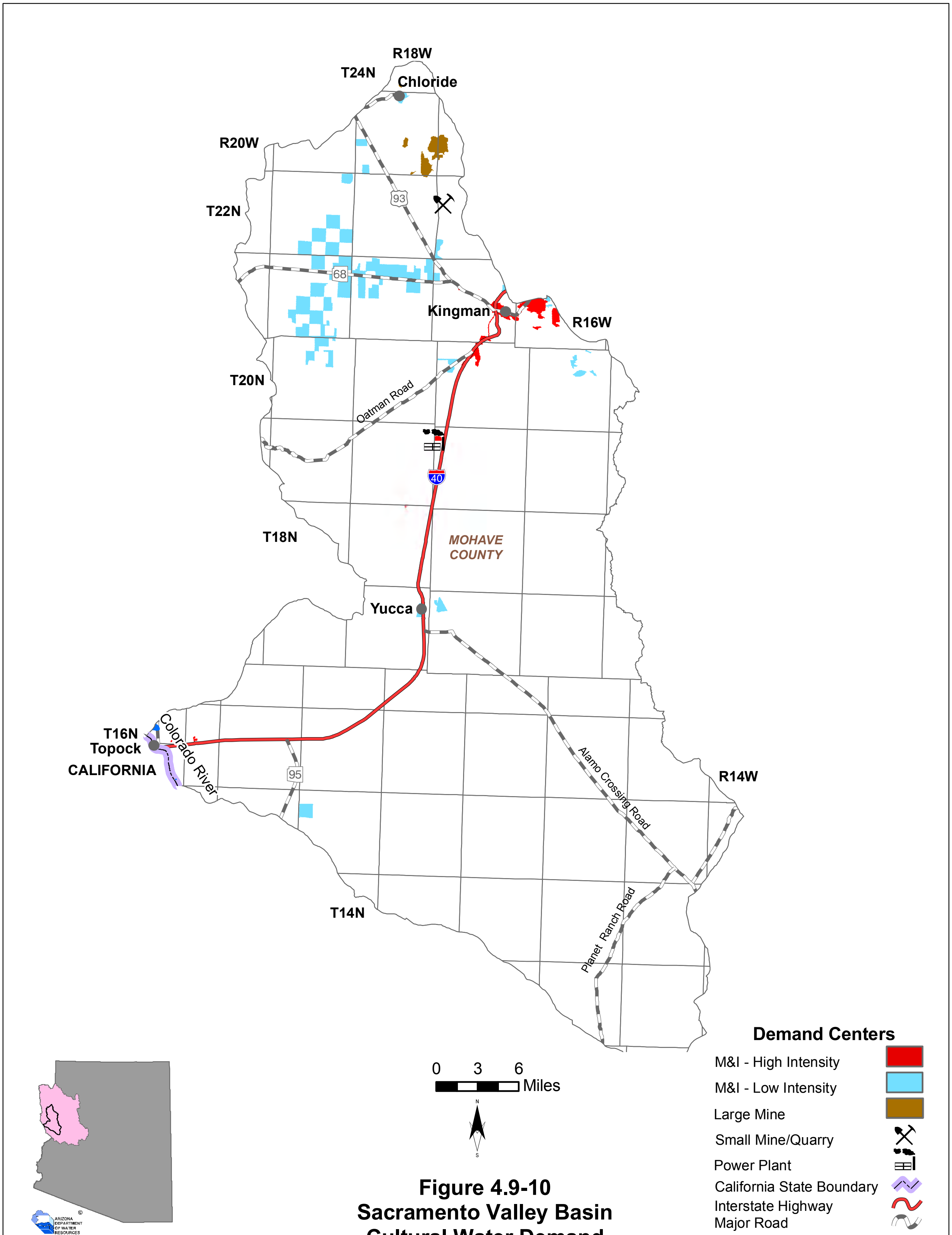


Figure 4.9-10
Sacramento Valley Basin
Cultural Water Demand

Primary Data Source: USGS National Gap Analysis Program, 2004

4.9.9 Water Adequacy Determinations in the Sacramento Valley Basin

Water adequacy determination information including the subdivision name, location, number of lots, adequacy determination, reason for the inadequacy determination, date of determination and subdivision water provider are shown in Table 4.9-10. Figure 4.9-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix A. Adequacy determination data sources and methods are found in Volume 1, Sections 1.3.1.

Water Adequacy Reports

- See Table 4.9-10A
- A total of 29 water adequacy determinations have been made in this basin through December 2006.
- 18 determinations of inadequacy have been made; these determinations are located throughout the basin.
- The most common reason for an inadequacy determination was based on the applicant's decision not to submit necessary information and/or available hydrologic data was insufficient to make a determination.
- Other reasons for an inadequacy determination were insufficient supply, insufficient infrastructure and water quality.
- All lots receiving an adequacy determination are in Mohave County. The total number of lots receiving a water adequacy determination is not available. Of the 4,083 lots in 27 subdivisions, 1,012 lots or 25% were adequate.

Analysis of Adequate Water Supply

- See Table 4.9-10B
- Two analysis of adequate water supply have been issued for this basin. One for 32,000 lots and the other for 33,500 lots. For more information on analysis of adequate water supply see Section 4.0.9.

Table 4.9-10 Adequacy Determinations in the Sacramento Valley Basin[1]

A. Water Adequacy Reports

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Arizona Gateway	Mohave	16 North	20 West	13	51	22-400703	Adequate		06/11/02	Arizona American Water Company (Citizens)
2	Black Hills Ranchos Tract 3301	Mohave	21 North	19 West	14	23		Adequate		03/15/95	Golden Valley Improvement District # 1
3	Desert Shadows Ranchos	Mohave	17 North	17 West	9, 15, 25, 33, 35	947		Inadequate	A1, A3	05/20/88	Dry Lot Subdivision
4	Desert Shadows Ranchos of Az # 2	Mohave	17 North	17 West	31	12		Adequate		08/23/91	Dry Lot Subdivision
5	Friendly Golden Valley # 1	Mohave	21 North	18 West	17	63		Adequate		09/14/93	Valley Pioneer Water Company
6	Holiday Shores # 7	Mohave	20 North	18 West	18	92		Adequate		07/29/77	Oasis Utility Company
7	Lake Havasu Estates Unit 8	Mohave	17 North	17 West	35	NA		Inadequate	A1	10/14/93	Dry Lot Subdivision
8	Lake Havasu Estates Unit 9	Mohave	17 North	17 West	25	120	22-400425	Inadequate	A1	11/21/00	Dry Lot Subdivision
9	Lake Havasu Estates Unit 9	Mohave	17 North	17 West	25	27	22-401941	Inadequate	A1	12/13/05	Dry Lot Subdivision
10	Lake Havasu Estates Unit 13	Mohave	17 North	16 West	31	184	22-400427	Inadequate	A1	11/21/00	Dry Lot Subdivision
11	Lake Havasu Estates Unit 14	Mohave	17 North	16 West	29	372	22-400428	Inadequate	A1	11/21/00	Dry Lot Subdivision
12	Lake Havasu Estates Unit 15	Mohave	17 North	16 West	17	NA		Inadequate	A1	10/21/93	Dry Lot Subdivision
13	Lake Havasu Heights	Mohave	15 North	19 West	7	21	22-400745	Inadequate	A2, B, C	08/16/02	Havasu Heights Domestic Water ID
14	Lake Mohave Knoll Estates	Mohave	23 North	18 West	21	127	22-401592	Inadequate	D	12/07/04	Dry Lot Subdivision
15	Last Lap Subdivision	Mohave	15 North	17 West	31	23	22-400014	Inadequate	A1	02/25/99	Dry Lot Subdivision
16	Paradise (Units) Sun West Acres (Unit 3)	Mohave	20 North	18 West	19, 21, 27, 29, 31, 33, 35	862	22-300149	Inadequate	A1, A2	06/25/96	Dry Lot Subdivision
17	Pioneer Valley	Mohave	18 North	18 West	35	64	22-401383	Adequate		08/02/04	Dry Lot Subdivision
18	Pioneer Valley and Paradise Trails Tract 3802	Mohave	18 North	18 West	35, 25	232	22-401816	Adequate		08/15/05	Double R Water Distributors, Inc.
19	Rancho Verde Estates	Mohave	21 North	18 West	17	60		Adequate		08/11/86	Valley Pioneers Water Company
20	Rancho Verde Estates # 2	Mohave	21 North	18 West	17	263		Adequate		02/05/88	Valley Pioneers Water Company
21	Sagebrush Trails Estate	Mohave	14 North	17 West	3	97	22-401821	Adequate		10/06/05	Sagebrush Trails Domestic Water ID
22	Santa Claus Acres # 2	Mohave	23 North	18 West	19	64		Inadequate	A2, A3	09/10/92	Dry Lot Subdivision
23	Sawmill Creek Tract 3049	Mohave	20 North	16 West	2	13	22-300039	Inadequate	A1	08/04/95	Dry Lot Subdivision
24	Walnut Creek Estates	Mohave	20 North	17 West	7	73	22-400727	Inadequate	A1	05/29/02	Walnut Creek Water Company, Inc.
25	Walnut Creek Estates # 1	Mohave	20 North	17 West	7	42		Inadequate	A1	02/22/85	Unformed water company
26	Walnut Creek Estates # 2	Mohave	20 North	17 West	7	109		Inadequate	A1	03/14/88	Walnut Creek Water Company, Inc.

Table 4.9-10 Adequacy Determinations in the Sacramento Valley Basin (cont'd)[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
27	Walnut Creek Estates Unit 2 Tract 3043A	Mohave	20 North	17 West	7	43		Inadequate	D	11/30/94	Walnut Creek Water Company, Inc.
28	Walnut Creek Estates Unit 3 Tract 3043B	Mohave	20 North	17 West	7	44	22-400258	Inadequate	A1	03/28/00	Walnut Creek Water Company, Inc.
29	Yucca Vista # 2	Mohave	16 North	19 West	11	55		Adequate		02/21/92	Dry Lot Subdivision

B. Analysis of Adequate Water Supply

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section				
a	Golden Valley 5800	Mohave	21 North	18 West	34	32,000	23-401823	10/19/05	NA
b	Sterling Arizona Villages I, II, II and IV	Mohave	16 North	19 West	18	33,500	23-300230	11/08/06	Sterling Water Company

Notes:

[1] Each determination of the adequacy of water supplies available to a subdivision is based on the information available to ADWR and the standards of review and policies in effect at the time the determination was made. In some cases, ADWR might make a different determination if a similar application were submitted today, based on the hydrologic data and other information currently available, as well as current rules and policies.

[2] Prior to February 1995, ADWR did not assign file numbers to applications for adequacy determination.

[3] A. Physical/Continuous
1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
2) Insufficient Supply (existing water supply unreliable or physically unavaible; for groundwater, depth-to-water exceeds criteria)
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)
B. Legal (applicant failed to demonstrate a legal right to use the water or failed to demonstrate the provider's legal authority to serve the subdivision)
C. Water Quality
D. Unable to locate records

NA= Data not currently available to ADWR

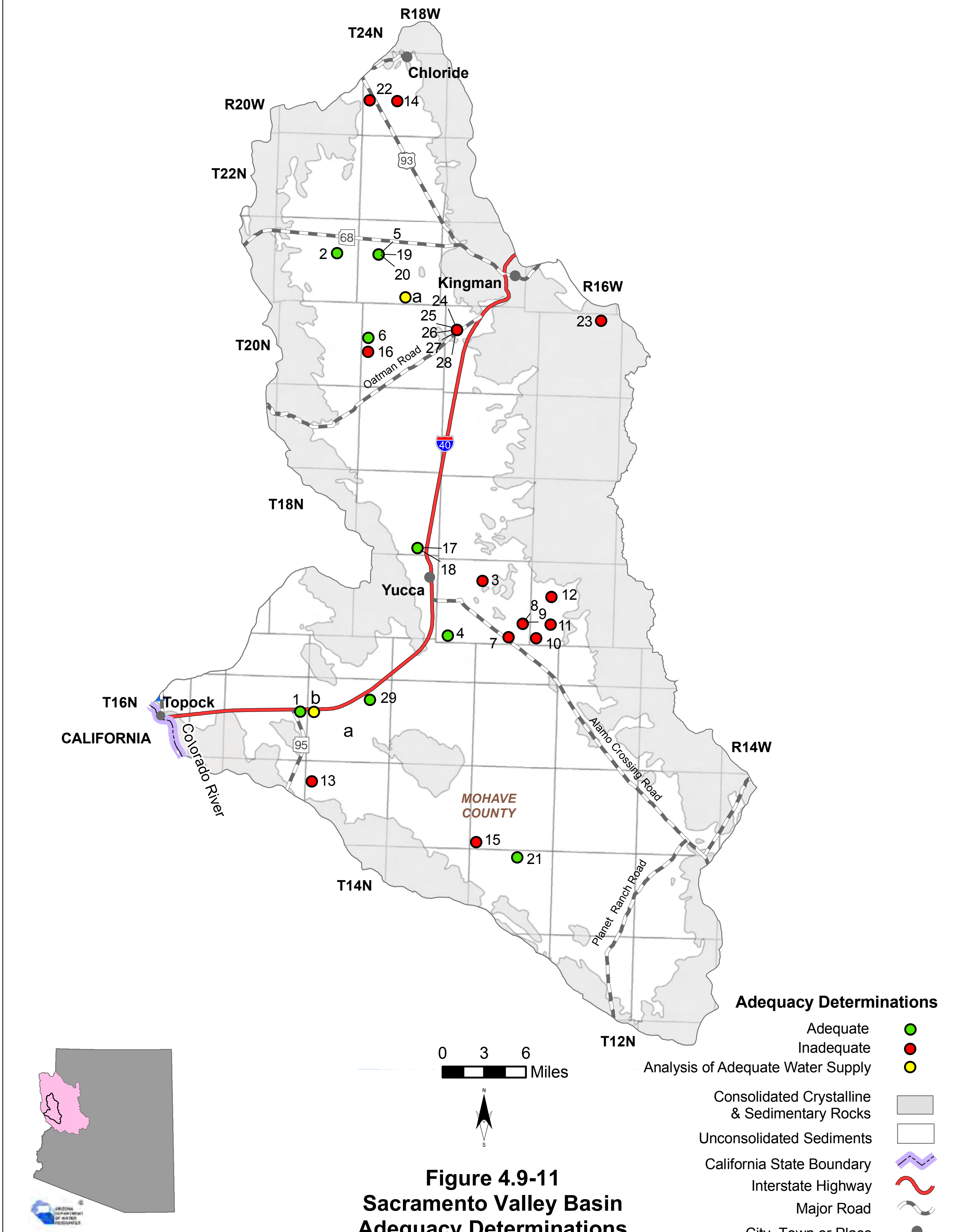


Figure 4.9-11
Sacramento Valley Basin
Adequacy Determinations

Sacramento Valley Basin
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ACRONYMS AND ABBREVIATIONS

AAWS	Analysis of Adequate Water Supply
ACC	Arizona Corporation Commission
ADMMR	Arizona Department of Mines and Mineral Resources
ADWR	Arizona Department of Water Resources
ADEQ	Arizona Department of Environmental Quality
AGFD	Arizona Game and Fish Department
ALERT	Automated Local Evaluation in Real Time
ALRIS	Arizona Land Resource Information System
AMA	Active Management Area
AWBA	Arizona Water Banking Authority
AWPF	Arizona Water Protection Fund
AZMET	Arizona Meteorological Network
BIA	United States Bureau of Indian Affairs
BLM	United States Bureau of Land Management
BOR	United States Bureau of Reclamation
BPCA	Boulder Canyon Project Act
CAP	Central Arizona Project
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CLIMAS	Climate Assessment for the Southwest
DES	Arizona Department of Economic Security
DOD	United States Department of Defense
ENSO	El Niño-Southern Oscillation
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FCD	Flood Control District
GIS	Geographic Information System
gpcd	Gallons per capita per day
gpm	Gallons per minute
GWSI	Groundwater Site Inventory System
HUC	Hydrologic Unit Code
ITCA	Intertribal Council of Arizona
LUST	Leaking Underground Storage Tank
maf	Million acre-feet
MCWA	Mohave County Water Authority
M&I	Municipal and Industrial
MSCP	Multi-Species Conservation Program (Colorado River)
MVIDD	Mohave Valley Irrigation and Drainage District
NEMO	Non-point Education for Municipal Officials
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NPS	United States National Park Service
NRA	National Recreation Area
NRCD	Natural Resources Conservation District

NRCS	Natural Resources Conservation Service
NWIS	National Water Information System
NWR	National Wildlife Refuge
NWS	National Weather Service
Pan ET	Pan Evaportranspiration
PDO	Pacific Decadal Oscillation
RCRA	Resource Conservation and Recovery Act
SCAS	Spatial Climate Analysis Service
SNOTEL	SNOpack TELemetry
SX/EW	Solvent extraction/electrowinning
TDS	Total Dissolved Solids
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VRP	Voluntary Remediation Program
WIFA	Water Infrastructure Finance Authority
WQARF	Water Quality Assurance Revolving Fund
WRCC	Western Regional Climate Center
WWTF	Wastewater Treatment Facility
WWTP	Wastewater Treatment Plant

Appendix A

APPENDIX A: Arizona Water Protection Fund projects in the Upper Colorado River Planning Area through 2005

UPPER COLORADO RIVER PLANNING AREA				
Groundwater Basin	**Map Number**	**AWPF Grant #**	**Project Title**	**Project Category**
Big Sandy	**262**	00-100	Willow Creek Riparian Restoration Project	Revegetation
Bill Williams	**93**	96-0017	Big Sandy River Riparian Project	Fencing
Bill Williams	**151**	96-0021	Riparian Vegetation and Stream Channel Changes Associated with Water Management along the Bill Williams River	Research
Bill Williams	**244**	99-085	Kirkland Creek Watershed Resource Assessment	Feasibility Study
Bill Williams	**268**	00-106	Tres Alamos Dirt-Tanks-To-Aquatic-Habitat-Conversion	Fencing & Upland Channel Restoration
Lake Mohave	**232**	99-073	Colorado River Nature Center Backwater --- Phase 2	Feasibility Study

Source: ADWR 2005e

Appendix B

APPENDIX B: Rural Watershed Partnerships in the Upper Colorado River Planning Area - participants, projects, accomplishments and issues (2005)

UPPER COLORADO RIVER PLANNING AREA			
Watershed Partnership	**Primary Participants**	**Projects & Accomplishments**	**Issues**
Northwest Arizona Watershed Council	Kingman Mohave County Dolan Springs Dolan Springs Water Co. Local citizens Hualapai Nation ADWR ADEQ Cooperative Extension BLM USFS USGS	• Groundwater reconnaissance survey of 3 basin area. • Coordinated the clean-up of numerous wildcat dump sites. • Water Resource Management Plan for watershed area initiated. • Comprehensive groundwater study and conceptual model initiated. • Relative gravity survey of Detrital Basin.	• Limited groundwater supplies • Huge growth projected for all three basins. • Detrital Basin envisioned as bedroom community of Las Vegas with the completion of the bypass bridge over the Colorado River. • Drought impact on private water suppliers, which impacts water haulers • Potential for subsidence from proposed development • Limited groundwater data. • Potential impact from large industrial users in the Big Sandy basin • Water quality concerns (hexavalent Chromium) • Potential problems with developments proposed within the Colorado River accounting surface area • Mohave County claims they will deny any subdivision that cannot obtain adequate water supply determination • Limited funding resources for planning, projects, infrastructure and studies

UPPER COLORADO RIVER PLANNING AREA			
Watershed Partnership	**Primary Participants**	**Projects & Accomplishments**	**Issues**
Upper Bill Williams Partnership (Currently not active)	Skull Valley Yarnell Peeples Valley Yavapai County Local Ranchers ADWR	• Preliminary water budget developed.	• Concern about Prescott potentially transferring water from the basin • Highly vulnerable to drought impacts on both surface and groundwater supplies • Poor infrastructure for private water suppliers • Limited financial capability to upgrade infrastructure • Little or no groundwater data • Cultural opposition to understanding status of water supply • Growth • Unregulated lot splits • Limited groundwater supplies • Limited funding resources for planning, projects, infrastructure and studies