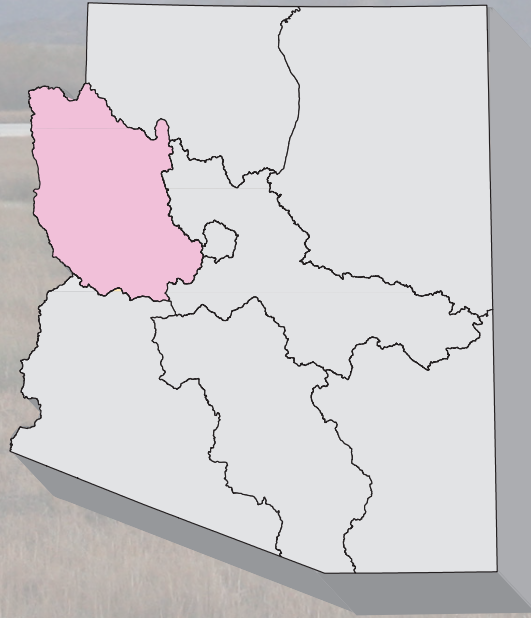




ARIZONA WATER ATLAS

VOLUME 4

UPPER COLORADO RIVER PLANNING AREA



ACKNOWLEDGEMENTS

Herbert Guenther

Director, Arizona Department of Water Resources

Karen Smith

Deputy Director, Arizona Department of Water Resources

Tom Carr

Assistant Director, Statewide Water Conservation and Strategic Planning

Sandra Fabritz-Whitney

Assistant Director, Water Management

Atlas Team

Linda Stitzer, Rich Burtell – Project Managers

Phyllis Andrews

Carol Birks

Kelly Mott Lacroix

Joe Stuart

Major Contributors

John Fortune

Leslie Graser

William H. Remick

Saeid Tadayon-USGS

Other Contributors

Matt Beversdorf

Patrick Brand

Roberto Chavez

Jenna Gillis

Laura Grignano (Volume 8)

Pam Nagel (Volume 8)

Mark Preszler

Kenneth Seasholes (Volume 8)

Jeff Tannler (Volume 8)

Larri Tearman

Dianne Yunker

Climate

Gregg Garfin - CLIMAS, University of Arizona

Ben Crawford - CLIMAS, University of Arizona

Casey Thornbrugh - CLIMAS, University of Arizona

Michael Crimmins – Department of Soil, Water and Environmental
Science, University of Arizona

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Special note about the Atlas Team

Completion of the Atlas would not have been possible without the dedicated professionals that compose the Atlas Team. Most have been involved with the project from its inception in 2003 and their contributions to the success of the project cannot be overstated.

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ARIZONA WATER ATLAS VOLUME 4 –UPPER COLORADO RIVER PLANNING AREA

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 to identify the needs of communities. The Atlas also indicates where data are lacking and further investigation may be needed.

The Atlas divides Arizona into seven planning areas (Figure 4.0-1). There is a separate Atlas volume for each planning area, an executive summary volume composed of background information, and a resource sustainability 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 found in Volume 1. Also included in Volume 1 is general background information for the state, a description of data sources and methods of analysis for the tables and maps presented in the Atlas, and appendices that provide information on water law, management and programs, and Indian water rights claims and settlements.

There are additional, more detailed data available to those presented in this volume. These data may be obtained by contacting the Arizona Department of Water Resources (Department).

4.0 Overview of the Upper Colorado River Planning Area

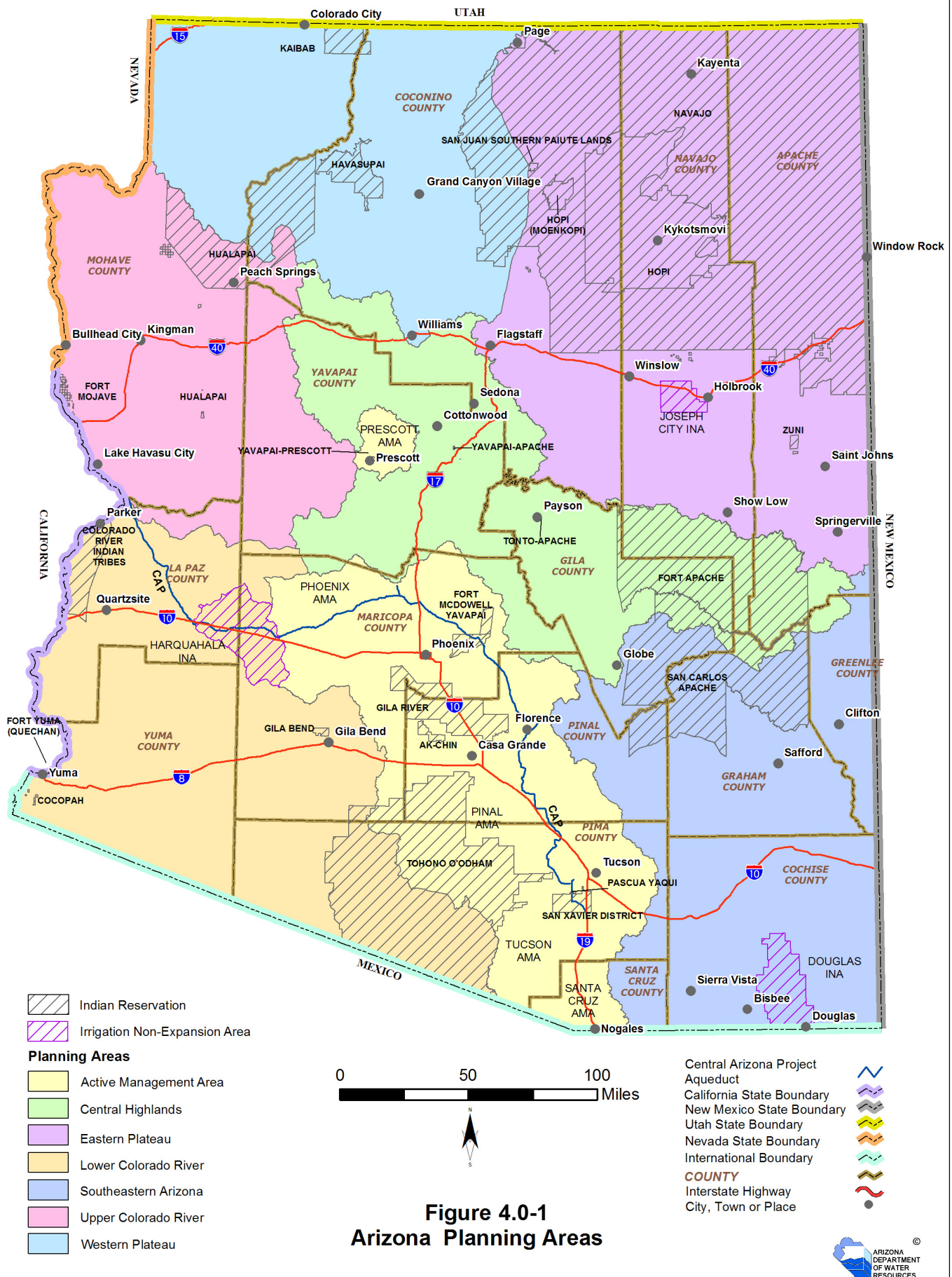
The Upper Colorado River Planning Area is composed of nine groundwater basins located

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 also includes small 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 162,100. Basin population ranged from 823 in the Meadview Basin to over 51,500 in the Lake Mohave Basin. Lake Havasu City is the largest metropolitan area with almost 42,000 residents in 2000.

Annual cultural water demand averaged about 174,100 acre-feet (including effluent) during the period 2001-2005. Agriculture was the largest water use sector in the planning area with an annual demand of approximately 99,550 acre-feet during this period, almost entirely within the Lake Mohave Basin. Municipal demand accounted for about 52,400 acre-feet/year (AFA), and industrial demand averaged about 22,100 AFA.



Agriculture in the Lake Mohave Basin. Agriculture was the largest water use sector in the planning area with an annual demand of approximately 99,550 during 2001-2005.



4.0.1 Geography

The Upper Colorado River Planning Area covers about 11,860 square miles (sq. mi.) 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. (Figure 4.0-1) 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

Figure 4.0-2 Upper Colorado River Planning Area



near Lake Havasu City to 8,417 feet at Hualapai Peak south of Kingman.

Arizona's three physiographic regions are found in the planning area (Figure 4.0-3). 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 Colorado Plateau physiographic province, characterized by high desert plateaus and incised canyons. The central 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 transition zone, characterized by rugged mountains of igneous, metamorphic and sedimentary rocks.

Figure 4.0-3 Physiographic Regions of Arizona



Data source: Fenneman and Johnson, 1946

Unique geographic features of the planning area include the the Colorado River and associated lakes impounded by several dams. The river and lakes influence cultural uses, groundwater conditions and habitat in a significant portion of the planning area.

4.0.2 Hydrology¹

Groundwater Hydrology

The Upper Colorado River Planning Area is characterized by semi-arid to arid alluvial basins with few perennial streams. Anderson, Freethy 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 area does not match the Department's groundwater basins exactly, the Upper Colorado River Planning Area is included in their study area with the exception of the Peach Springs Basin. Four basin categories identified by Anderson are represented in the planning area and are discussed below: West, Colorado River, Highland and Southeast.

As shown in Figure 4.0-4, there are extensive outcrops of sedimentary and volcanic rocks of varying ages throughout the planning area. Large areas of basin-fill covered by alluvial and surficial deposits are found in the western part of the planning area, primarily in the West basins.

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. Groundwater inflow and outflow are small and there is almost no stream baseflow. These basins contain extensive areas

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

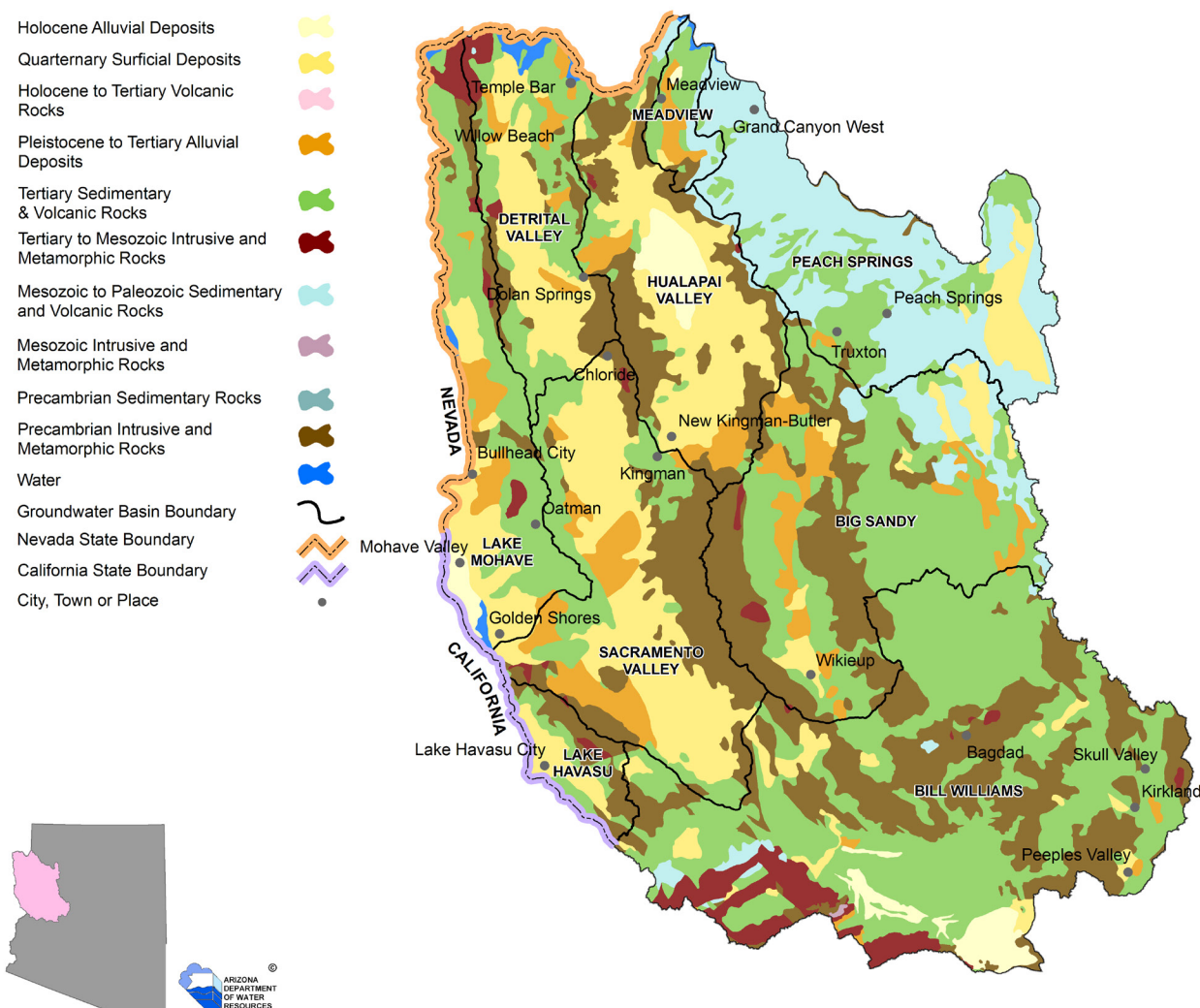
of basin fill deposits that comprise the primary groundwater bearing unit (aquifer).

Detrital Valley Basin

The Detrital Valley Basin is characterized by a relatively long valley whose floor slopes from 3,400 feet at the southern boundary to around 1,200 feet at Lake Mead. Groundwater occurs mostly in basin-fill material and in alluvial deposits along mountain washes. Intermediate and younger basin fill are above the water table in most areas, consequently 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. There are extensive evaporate

deposits in the older alluvium in the northern part of the basin (Anning and others, 2007). Depth to bedrock may exceed 6,000 feet at the deepest point. A clay unit may extend from 600 to 1,400 feet below land surface (bls) in the central portions of the basin, which 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 (Mason and others, 2007). Groundwater flow direction is north toward Lake Mead. At the northern end of Detrital Valley water from Lake Mead infiltrates to the basin-fill aquifer and near by groundwater levels fluctuate with the levels. Depth to water may be less than 100 feet bls in this area (Anning and others, 2007).

Figure 4.0-4 Surface Geology of the Upper Colorado River Plateau Basin
(Based on Reynolds, 1988)





Detrital Valley Basin. In this basin groundwater occurs mostly in basin-fill material and in alluvial deposits along mountain washes.

Groundwater recharge is estimated at 1,000 AFA. Groundwater discharge is to springs and from relatively small well withdrawals for municipal purposes. The volume of recoverable groundwater to a depth of 1,200 feet bls is estimated to range from about 1.48 to 3.94 maf (Mason and others, 2007). The median well yield in measured wells is generally 35 gpm or less (Table 4.3-5). As shown in Figure 4.3-6, groundwater levels were relatively stable in wells measured in 1990-91 and 2003-04, although water-level measurements for different time periods show long-term declines in an area northeast of Dolan Springs (Anning and others, 2007). Water quality is suitable for most purposes although concentrations of radionuclides and arsenic that exceed drinking water standards have been measured at wells throughout the basin. (Table 4.3-6, Figure 4.3-9).

Hualapai Valley Basin

The Hualapai Valley Basin trends north-northwest and is about 60 miles long, stretching from the Hualapai Mountains to Lake Mead. The basin has relatively deep, sediments divided into three units. The younger basin fill includes recent streambed deposits in Hualapai Valley and alluvium along mountain canyons. This unit yields relatively small volumes of water

to stock and domestic wells. The intermediate basin fill, 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 basin fill is the primary water supply. Similar to the Detrital Valley Basin located to the west, older basin fill in the northern part of the valley includes clastic sediments, limestone and basalt flows of the Muddy Creek and Chemehueve Formations. Volcanic rocks are interbedded with the older basin fill in the southern part of the basin and yield water for municipal and domestic purposes. Groundwater flows into the central part of the basin from the south and along Truxton Wash near Hackberry (Figure 4.4-6). Surface water collects in the Red Lake playa near the center of the basin, whereas groundwater flows to the north underneath the topographic divide near Pierce Ferry Road (Anning and others, 2007).

Groundwater recharge comes primarily from streambed infiltration and is estimated at 2,000 to 3,000 AFA (Table 4.4-4). Groundwater discharge is to several major springs and from relatively large volumes of well pumpage for municipal use by Kingman. The well pumpage is almost three times the estimated groundwater recharge rate. Groundwater in storage estimates range widely from 3 to 21 maf. Median reported well yields are relatively high at 900 gpm (Table 4.4-4). In the central and northern part of the basin groundwater levels were relatively stable or rising between 1990-91 and 2003-04 while water levels were declining in the southern part of the basin (Figure 4.4-6). Water-level measurements over longer time periods show fluctuating water levels in the basin with long-term declines found in the area northwest of Hackberry (Anning and others, 2007). Groundwater is highly mineralized in some areas near the mountains and near Red Lake. Chromium has been detected in some wells in the basin.

Meadview Basin

The relatively small Meadview Basin is characterized by a valley formed by Grapevine Wash in the north, and a highland area, Grapevine Mesa in the south. The basin floor slopes toward Lake Mead from an elevation of about 4,400 feet to 1,400 feet. The main aquifer occurs in the Muddy Creek Formation which contains three units. The upper limestone unit yields water to springs and shallow wells. 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 has been in this lower unit. Groundwater flow is from south to north, following Grapevine Wash.

Groundwater recharge is relatively small, about 4,000 AFA, due to low rainfall and high evaporation rates. Groundwater discharge is to springs and a relatively small volume of municipal well pumpage. Groundwater in storage is estimated at 1.0 maf or less. The median measured well yield is 33 gpm (Table 4.7-5). There is little water level monitoring in the basin. Available data show water levels as deep as 931 feet bls in the southern part of the basin and declines of more than 15 feet have been measured in a well in the vicinity of Meadview during the period 1990-91 and 2003-04 (Figure 4.7-6). Groundwater quality is generally good in the basin, with elevated concentrations of radionuclides measured primarily in or near granitic areas (ADEQ, 2005).

Sacramento Valley Basin

Sloping alluvial fans extend from surrounding mountains to the north-south trending valley floor of the Sacramento Valley Basin. The valley floor generally slopes to the south with elevation ranging from more than 8,400 feet at Hualapai Peak to about 500 feet where Sacramento Wash enters the Colorado River. Older basin fill is the principal aquifer in the basin. There are fractured and faulted volcanic rocks in the vicinity of Kingman that separate this basin

from the Hualapai Valley Basin. Water stored in the fractures is used as part of the municipal water supply for Kingman and for domestic wells. The fractured granite aquifer beneath the community of Chloride is insufficient to meet its needs and water must be hauled from Kingman. Groundwater flow is toward the center of the Sacramento Valley and west to the Colorado River.

Groundwater 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. Groundwater recharge is estimated at 1,000 to 4,000 AFA. Groundwater discharge is to a number of springs and from municipal and industrial well pumpage. Groundwater in storage estimates range from 7 to 14 maf. Recent investigations using a range of specific yield values estimated 3.6 to 9.5 maf of groundwater in storage to a depth of 1,200 feet bls (Conway and Ivanich, 2008). Median well yields are between 100 and about 170 gpm (Table 4.9-6). Groundwater levels may be relatively deep with depths greater than 500 feet measured at several locations. Water levels declined in measured wells in the vicinity of Kingman and east of Topock between 1990-91 and 2003-04 (Figure 4.9-6). Water-level measurements over longer



Colorado River, Sacramento Valley Basin. Groundwater flow is toward the center of the Sacramento Valley and west to the Colorado River.

time periods show fluctuating water levels in the basin with long-term declines in the Kingman area and Golden Valley area (Anning and others, 2007).

Groundwater quality is generally good in the basin except along the base of the mountains where waters of high mineral content are common. A study conducted by ADEQ found water quality exceedences in the majority of sample sites in three areas: near the town of Chloride; in the central and southern Hualapai Mountains; and near the town of Topock (ADEQ, 1999). Concentrations of radionuclides in Chloride town wells have exceeded Safe Drinking Water Act maximum contaminant levels (City of Kingman, 2003).

Bill Williams Basin (western portion)

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). The area in the vicinity of the Colorado River is influenced by infiltration of river water. Groundwater in the western part of the basin occurs primarily in recent stream alluvium and basin fill. The water-bearing ability of these units varies within the basin. The stream 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, which is more than 5,000 feet thick in the Bullard Wash-Date Creek Area southeast of Alamo Lake State Park. Groundwater flow is toward the Bill Williams drainage.

Groundwater recharge is from streamflow and mountain front precipitation and is estimated at 32,000 AFA for the entire basin. From 10 to 23 maf of groundwater is estimated in storage. There is little groundwater development in the western portion of the basin and relatively little groundwater level data (see Figure 4.2-6).

Available water level data show stable water levels. Well yields may exceed 2,000 gpm along the Bill Williams River. Arsenic and fluoride concentrations that exceed drinking water standards have been reported from this portion of the basin as well as elevated levels of cadmium near the mouth of the Bill Williams River.

Colorado River Basins

The Colorado River Basins include the Lake Havasu and Lake Mohave basins and those 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 in this area. The aquifers are composed primarily of recent stream alluvium deposits that is hydraulically connected to underlying basin fill. Groundwater occurs under



Bill Williams River at Lake Havasu. The area in the vicinity of the Colorado River is influenced by infiltration and flow of river water.

unconfined conditions in both the stream alluvium and basin fill.

Lake Havasu Basin

The Lake Havasu Basin is a relatively small basin with its western boundary defined by the Colorado River. Extensive areas of the basin are covered by consolidated rock. Basin fill, consisting of sand, silt and gravel, overlies the Bouse Formation (siltstone and fine-grained sandstone) and an underlying conglomerate unit. These deposits decrease in thickness toward the basin margin. Most wells in the basin penetrate the upper 100-200 feet of the basin fill. There is a direct hydraulic connection between the basin fill and the Colorado River, with groundwater occurrence and movement near the river controlled by the elevation of Lake Havasu. The lake elevation is relatively constant with a maximum fluctuation of approximately five feet during the period 1990-2008 (USBOR, 2009).

Regional groundwater flow is north to south. Groundwater recharge is estimated at 35,000 AFA with an estimated 1.0 to 2.0 maf of groundwater in storage. Water withdrawals from wells are primarily pursuant to Colorado River entitlements. Median well yields are relatively high at 1,500 gpm. Water level data for one public supply well showed a decline of 15 to 30 feet between 1990-91 and 2003-04. Drinking water standard exceedences are primarily due to elevated concentrations of nitrate/nitrite and organics measured in the vicinity of Lake Havasu City.

Lake Mohave Basin

The Lake Mohave Basin is a long narrow basin located adjacent to the Colorado River. The principal water-bearing formations 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. Groundwater flow direction is from north to south. A granite ridge extends



Lake Mohave Basin, Colorado River. In the Colorado River basins the direction and occurrence of groundwater are influenced by the amount of streamflow in the Colorado River.

across the Colorado River near Davis Dam, restricting recharge from the lake to the south. Groundwater is generally unconfined in the basin. Compared to groundwater recharge from the lake, mountain front recharge is negligible.

Groundwater recharge is estimated to total 183,000 AFA. Groundwater in storage estimates vary from 1.2 to 8.0 maf. Water withdrawals from wells in the basin are primarily pursuant to Colorado River entitlements. Median well yield is 1,000 gpm reported from 96 large (>10-inch) diameter wells (Table 4.6-6). Water level change data for the period 1990-91 to 2003-04 show slight declines south of Bullhead City and an increase north of the city. The water level in these wells ranged between 337 and 427 feet bls. Elevated concentrations of to-

tal dissolved solids (TDS) and fluoride occur in welled completed along the mountain fronts. The drinking water standard for arsenic was the most frequently exceeded standard measured in the basin (Table 4.6-7). Springs, some of which are thermal, occur downstream of Hoover Dam and represent the only surface water in the basin other than the lake and the Colorado River.

Highland Basins

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 stream alluvium. These aquifers tend to be discontinuous and limited in extent. Groundwater inflow is from stream channels, mountain front recharge and adjacent consolidated rock aquifers. Groundwater outflow is due to evapotranspiration and baseflow to streams (Anderson, Freethey and Tucci, 1992).

Big Sandy Basin (northeastern portion)

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 limestones form a regional aquifer that extends north and east. There is little water development in this portion of the Big Sandy Basin and groundwater flow direction has not been reported. Well yields in three wells varied from 100 to over 1,000 gpm. In this area, water levels were stable in most wells measured between 1990-91 and 2003-04, with water levels ranging from about 130 to 860 feet bls (Figure 4.1-6). Water quality measurements from three wells in the southern portion of the Fort Rock sub-basin showed drinking water exceedences of arsenic and cadmium.

Bill Williams (eastern portion)

Groundwater in the eastern 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 stream alluvium. In the Peeples Valley area, the stream 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 well yields in the upper 350 to 400 feet. Other sources of groundwater are from faults in granite and metamorphic rocks. Groundwater flow in the Skull Valley Sub-basin is to the southwest in the northern part, and to the northwest south of Kirkland (Figure 4.2-6).

Groundwater recharge occurs from streamflow and mountain front precipitation. Most groundwater development is in the Skull Valley Sub-basin and at Bagdad although most of the water used at Bagdad for mining operations is transported from the Big Sandy Basin near Wikieup. Well yields in this portion of the basin are generally less than those in the western portion with a number of wells yielding less than 100 gpm (Figure 4.2-8). Median well yield for the entire basin, reported from large diameter (>10 inch) wells, is 280 gpm. Water level measurements are available primarily for wells located in the Skull Valley Sub-basin. These show relatively shallow water levels in most measured wells (<100 feet bls). Water level change data was not available for most wells in the sub-basin for the period 1990-91 to 2003-04, but was relatively stable for the few wells measured during this period (Figure 4.2-6). Drinking water standard exceedences in this area are generally due to elevated concentrations of fluoride, arsenic and radionuclides.

Southeast Basins

Big Sandy Basin (western portion)

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



Big Sandy Basin near Wikieup. In the Wikieup area, wells greater than 40 feet in depth tap the upper basin fill, which is estimated to be 300 feet deep.

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 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. North of Wikieup, the upper basin fill is estimated to be 150 to 200 feet deep. Groundwater flow is generally from north to south down the central valley.

Groundwater recharge is estimated at 22,000 AFA and the volume of groundwater in storage is estimated at 9.5 to 21 maf for the entire basin (Table 4.1-6). Median well yield for the entire basin is 300 gpm reported for large (>10-inch) diameter wells and as high as 2,000 gpm at Cane Springs (Figure 4.1-8). Water levels are relatively stable with some declines measured

near Wikieup and south of Valentine. Depth to water ranges from 15 feet bls along the Big Sandy River south of Wikieup to over 370 feet along Hackberry Road in the northern part of the Wikieup Sub-basin (Figure 4.1-6). Arsenic, fluoride, lead and radionuclide concentrations that exceed drinking water standards have been measured in wells and springs throughout the western portion of the basin (Figure 4.1-9). Elevated radionuclide and fluoride concentrations are found primarily along the mountain drainages (Cady, 1981).

Other

Peach Springs Basin

The Peach Springs Basin was not included in the study area of Anderson, Freethey and Tucci (1992). This basin is characterized by an upland area to the west, the Hualapai Plateau, 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 bls. Groundwater is limited to a few permeable layers in the basin's two primary valleys. In Aubrey Valley in the far northeastern part of the basin near Frazier Wells, groundwater is found in gravel beds at relatively shallow depth. In Truxton Valley, lake-bed deposits are a local source of groundwater. In other areas of the basin, Precambrian rocks, isolated volcanic rocks and local alluvial sands in washes provide small amounts of water. Groundwater flow is toward the north where it exits the basin at springs emanating from the Muav Limestone in the Grand Canyon. Groundwater flow in Aubrey Valley south of Frazier Wells may be from north to south (Myers, 1987).

An annual groundwater recharge estimate is not available for the basin. The estimated volume of groundwater in storage ranges from 1.0 maf

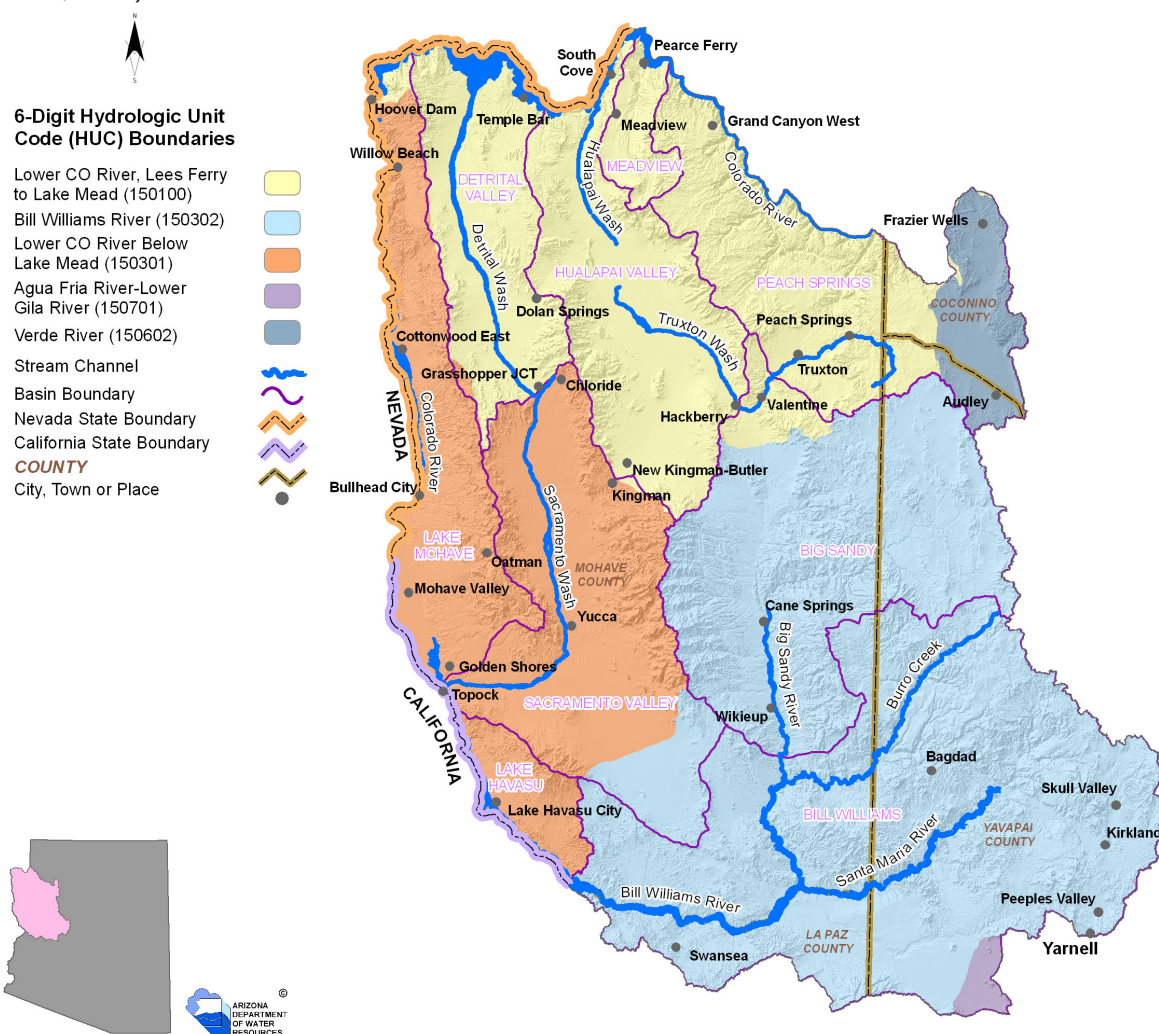
to more than 4.0 maf. Data from the southern part of the basin show well yields ranging from less than 100 gpm up to 1,000 gpm. Water levels vary from 60 feet bls east of Truxton to over 1,300 feet bls northwest of Audley (Figure 4.8-7). Hydrographs of four wells in the basin show relatively stable water level conditions (Figure 4.8-6). Most of the water quality data shown in Table 4.8-7 is from springs, with arsenic most frequently exceeding the drinking water standards.

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). A 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 River. In addition, there are portions of four others: the Lower Colorado River-Lees Ferry to Lake Mead; the Lower Colorado River below Lake Mead; the Agua Fria River-Lower Gila River; and the Verde River (Figure 4.0-5).

Figure 4.0-5 Upper Colorado River Planning Area USGS Watersheds
(USGS, 2005)



Lower Colorado River-Lees Ferry to Lake Mead Watershed

The Lower Colorado River-Lees Ferry to 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 northernmost 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 and Detrital Wash. 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 part of the watershed in the planning area. There is only one intermittent stream, a portion of Truxton Wash, located in Peach Springs Basin (AZGF, 1997 & 1993).

Lake Mead, created by Hoover Dam, has affected groundwater conditions in adjacent ba-



Lake Mead National Recreation Area. Lake Mead has affected groundwater conditions in adjacent basins in the watershed. There is outflow from the lake into the surrounding aquifers.

sins 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 maf. Of this, approximately 2.38 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 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 AFA.

Lower Colorado River below Lake Mead Watershed

This watershed covers parts of two planning areas. 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 ephemeral 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 4.9-5).

Parker and Davis dams have created lakes that also 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 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.



Davis Dam. Maximum storage in Lake Mohave, created by Davis Dam, is about 1.8 maf (including dead storage) and average storage from 1996 to 2005 was 1.65 maf.

Bill Williams River Watershed

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, Date Creek, the

Santa Maria River, and Trout Creek. Numerous intermittent streams are also present (Figures 4.1-5 and 4.2-5).

Construction of Alamo Dam on the Bill Williams River in 1968 significantly impacted streamflow below the dam. Built as a flood-control structure, the dam is now operated in a manner to benefit downriver wildlife refuges and vegetation along the river. According to NEMO (2005), 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 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. Prior to dam construction the Bill Williams River produced some of the largest floods in Arizona history, with a peak discharge (200,000 ft³/s) comparable to the largest known Colorado River floods (Webb and others, 2007).

Median annual streamflow in the Bill Williams River below Alamo Dam is about 34,000 acre-feet, but a maximum annual 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 af. 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 af.

Within the watershed, perennial streams originate from spring 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; the largest is located in the Big Sandy Basin where discharge from an unnamed spring south of Cane Springs measured 1,600 gpm. The largest spring in the Bill Williams Basin was measured at 228 gpm. There are no large springs



Bill Williams River near its confluence with Lake Havasu. 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

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.

Agua Fria-Lower Gila Watershed

A very small portion of this watershed extends into the southeastern portion of the Bill Williams Basin. There are no major tributaries, perennial or intermittent streams, stream gages or major springs in this area.

Verde River

A very small portion of the Verde watershed extends into the eastern portion of the Peach Springs Basin. There are no major tributaries, perennial or intermittent streams, stream gages or major springs in this area.

4.0.3 Climate²

The Upper Colorado River Planning Area has a distinctive bi-modal precipitation pattern found in other regions of the State, though this

² Information in this section was provided by the Institute for the Study of Planet Earth, Climate Assessment for the Southwest (CLIMAS), University of Arizona, October 2006

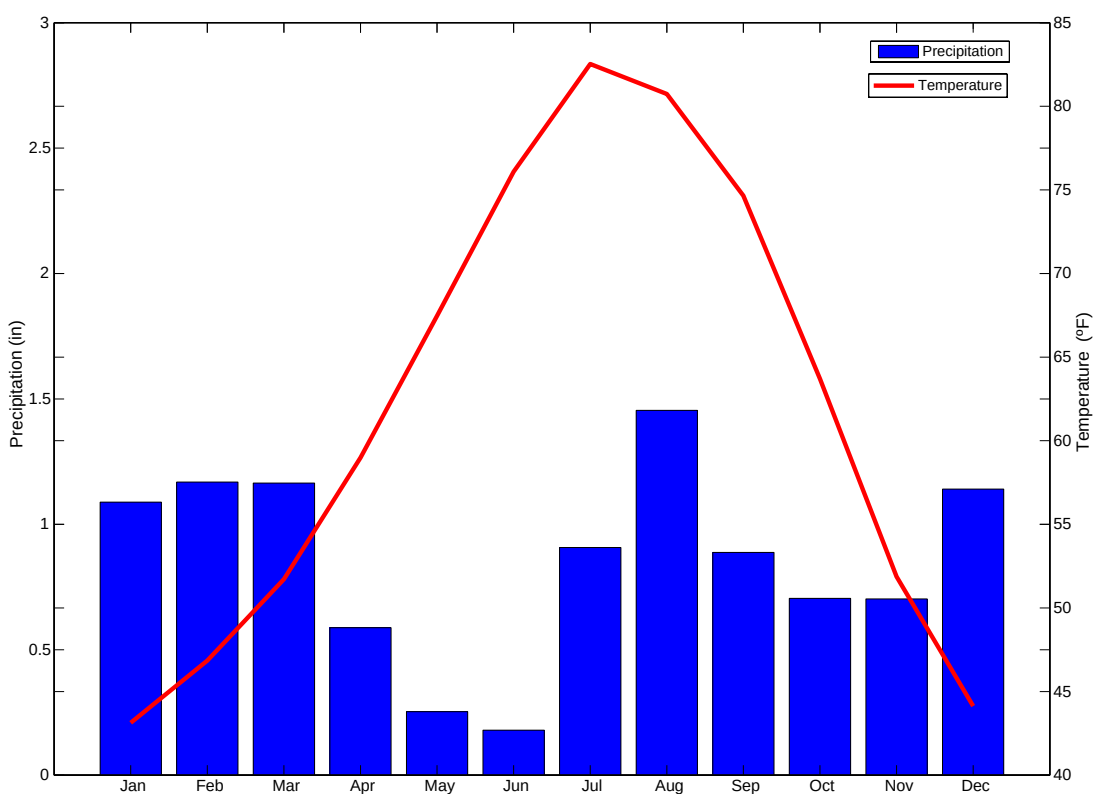
planning area is overall relatively dry. Summer precipitation peaks in August during the summer monsoon thunderstorm season.

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 4.0-6). 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 are generally representative of much 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 4.0-7).

Figure 4.0-6 Average Monthly Precipitation and Temperature in Kingman, Arizona, 1930-2002



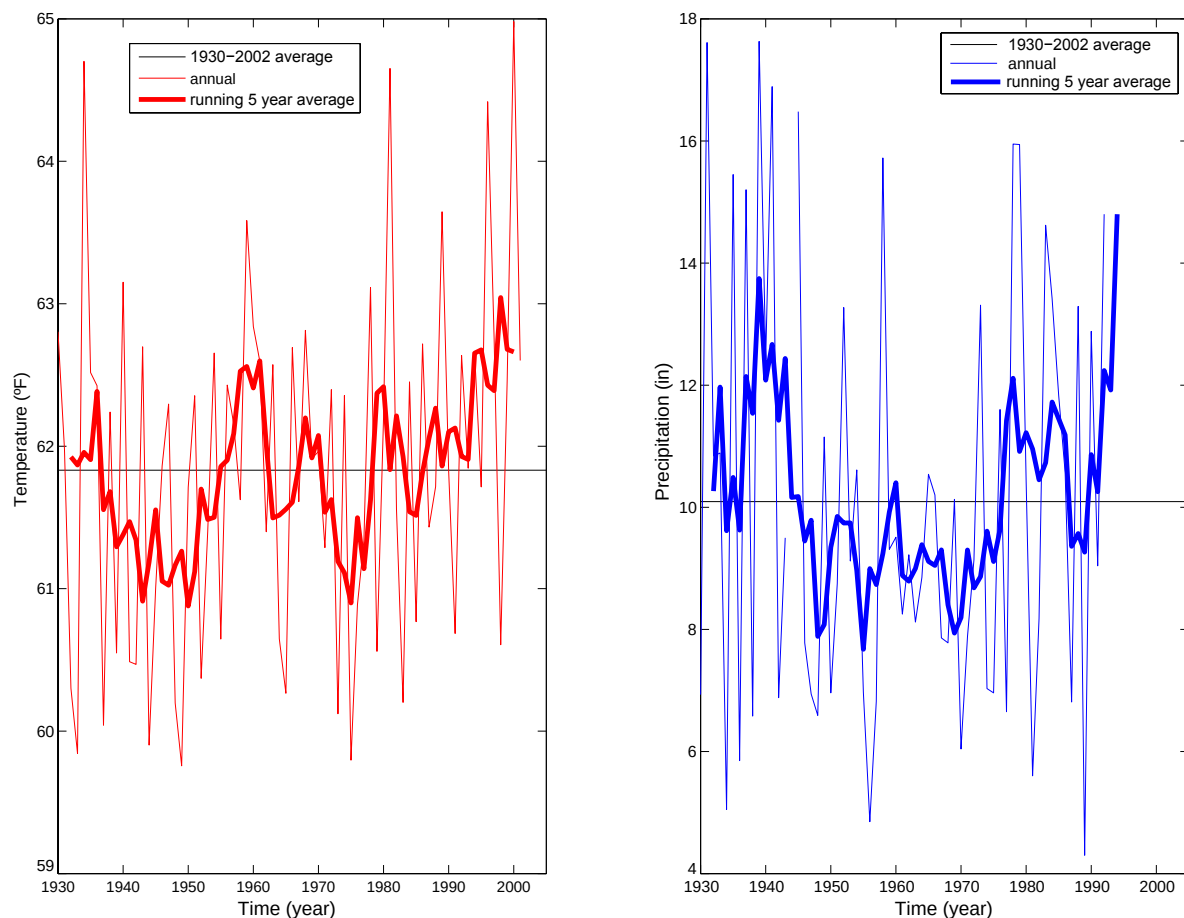
Data are from the U.S. Historical Climatology Network Figure author: CLIMAS

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 4.0-8). A climate division is a region within a state that is generally climatically homogeneous. Arizona has been divided into 7 climate divisions. In addition to Climate Division 1, the western part of Climate Division 3 (Yavapai County) and small portions

of Climate Divisions 2 (Coconino, Navajo and Apache counties) and 5 (La Paz and Yuma counties) are located in the planning area.

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

Figure 4.0-7 Average Annual Temperature and Total Average 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: CLIMAS

North America shift farther south than normal. La Niña conditions usually are associated with below-average winter precipitation.

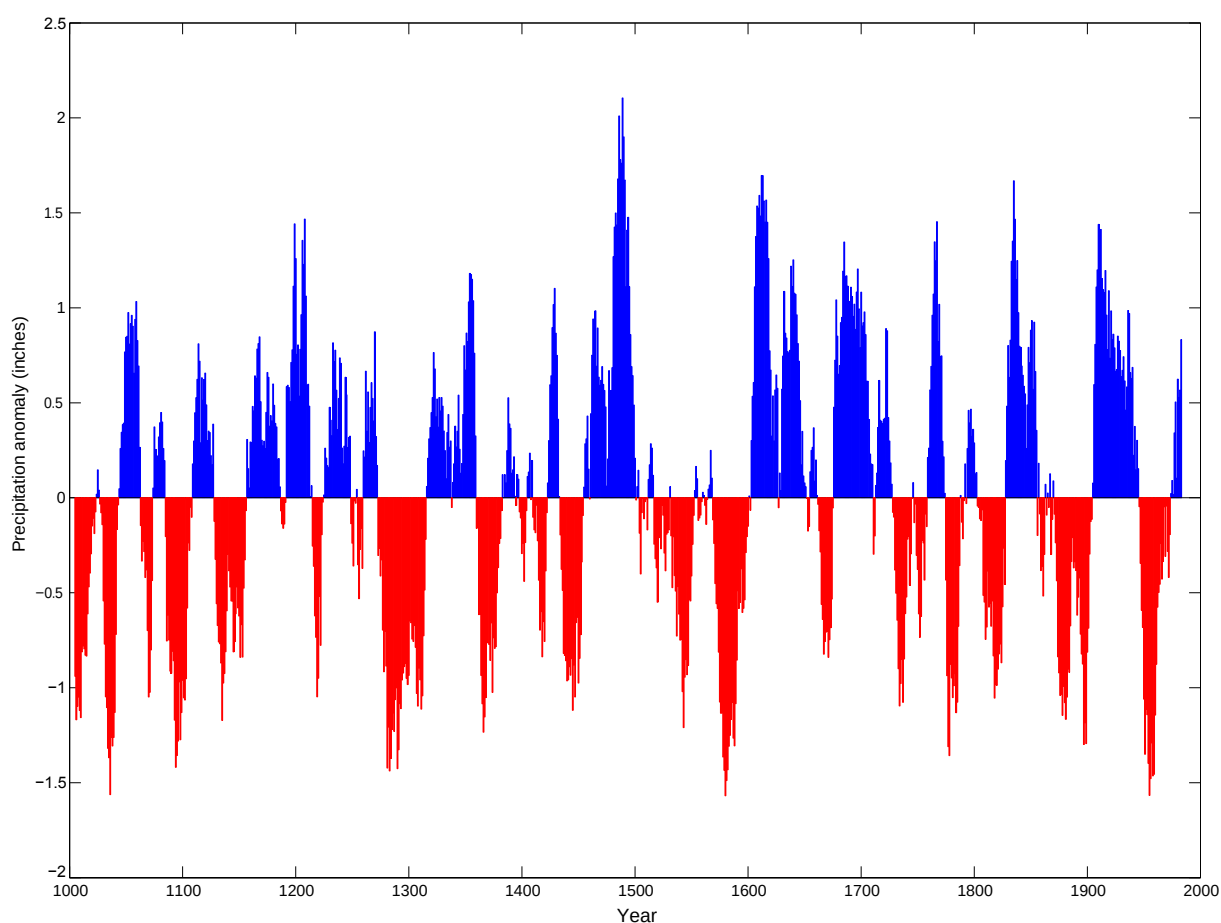
Annual average temperature in Kingman is 61.9° F, compared to the statewide average of 59.9° F. The annual average temperature in Bullhead City for the period 1977 to 2006 was 74.2°F. As in other planning areas, temperatures have been increasing the past several decades (Figure 4.0-7), consistent with global temperature trends. Some warming may be attributed to changes in land-cover resulting from population growth.

4.0.4 Environmental Conditions

Vegetation

Four of Arizona's six ecoregions are represented in the Upper Colorado River Planning Area: the Mojave Desert, Sonoran Desert, Colorado Plateau Shrublands and the Arizona Mountains Forests. (Figure 4.0-9) The planning area is diverse in terms of biotic communities, ranging from lower Colorado River Sonoran desertscrub to pine forests. Much of the area vegetation is Mohave and upland Sonoran desertscrub and

Figure 4.0-8 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: CLIMAS.

semidesert grassland and Great Basin conifer woodland in the northeastern portion. The largest yucca species, the Joshua tree, characterizes the Mojave Desert ecoregion, a transitional desert between the higher and cooler Great Basin Desert and the lower, hotter Sonoran Desert. The Sonoran Desert ecoregion occurs in the southern part of the planning area where the saguaro is the characteristic plant and biodiversity is quite high. The Colorado Plateau Shrublands and Arizona Mountains Forests ecoregions are characterized by chaparral, conifer woodlands and higher elevation grasslands.

Rocky Mountain (Petran) and Madrean montane conifer forests commonly occur between about 7,200 to 8,700 feet in Arizona. In the planning area, most of this community is below 8,000 feet in elevation where ponderosa pine is the predominant species in areas that receive about 18 to 26 inches of annual precipitation. About half of the precipitation occurs during the growing season, which permits forests to exist on less than 25 inches of annual rainfall, making them some of the driest forests in North America (Brown, 1982). In the planning area these forests exist in only a few relatively small areas: the Hualapai Mountains south of Kingman; the northeast part of the Bill Williams Basin; and the northeast part of the Peach Springs Basin.

Great Basin conifer (piñon-juniper) woodlands cover large areas below the ponderosa pine forest at elevations between about 5,000 and 7,500 feet that receive about 12 to 20 inches of annual precipitation. Extensive stands exist in the Peach Springs Basin and the eastern part of the Big Sandy Basin as shown on Figure 4.0-9.

Great Basin desertscrub occurs in northern Arizona mostly at elevations of 4,000 to 6,500 feet with average rainfall of about 7 to 12 inches. This vegetative community is dominated by multi-branched, aromatic shrubs with evergreen leaves, primarily sagebrush, blackbrush and

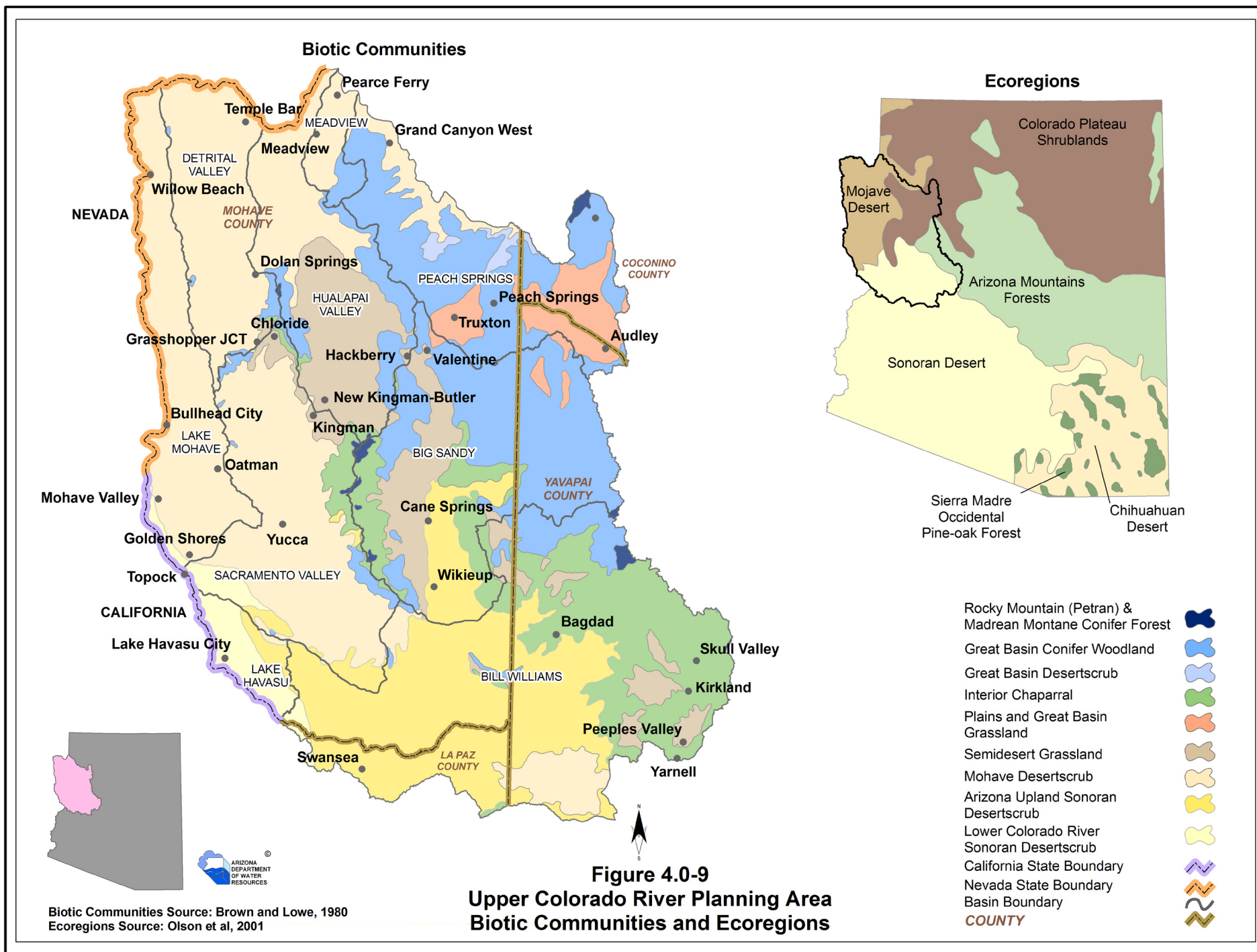


Great Basin conifer woodland in the Peach Springs Basin.

shadscale and grasses. Great Basin desertscrub is found only in relatively small areas of the Peach Springs Basin.

At similar elevations to Great Basin desertscrub (4,000-6,000 feet), interior chaparral is found in areas that receive 13 to 23 inches of annual precipitation. This community occurs extensively in the eastern portion of the Bill Williams Basin. Chaparral consists of dense shrubs that grow around the same height with occasional taller shrubs or small trees. Chaparral communities typically are a mix of several shrubby species such as mountain mahogany, shrub live oak, and manzanita and commonly include cactus, agave, and yucca. Chaparral plants are well adapted to drought conditions.

Plains and Great Basin grasslands, primarily composed of mixed or short-grass communities, are found in the Peach Springs Basin primarily at elevations above about 4,000 feet that receive between 11 and 18 inches of annual precipitation. Semi-desert grasslands are more extensive and occur in valleys between the desert and woodlands or chaparral at elevations between 3,500 and 5,000 feet that receive 10 to 15 inches of annual precipitation. Semi-desert grasslands are found primarily in the Hualapai



Valley, Big Sandy and eastern portion of the Bill Williams basins. Desert grasslands often contain a mixture of grasses, shrubs and small trees.

The boundary between Mohave desertscrub and Arizona Upland and Lower Colorado River Sonoran desertscrub is often difficult to discern. While many of the same plants found in the other deserts occur here, some are indicative of the Mohave Desert such as the Joshua tree and certain cacti and endemic ephemeral plants, most of which are winter annuals (Brown, 1982). The community is shrub-dominated and creosote bush and bursage are often dominant species. Mohave desertscrub covers most of the Detrital Valley, Lake Mohave and Sacramento Valley basins at elevations below about 3,500 feet that receive 5 to 11 inches of annual rainfall.

Two subdivisions of the Sonoran desertscrub region exist in the planning area-the Lower Colorado River Valley subdivision and the Arizona Upland subdivision. The Lower Colorado River Valley subdivision is the hottest and driest of the Sonoran desertscrub subdivisions. It covers most of the Lake Havasu Basin and smaller areas of adjacent basins (Figure 4.0-9). Intense competition for water results in widely spaced plants and more concentrated vegetation along drainage channels. In some areas the soil is covered by a single layer of tightly packed pebbles known as “desert pavement” that restricts plant types to ephemeral species. Characteristic plants include creosote bush, bursage, saltbush, and mixed, more diverse vegetation along washes including blue palo verde, ironwood and jojoba. Also commonly found in the subdivision are several types of cholla and other cacti. (Brown, 1982)

The Arizona Upland subdivision occurs primarily on slopes and sloping plains at elevations of 980 to over 3,000 feet where it

merges with interior chaparral or semidesert grassland. This subdivision receives between 8 to 16 inches of average annual precipitation. It is the dominant biotic community in the Bill Williams Basin. Vegetation is scrubland or low woodland in appearance with blue and foothill palo verde, ironwood, mesquite and cat-claw acacia as common tree species. Cacti are extremely important in this subdivision including saguaro, organ pipe, cholla and barrel cacti. (Brown, 1982)

Riparian vegetation has been mapped along some perennial watercourses in the planning area including the Colorado, Bill Williams, Big Sandy and Santa Maria rivers and along smaller watercourses including Date, Trout and Burro creeks (Figure 4.0-10).

Webb and others (2007) studied changes in riparian vegetation along a number of watercourses in the southwestern United States. Watercourses studied in the Upper Colorado River Planning Area include Lake Mead, Lake Mohave, Lake Havasu, the Bill Williams River, Big Sandy River, and the Santa Maria River. Historically, locally lush riparian vegetation existed along reaches of the Colorado, particularly at major tributary confluences, although most of the now submerged river corridor was either barren sand or bedrock (Webb and others, 2007). With construction of dams on the river,



Riparian vegetation along the Bill Williams River.

new habitat has formed including cottonwood and willow, and tamarisk along reservoir margins. Fluctuating reservoir elevations and high salinity favor tamarisk. The mouth of the Bill Williams River at the Colorado River historically supported a considerable amount of riparian vegetation including cottonwood-willow. Lake Havasu now inundates the mouth of the river, supporting a 2,300 acre riparian zone including a cottonwood-willow forest and 500 acres of cattail marshes designated as the Bill Williams National Wildlife Refuge that extends 12 miles upstream. This area is also supported from releases of water from Alamo Dam, which completely regulates flow in the river downstream from the dam. Beaver dams are now common and riparian vegetation has increased substantially in many places.

The floodplain of the Big Sandy River upstream from Wikieup supports dense riparian vegetation including cottonwood and tamarisk. Downstream from Burro Creek, native and non-native vegetation have increased from historic observations. At the confluence of the Santa Maria River and the Big Sandy River, riparian vegetation, including tamarisk, has increased but also native species, particularly cottonwood and black willow. (Webb and others, 2007)

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 2008. 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 2008 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 a Volume 1 Appendix).

Instream Flow Claims

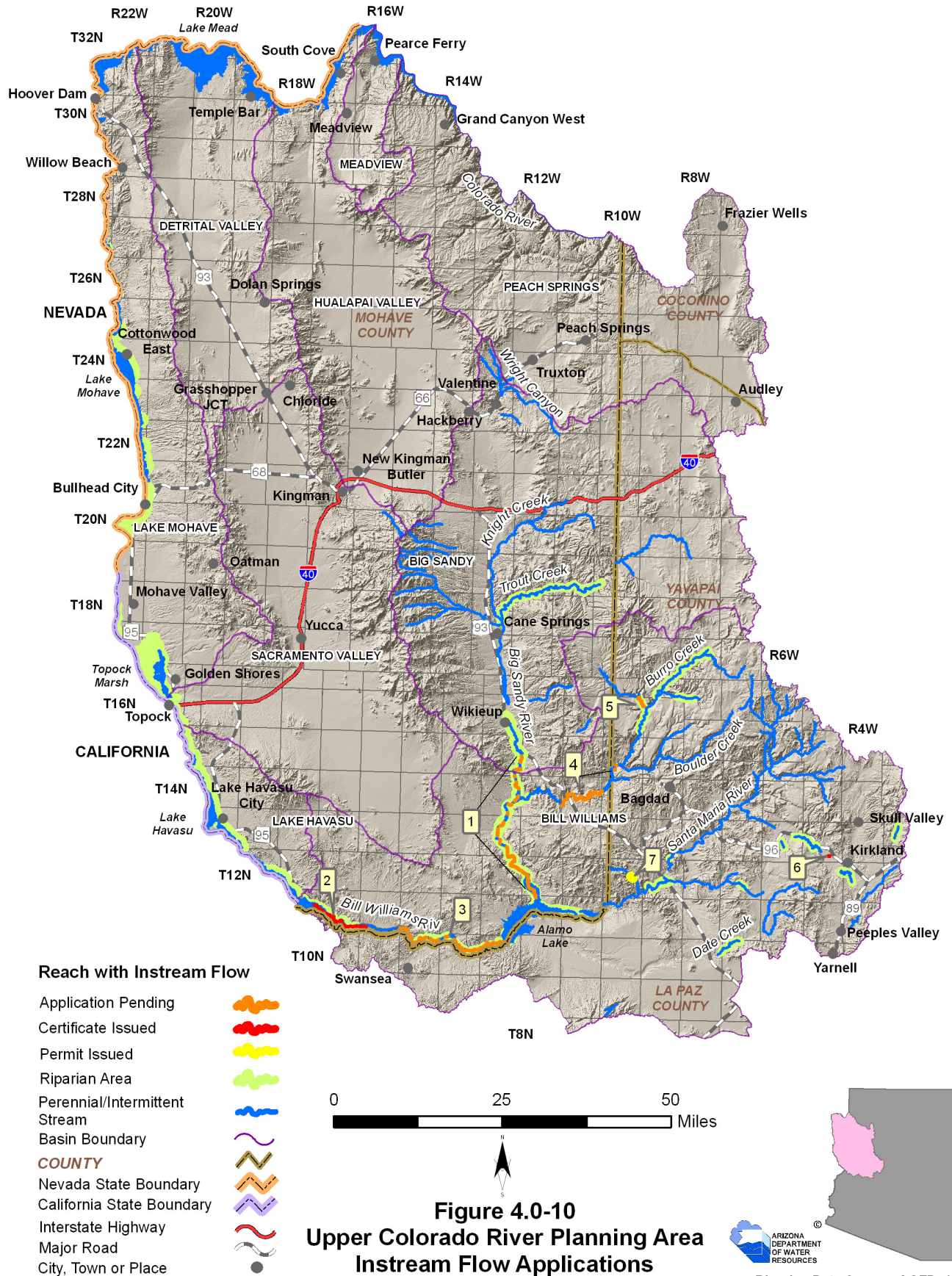
Seven claims for instream flow water rights have been filed in the Upper Colorado River Planning Area, listed in Table 4.0-1 and shown on Figure 4.0-10. An instream flow right is a non-diversionary appropriation of surface water for recreation and wildlife use. Claims were filed only in the Bill Williams and Big Sandy

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 2008a

NA = Not Applicable



basins on six different watercourses. Permits or certificates were issued for claims on the Bill Williams River, Kirkland Wash and People's Canyon Creek.

Threatened and Endangered Species

A number of listed threatened and endangered species may be present in the Upper Colorado River Planning Area. Those listed by the U.S. Fish and Wildlife Service (USFWS) as of 2008 are shown in Table 4.0-2. 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.

Actions related to operation of the Lower Colorado River water delivery and electrical power generation systems by both federal and non-federal entities may affect listed species and habitat or contribute to the listing of additional species in the future. The ESA directs Federal agencies to support the conservation of listed threatened and endangered species and to make sure that their actions do not jeopardize the continued existence of listed species or result in adverse modification of critical habitat. To comply with the requirements of the ESA, state and federal water and power interests created the Lower Colorado River Multi-Species Conservation Program (LCR MSCP). The LCR MSCP is a cooperative, Habitat Conservation Program that identifies specific measures to address the needs of 26 threatened, endangered and other species that rely on habitat associated with the lower Colorado River (USDIOI, 2004).

Table 4.0-2 Threatened and endangered species in the Upper Colorado River Planning Area³

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		500-5,100 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/riverine 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 2008, AZGF 2008

³ 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."

Figure 4.0-11 LCR MSCP Reaches in the Upper Colorado River Planning Area



Source: USDOI 2004

Its purposes include: 1) protection of habitat while ensuring current river water and power operations; 2) addressing the needs of listed species under the ESA; and 3) reduction of the likelihood of listing additional species along the river (USBOR, 2007a). LCR MSCP reaches 1-3 are within the planning area and their general location is shown in Figure 4.0-11.

The LCR MSCP also addresses compliance with the “take” provisions of the ESA.⁴ Incidental take of a listed species, as the result of carrying out an otherwise lawful activity, is not allowed without acquiring a permit from the U.S. Fish and Wildlife Service. The LCR MSCP documents the extent of the incidental take related to river operations and maintenance activities by both Federal and non-Federal entities and includes

measures to avoid, minimize and mitigate the effect of the take (USDOI, 2004).

Implementation of the LCR MSCP began in 2005. The program area extends from the full pool elevation of Lake Mead to the Southern International Boundary with Mexico, a distance of 400 river miles and includes the historical floodplain of the Colorado River (USBOR, 2007a). The LCR MSCP is intended to serve as a coordinated and comprehensive conservation approach for a 50-year period and therefore includes measures for species not currently listed that may become listed in the future. Implementation of the program is funded by a partnership of state, Federal and other public and private stakeholders in Arizona, California and Nevada. The plan will create riparian, marsh and backwater habitat for six federally listed species and 20 other native species including conservation programs for razorback sucker and bonytail chub, both federally listed endangered species.

The LCR MSCP 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 a genetic refuge for razorback sucker. Under the LCR MSCP for the Lake 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-

⁴ As defined by the ESA, take means to “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in other conduct.” (16 U.S.C. section 1531[18])

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

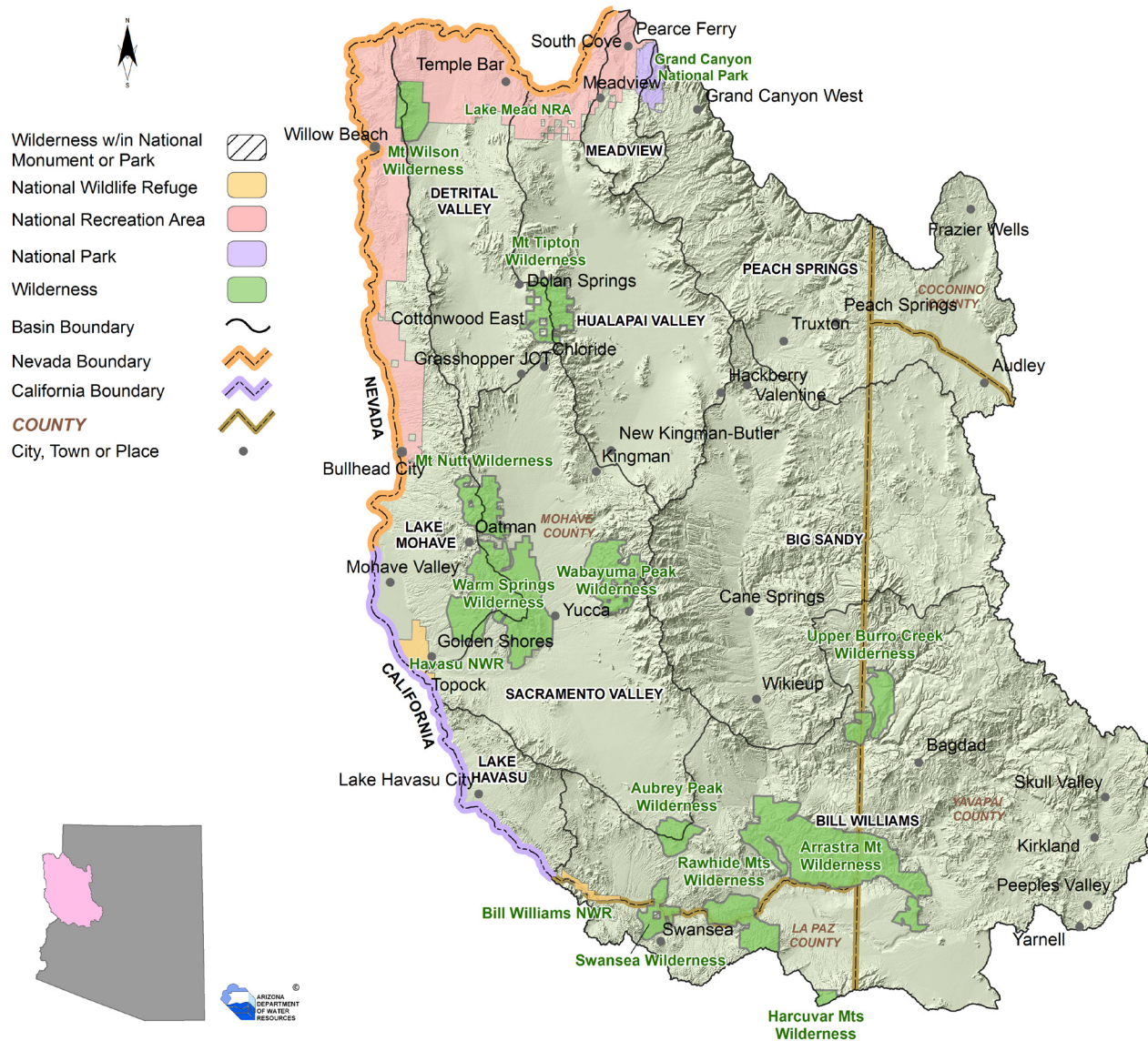
The Upper Colorado River Planning Area contains most of the Lake Mead National Recreation Area (NRA), two national wildlife refuges (NWR) and 11 wilderness areas administered by the Bureau of Land Management (BLM). The southwestern portion of Grand Canyon

National Park is located along the Meadview-Peach Springs basin boundary. These protected areas are shown in Figure 4.0-12.

A significant portion of the Lake Mead NRA, created in 1964 and administered by the National Park Service, is located in the northwestern portion of the 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.

Figure 4.0-12 Upper Colorado River Protected Areas

(Wilderness Data Source: National Atlas of the United States, Land Ownership Data Source: ALRIS 2004)



NRA lands also are located in Detrital Valley and Hualapai Valley Basins.

The two national wildlife refuges in the planning area are 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 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



Bill Williams River, Bill Williams Basin. This reach within the Bill Williams River National Wildlife Refuge is one of seven reaches in the planning area with an instream flow claim.

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).

Not shown on Figure 4.0-12, Alamo Wildlife Area, managed by Arizona Game and Fish, is located at the confluence of the Big Sandy, Santa Maria, and Bill Williams Rivers. The area 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 related to the operation of Alamo Dam and management of resources from Alamo Lake downstream along the Bill Williams River to Lake Havasu. 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.

Table 4.0-3 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 2008

Unique Waters

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 the planning area. Designated unique waters include sections of Peoples Canyon, Francis Creek and Burro Creek in the Bill Williams Basin.

4.0.5 Population

Census data for 2000 show about 162,100 residents in the Upper Colorado River Planning Area. Arizona Department of Commerce (ADOC) population projections forecast that the planning area population will double by 2030, to about 323,100 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.

As listed in Table 4.0-4 the most populous basins reported in the 2000 Census were Lake Mohave (51,549), Lake Havasu (44,591), Hualapai Valley (37,544), and Sacramento Valley (17,575). The remaining basins had a combined population of less than 10,000 residents. The 2000 Census population of the Fort Mojave Reservation was 773, with 1,353 residents on the entire Hualapai Indian Reservation.

Listed in Table 4.0-5 are incorporated and unincorporated communities in the planning area with 2000 Census populations greater than 1,000 and their 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 2000 Census. 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 71% during this time. Mohave County is the fourth most “urban” county in the state, with 75% of its residents residing in “urban clusters,” defined by the U.S. Census Bureau as densely settled areas with a population of



London Bridge in Lake Havasu City, Lake Havasu Basin. Lake Havasu City is the largest city in the Planning Area with a 2000 Census population of 41,938.

2,500 to 49,999. Communities with more than 1,000 residents grew at a rate of 58% compared to 184% outside these areas between 1990 and 2000.

Population Growth and Water Use

Growing Smarter and Local Planning

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 portion 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

Table 4.0-4 2000 Census population of the Upper Colorado River Planning Area and Indian Reservations

Basin/Reservation	2000 Census Population
Lake Mohave	51,549
Fort Mojave	773
Lake Havasu	44,591
Hualapai Valley	37,544
Sacramento Valley	17,575
Bill Williams	4,691
Peach Springs	1,780
Hualapai	1,353
Detrital Valley	1,373
Big Sandy	1,142
Meadview	823

Source: U.S. Census Bureau 2006

Table 4.0-5 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	2006 Pop. Estimate ¹	Percent Change 2000-2006	Projected 2030 Pop.
Lake Havasu City	Lake Havasu	24,363	41,938	72%	54,610	30%	103,093
Bullhead City	Lake Mohave	21,951	33,769	54%	39,930	18%	57,391
Kingman	Sacramento Valley	12,722	20,069	58%	27,635	38%	50,872
New Kingman-Butler	Hualapai Valley	11,627	14,810	27%	16,651	12%	22,911
Mohave Valley	Lake Mohave	6,962	13,694	97%	17,587	28%	30,826
Golden Valley	Lake Mohave	2,619	4,515	72%	5,611	24%	9,340
Desert Hills	Lake Havasu	1,700	2,183	28%	2,462	13%	3,412
Dolan Springs	Detrital Valley	1,090	1,867	71%	2,316	24%	3,845
Bagdad	Bill Williams	1,858	1,578	-15%	1,578	0%	1,578
Total >1,000		84,892	134,423	58%	168,380	25%	283,268
Other		9,722	27,645	184%	26,928	-3%	40,079
Total		94,614	162,068	71%	195,308	21%	323,347

¹ 2006 populations are estimated for incorporated areas and projected for unincorporated areas.

Source: Arizona Department of Commerce, 2006 & 2007, U.S. Census Bureau 2006

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 water resource 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. Completed plans are listed in basin references in this volume.

Water System Plans and Annual Reports

Beginning in 2007, all community water systems in the state were required to submit Annual Water Use Reports and System Water

Plans. The reports and plans are intended to reduce community water system vulnerability to drought, and to promote water resource planning to ensure that water providers are prepared to respond to water shortage conditions. In addition, the information will allow the State to provide regional planning assistance to help communities prepare for, mitigate and respond to drought. An Annual Water Use Report must be submitted each year by the systems that includes information on water pumped, diverted and received, water delivered to customers, and effluent used or received. The System Water Plan must be updated and submitted every five years and consist of three components, a Water Supply Plan, a Drought Preparedness Plan and a Water Conservation Plan. By January 1, 2008, all systems were required to submit plans. By the end of 2008, plans had been submitted by 34 community water systems in the planning area. Almost all of the larger systems submitted plans and were used to prepare this document. Annual water report information and a list of water plans are found in Appendix B.

Water Adequacy Program

The Department's Water Adequacy Program also relates water supply and demand to growth to some extent, but does not control growth. 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 inadequate, lots may still be sold, but the condition of the water supply must be disclosed in promotional materials and in sales documents. Legislation adopted in June 2007 (SB 1575) authorizes a county board of supervisors to adopt a provision, by unanimous vote, that requires a new subdivision to have an adequate water supply in order for the subdivision to be approved by the platting authority. If adopted, cities and towns within the county may not approve a subdivision unless it has an adequate water supply. If the county does not adopt the

provision, the legislation allows a city or town to adopt a local adequacy ordinance that requires a demonstration of adequacy before the final plat can be approved. To date, no counties, cities or towns in the planning area have adopted the provisions of SB 1575.

Subdivision adequacy determinations (Water Adequacy Reports), including the reasons for inadequate determination, are provided in basin tables and maps and are summarized in Table 4.0-6. Also shown in the basin sections are approved applications for an Analysis of Adequate Water Supply (AAWS). This application is typically associated with large, master planned communities. During 2005 to 2007, there was considerable development activity in the northwestern part of the planning area. This area is relatively near Las Vegas, NV, then 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. AAWS applications for a number of large developments in the planning area have been approved by the Department. As of the end of 2008 a total of 19 applications totaling more than 421,800 lots had been approved. Approved applications include approximately: 51,000 lots



White Hills Road, Detrital Valley Basin. During 2005-2007 there was considerable development activity occurring in the northwestern part of the planning area.

in the Detrital Valley Basin; 259,900 lots in the Hualapai Valley Basin; and 110,300 lots in the Sacramento Valley Basin. Information regarding the status of pending and approved applications is available at the Department's website.

The service areas of eight water providers in the planning area are designated as having an adequate water supply. A service area designation exempts subdivisions from demonstrating water adequacy if served by the provider. Designation information and the general location of designated service areas are also shown in basin maps and tables. As of December, 2008, designated providers included:

- Cerbat Water Company (Cerbato 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 April 2009, an application was pending to modify the designation of the Golden Valley Water Improvement District. The designation modification for the City of Bullhead City was approved in 2008. It is planning to become a water provider and applied to modify its des-

Table 4.0-6 Water adequacy determinations in the Upper Colorado River Planning Area

Basin	Number of Subdivisions	Number of Lots ¹	Lots w/Adequate Determination	Lots w/Inadequate Determination	Approx. Percent of Lots w/ Inadequate Determination
Big Sandy	4	>608	UNK	608	UNK
Bill Williams	8	>264	>264	0	0%
Detrital Valley	29	>6,090	0	>6,090	100%
Hualapai Valley	50	>19,393	10,969	>8,424	43%
Lake Havasu	14	>1,697	>1,697	UNK	UNK
Lake Mohave	265	>32,802	>32,530	272	1%
Meadview	5	4,793	0	4,793	100%
Peach Springs	2	51	0	51	100%
Sacramento Valley	32	>4,415	1,200	>3,215	73%
TOTAL	409	>70,113	>46,660	>23,453	33%

Source: ADWR 2008b

¹ Data on number of lots are missing for some subdivisions, actual number is larger (>)

UNK = Unknown

ignation to reflect that change. Prior to modification it was designated 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.

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 is 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 here. Subsequent water supply and demand discussions and basin chapters 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 4.0-7 shows the average annual Colorado River water that was consumptively used 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 flows 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



Colorado River, Bill Williams Basin. Water supplies in the Upper Colorado River Planning Area include Colorado River water, other surface water, groundwater, and effluent.

Table 4.0-7 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 ²	Current Entitlement
Bill Williams								84
Agricultural	None							
Industrial	None							
Municipal	0	0	0	0	20	18	26	
Environmental	None							
Detrital								Unspecified
Agricultural	None							
Industrial	None							
Municipal	0	0	0	0	116	146	126	
Environmental	None							
Lake Havasu								29,254 16,317
Agricultural	None							
Industrial	None							
Municipal	5,554	8,075	8,872	11,604	13,376	15,053	14,619	
Environmental ³	14,300	14,064	7,828	15,456	15,927	12,561	7,577	
Lake Mohave								144,535 175 44,192 16,317
Agricultural	20,209	47,172	73,885	83,109	96,123	107,700	82,639	
Industrial	216	220	158	103	80	0	0	
Municipal	295	298	581	6,062	7,857	9,669	9,328	
Environmental ³	14,300	14,064	7,828	15,456	15,927	12,561	7,577	
Sacramento								9,205 260,079
Agricultural	None							
Industrial	None							
Municipal	None							
Environmental ³	8,066	7,934	4,416	8,719	8,984	7,086	4,274	
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

Notes:

¹ The reported consumptive use for individual users may not cover an entire 5 year period; the averages are based on the years of record.

² In 2003, the United States Bureau of Reclamation (Reclamation) began deducting unmeasured return flows from individual divertors. Prior to this time, Reclamation only deducted the total unmeasured return flow from the total Lower Basin diversions.

³ The Havasu National Wildlife Refuge spans an area in the Lake Mohave, Lake Havasu, and Sacramento Valley basins. Consumptive use has been prorated based on the percentage of refuge land area in each basin.

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

and return flowe separately by diverter for each lower basin state.

flow and estimates of unmeasured return flows to the mainstream.

According to the Article V report, consumptive use of Colorado River water in the planning area for agricultural, municipal, industrial and environmental purposes averaged 107,923 AFA for the 2001-2005 time period. Table 4.0-7 lists the total quantities of Colorado River 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

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 July 16, 2008, Reclamation proposed to develop a rule for Regulating Non-Contract Use of Colorado River Water in the Lower Basin (73 Federal Register 40916 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. The proposed rule would establish a methodology that Reclamation would use to determine if a well pumps Colorado River water and a process for a water user to appeal a subsequent finding (USBOR, 2008). As of June 2009, Reclamation had not adopted a rule.

Because of the complexity of the accounting system and its unique methodology that includes return flow and other considerations, the surface water and groundwater discussions in this overview section and 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. This approach is comparable to that used for other planning areas. The tables do not attempt to distinguish whether the water is used pursuant to the Colorado River entitlement system.

Entitlement Priority Levels

Rights to Colorado River water include the following priority levels in the State of Arizona:

- 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 Arizona entitlement; and

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



Agriculture on the Fort Mojave Indian Reservation. 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.

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. MCWA members include Arizona-American Water Company (Havasu), 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, MCWA can acquire additional water supplies, including effluent, and it may store, recharge and recover these supplies for the benefit of Mohave County water users. MCWA 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 on-river Colorado River M&I water users have no alternate water supply during times of shortage. Regardless of whether water is diverted directly from the Colorado River or pumped from wells 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 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



Colorado River, Lake Mohave Basin.

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.

Drought

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 in 2006 and 2007 (USBOR, 2006a and 2007c). During this period, storage in Colorado River reservoirs dropped from near

capacity to 54 percent of capacity by the end of 2007. Conditions improved somewhat in 2008 but by April 2009 Lake Powell water levels were at 52% of capacity.

Reclamation lacked specific 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. The Final EIS was adopted in November 2007 and the Record of Decision was signed in December (USDO, 2007). One of the purposes of the guidelines is to provide greater predictability regarding the amount of annual water deliveries to mainstream Colorado River water users in the Lower Division states (USBOR, 2007a). The effect of drought and other hydrologic conditions on water levels in Lake Mead is shown in Figure 4.0-13. Lowering water levels have resulted in closure



Black Canyon below Hoover Dam, Lake Mohave Basin. The Colorado River Basin experienced five consecutive years of extreme drought during water years 2000-2004.

and relocation of boat marinas at Lake Mead, and formation of a rapid at Pearce Ferry which had been a boat ramp.

Surface Water

An average of about 69,800 AFA of surface water was used during 2001-2005, which constitutes about 39% of the total water supply during this period. Surface water diverted from the Colorado River was the primary water supply in the Lake Mohave Basin (69,000 AFA) where it was the principal supply for agricultural and industrial use, particularly by the Fort Mojave Indian Tribe. About 500 acre-feet of surface water from springs near Bagdad in the Bill Williams Basin provided a municipal and industrial supply for the town of Bagdad and the Bagdad

mine. Small volumes of surface water, diverted from the Colorado River, are used in the Detrital Valley and Lake Havasu basins. Surface water may have been 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 volume of surface water, groundwater and effluent used in the planning area is shown in Figure 4.0-14.

Legal availability of a surface water supply is an important consideration. As described in detail in Appendix C, the legal framework and process under which surface water right applications and claims are administered and determined is complex. Rights to surface water are subject

Figure 4.0-13 Lake Mead End of Month Elevation 1980-2007



Source: USBOR, 2007c

to the doctrine of prior appropriation which is based on the tenet “first in time, first in right”. This means that the person who first put the water to a beneficial use acquires a right that is superior to all other surface water rights with a later priority date. Under the Public Water Code, beneficial use is the basis, measure and limit to the use of water. Each type of surface water right filing is assigned a unique number as explained in Appendix C and shown in Table 4.0-8. A Certificate of Water Right (CWR) may be issued if the terms of the permit to appropriate water (3R, 4A, or 33, and in certain cases 38), are met. CWRs retain the original permit application number. However, the act of filing a statement of claim of rights to use public waters (36) does not in itself create a water right.

Surface water rights may also be determined through judicial action in state or federal court in which the court process establishes or confirms the validity of the rights and claims and ranks them according to priority. Court decreed rights

are considered the most certain surface water right. A court decree, *Arizona v. California* 373 U.S. 546 (1963), confirmed the apportionment of waters from the mainstem of the Colorado River to the Lower Basin States, set Arizona’s allotment of Colorado River water at 2.8 maf and reserved irrigation water for reservations along the river including the CRIT and Fort Mohave reservations in the planning area.

Arizona has two general stream adjudications in progress to determine the nature, extent and priority of water rights across the entire river systems of the Gila River and the Little Colorado River. The Upper Colorado River Planning Area is outside of the stream adjudication boundaries.

Table 4.0-8 summarizes the number of surface water right filings in the planning area. The methodology used to query the Department’s surface water right and statement of claimant (SOC) registries is described in Appendix C. Of the 9,916 filings that specify surface water diversion points and places of use in the planning area, 1,223 CWRs have been issued to date. Most of these are located in the Bill Williams (713) and Big Sandy (301) basins. Figure 4.0-15 shows the location of surface water diversion points listed in the Department’s surface water rights registry. The numerous points reflect the large number of stockponds and reservoirs that have been constructed in the planning area as well as diversions from streams and springs. Locations of registered wells, many of which are referenced as the basis of claim in SOC’s are also shown in Figure 4.0-15.

The location of surface water resources for each basin are shown on surface water condition maps and maps showing perennial and intermittent streams and major springs in sections 4.1 to 4.9. Basin tables list data on streamflow, flood ALERT equipment, reservoirs, stockponds and springs.

Figure 4.0-14 Average Annual Water Supply Utilized in the Upper Colorado River Planning Area, 2001-2005 (in acre-feet)

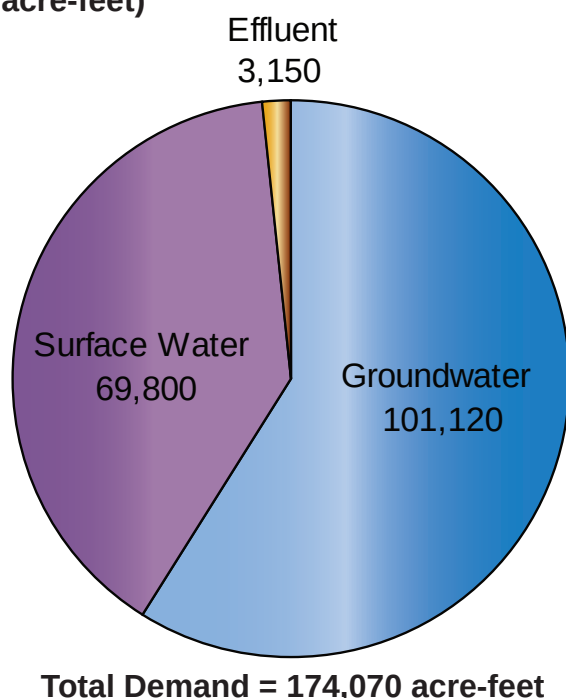


Table 4.0-8 Inventory of surface water right and adjudication filings in the Upper Colorado River Planning Area¹

Basin	Type of Filing							Total
	BB ²	3R ³	4A ³	33 ³	36 ⁴	38 ⁵	39 ⁶	
Big Sandy	0	80	81	75	743	205	0	1,184
Bill Williams	0	111	136	326	1,492	5,595	0	7,660
Detrital Valley	0	2	6	4	58	41	0	111
Hualapai Valley	0	5	34	15	103	73	0	230
Lake Havasu	0	0	2	1	6	0	0	9
Lake Mohave	0	0	11	9	75	1	0	96
Meadview	0	0	6	1	20	14	0	41
Peach Springs	0	25	0	13	70	111	0	219
Sacramento Valley	0	1	34	12	279	40	0	366
Total	0	224	310	456	2,846	6,080	0	9,916

Notes:

¹ Based on a query of ADWR's surface water right and adjudication registries in February 2009. A file is only counted in this table if it provides sufficient information to allow a point of diversion (POD) to be mapped within the basin. If a file lists more than one POD in a given basin, it is only counted once in the table for that basin. Numerous surface water right filings are not counted here due to insufficient information on POD locations. However, multiple filings for the same POD are counted.

² Court decreed rights; not all of these rights have been identified and/or entered into ADWR's surface water rights registry.

³ Application to construct a reservoir, filed before 1972 (3R); application to appropriate surface water, filed before 1972 (4A); and application for permit to appropriate public water or construct a reservoir, filed after 1972 (33).

⁴ Statement of claim of right to use public waters of the state, filed pursuant to the Water Rights Registration Act of 1974.

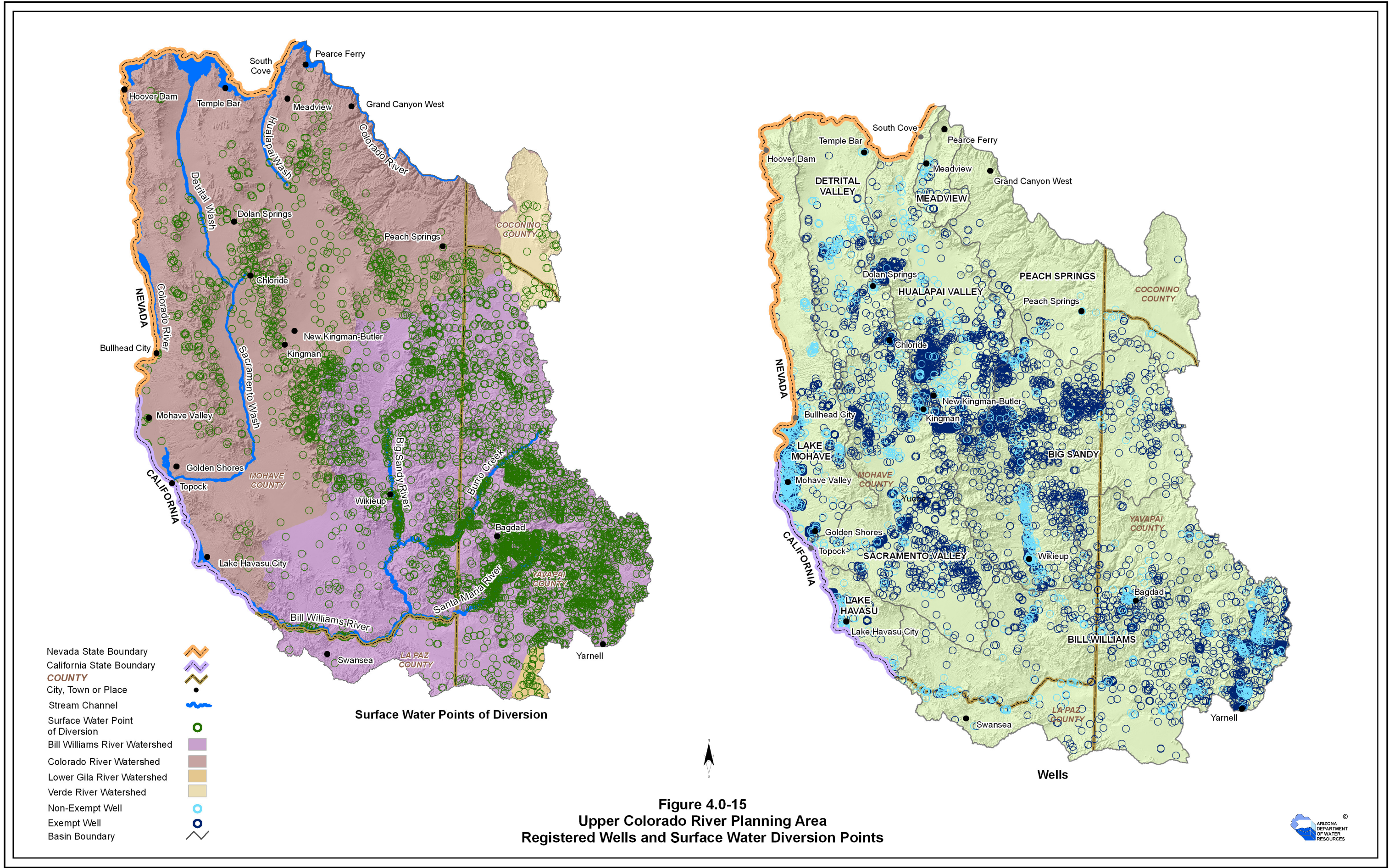
⁵ Claim of water right for a stockpond and application for certification, filed pursuant to the Stockpond Registration Act of 1977.

⁶ Statement of claimant, filed in the Gila or LCR General Stream Adjudications.

Groundwater

Groundwater is a major water supply in the planning area, meeting 59% of the water demand during the period 2001-2005. (Some of this water was pumped pursuant to a Colorado River entitlement). The location of registered exempt and non-exempt wells is shown in Figure 4.0-15. Groundwater met 92% of the municipal demand, 83% of the industrial demand and 35% of the agricultural demand during this time period and averaged about 101,000 AFA. 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 bls are found in the Hualapai Valley, Peach Springs and northern Sacramento Valley basins. Groundwater is pumped from basin fill in most basins with the exception of the Meadview and

Lake Mohave basins. Recent stream alluvium 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 basins. In the Bill Williams and Sacramento Valley basins, aquifers in volcanic rock are also utilized. Groundwater is limited due to water quality and quantity problems at the town of Chloride, north of Kingman. Groundwater is the primary or only water supply in most basins with the exception of the Lake Mohave Basin where large volumes of surface water are diverted for agricultural and industrial use.



Well yields appear to be sufficient for most uses in the planning area. Median well yields from large (>10-inch) diameter wells ranged from approximately 35 gpm in Detrital Valley and Meadview basins to more than 1,000 gpm in Lake Havasu and Lake Mohave basins where most wells are in proximity to the Colorado River. Yields from large wells in the Hualapai Valley Basin were also relatively high, with a median of 900 gpm. In other basins median well yields range from 100 gpm in the Sacramento Valley Basin to 300 gpm in the Bill Williams Basin. Estimated volumes of groundwater in storage may be relatively limited to meet future demands in some areas especially given low groundwater recharge rates.

The USGS, in conjunction with the Department, in light of proposed land developments, recently conducted investigations of groundwater conditions in the Detrital Valley, Hualapai Valley and Sacramento Valley basins. As a result, the Department released revised estimates of the volume of groundwater in storage in the Detrital Valley and Sacramento Valley basins. Groundwater storage estimates to a depth of 1,200 feet bls in 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.

The Department's Groundwater Site Inventory (GWSI) database, the main repository for statewide groundwater well data, is available on the Department's website (www.azwater.gov). The GWSI database contains of over 42,000 records of wells and over 210,000 groundwater level records statewide. GWSI contains spatial and geographical data, owner information, well construction and well log data, and historic groundwater data including water level, water quality, well lift and pumpage records. Included are hydrographs for statewide Index Wells and Automated Groundwater Monitoring Sites (Automated Wells), which can be searched and down-

loaded to access local information for planning, drought mitigation and other purposes.

Approximately 1,700 wells are designated as Index Wells statewide out of over 43,700 GWSI sites (GWSI sites are primarily wells but include other types of sites such as springs and drains). Typically, Index Wells are visited once each year by the Department's field staff to obtain a long-term record of groundwater level fluctuations. Approximately 200 of the GWSI sites are designated as Automated Wells. These systems measure water levels 4 times daily and store the data electronically. Automated wells are established to better understand the water supply situation in areas of the state where data are lacking. These devices are located 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.



Automated Groundwater Monitoring Site in the Hualapai Valley Basin.

Volume 1 of the Atlas shows the location of Index Wells and Automated Wells as of January 2009. At that time there were a total of 93 Index Wells and nine Automated Wells in the Planning Area. The Automated Wells are located in the Hualapai Valley, Sacramento Valley, Detrital Valley, Bill Williams and Meadview basins. The most updated maps of Index and Automated wells may be viewed at the Department's website.

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 basin sections.

Effluent

Effluent is a potential water supply at locations throughout the planning area, with about 10,200 acre-feet produced annually. Currently, about 3,100 AFA of effluent is used in the Lake Havasu and Lake Mohave basins for turf irrigation. Approximately 3,300 acre-feet of effluent was produced in the Lake Havasu Basin in 2008 and

in 2006 more than 2,400 acre-feet was used. Lake Havasu City is evaluating new sources of effluent demand as well as effluent recharge.

Approximately 3,100 acre-feet of effluent is produced in the Lake Mohave Basin each year. Within the basin, Bullhead City annually delivers about 600 acre-feet of effluent and Arizona-American Water Company delivers about 180 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 that serves the community of Peach Springs consists of a sewer 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 produced a total of about 400 acre-feet of effluent, that was disposed in evaporation ponds or in a watercourse.



View of the City of Kingman from the Hualapai Valley Basin. Effluent is not currently reused in the Hualapai Valley or Sacramento Valley Basins.

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 the volume of wastewater treated and the disposal method(s) 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 (DOD), Superfund (Environmental Protection Agency designated sites), Resource Conservation and Recovery Act (RCRA), Water Quality Assurance Revolving Fund (state designated WQARF sites), Voluntary Remediation Program (VRP), and Leaking Underground Storage Tank (LUST) sites was conducted for the planning area. Of these various contamination sites only LUST and VRP sites are found in this planning area. Table 4.0-9 lists VRP sites, their contaminants and affected media, and respective basins. The location of all contamination sites in the planning area is shown on Figure 4.0-16.

There are five active VRP sites, primarily associated with crude oil contamination of soil. 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).

There are 153 active LUST sites including 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

Cultural water demand in the Upper Colorado River Planning Area is shown in Figure 4.0-17. As shown, agricultural demand is the largest use sector at approximately 99,550 AFA due

Table 4.0-9 Contamination sites in the Upper Colorado River Planning Area

SITE NAME	MEDIA AFFECTED AND CONTAMINANT	GROUNDWATER BASIN
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 2006a, ADEQ 2006b



Figure 4.0-16
Upper Colorado River Planning Area
Contamination Sites



almost entirely to farming in the Lake Mohave Basin. Municipal demand is the next largest water demand sector with approximately 52,400 AFA met primarily by groundwater. Industrial demand, mainly for mining, is about 22,100 AFA. Total demand averaged approximately 174,100 AFA during the period from 2001-2005.

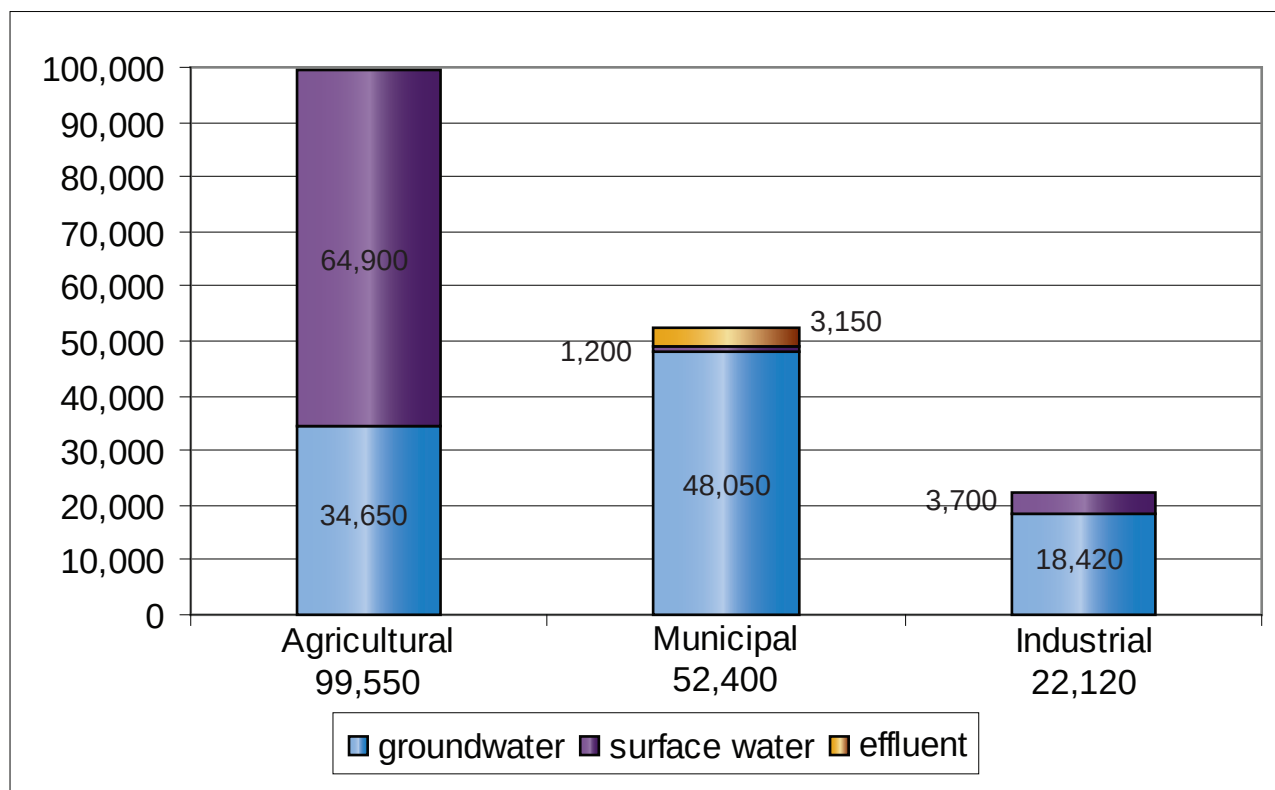
The volume of cultural demand varies substantially between the planning area basins and ranges from about 150 AFA in the Meadview Basin to about 118,800 AFA in the Lake Mohave Basin (see Figure 4.0-18).

Tribal Water Demand

The Fort Mojave Indian reservation includes lands in Arizona, Nevada and California but almost 70% of its land base (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 provides municipal 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 South Point plant is designed to capture waste heat to generate a second phase of electricity, making it 40% more efficient than

Figure 4.0-17 Average Annual Upper Colorado River Planning Area Cultural Water Demand by Sector, 2001-2005 (in acre-feet)



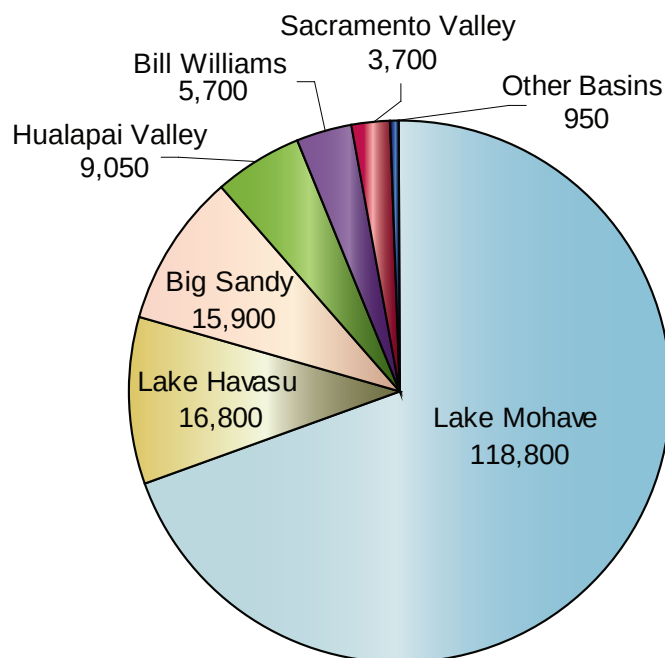
older natural gas plants. Water use is estimated at 4,000 AFA of surface water (BIA, 1998).

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 AFA. 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 water pipeline maintenance to cattle districts. (Hualapai Tribe, 2007)

The Hualapai Nation operates a tourist development at Grand Canyon West where a 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 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.

Figure 4.0-18 Average Annual Basin Water Demand, 2001-2005 (in acre-feet)



Municipal Demand

Average municipal demand for 2001-2005 was about 52,400 AFA; 32% of the total cultural water demand. Municipal water demand is summarized by groundwater basin and water supply in Table 4.0-10. 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. An average of 48,050 AFA of groundwater was used during the period 2001-2005. The largest volume of municipal groundwater use is in the Lake Mohave Basin with 18,800 AFA of demand, 39% the total groundwater use. About 1,200 AFA of surface water is used for municipal purposes. The town of Bagdad in the Bill Williams Basin may use up to 500 acre-feet of surface water diverted from springs as a primary municipal supply. About 3,100 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 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 AFA.

Only nine water providers in the planning area served 450 acre-feet of water or more in 2000 or 2006. These providers and their demand in selected years are listed in Table 4.0-11 and are discussed below. 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. In 2007, the City acquired the legal authority to become a municipal water provider and serves Laughlin Ranch on the east side of the city.

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.

With two exceptions, all golf courses in the planning area are served from a municipal water supply. All golf courses are listed in Table 4.0-12 with estimated demand and source of water. Golf courses that irrigate with water pumped entirely 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.

Fifty-six 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, two facilities used 100% effluent in 2006: London Bridge Golf Course, and Nautical/Havasu Island Inn Golf Club. In addition, some effluent was delivered to Refuge Golf Course (amount not known) and about 100 acre-feet of effluent was used for other turf irrigation. In the Lake Mohave Basin, about 720 acre-feet of effluent is used to irrigate three golf courses and one park. Bullhead City delivers about 475 acre-feet of effluent per year to Chaparral Country Club and Laughlin Ranch, and about 65 AFA to Rotary Park. Arizona-American Water Company delivers about 180 acre-feet of effluent per year to the Riverview Golf

Table 4.0-10 Average annual municipal water demand in the Upper Colorado River Planning Area, 2001-2005 (in acre-feet)

Basin	Groundwater	Surface Water	Effluent ¹	Total
Big Sandy	<300	0	0	150
Bill Williams	950	500	0	1,450
Detrital Valley	<300	<300	0	300
Hualapai Valley ²	8,900	0	0	8900
Lake Havasu	16,500	<300	2,433	19,083
Lake Mohave	18,800	400	715	19,915
Meadview	<300	0	0	150
Peach Springs	350	0	0	350
Sacramento Valley	2,100	0	0	2,100
Total Municipal	48,050	1,200	3,148	52,398

Sources: USGS 2007, ADWR 2007

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

Table 4.0-11 Water providers serving 450 acre-feet or more of water per year in 2000 or 2006, excluding effluent, in the Upper Colorado River Planning Area

Water Provider	1991 (acre-feet)	2000 (acre-feet)	2006 (acre-feet)
Bill Williams			
Phelps Dodge Bagdad, Inc, Utilities Dept.	871	749	445
Lake Havasu			
Lake Havasu City	11,961	14,630	14,534
Lake Mohave			
Arizona American Water-Mohave Water (Bullhead City)	4,012	6,220	6,733
Bermuda Water Company (Bullhead City)	915	951	3,883
Golden Shores Water Company	353	452	492
North Mohave Valley Water (Bullhead City)	269	642	1,148
Willow Valley Water (Mohave Valley)	542	455	395
Sacramento Valley			
City of Kingman	5,950	7,294	9,078
Valley Pioneers Water Company	316	500	688

Sources: ADWR 2004, ADWR Community Water System 2006 Annual Reports

Notes:

1991 and 2000 demand for the Town of Bagdad may include some industrial demand by the Bagdad Mine.

Course. It is anticipated that effluent use for turf irrigation will increase in the planning area since Colorado River contract entitlements are capped and growth continues.

Freeport McMoRan Copper and Gold, Inc. Utilities Department

The Town of Bagdad is a mining community served water by Freeport McMoRan Copper and Gold, Inc. Utilities (Freeport McMoRan) formerly Phelps Dodge, Inc. Utilities. The reported groundwater withdrawal in 2006 was 445 acre-feet, and 991 acre-feet in 2007. Six wells and 2 emergency wells serve the community of approximately 1,600 residents. The system water plan for Freeport McMoRan refers to water from Francis Creek Springs as “the primary source of potable water” for the town of Bagdad, but this is not reported on the CWS annual reports (Malcolm Pirnie, 2006). Either this water is used entirely at the mine site or the actual water use by the town is larger. Freeport McMoRan reported 82% of its deliveries to residential customers, 6% to commercial and 12% to turf. In addition to the

main town site, Freeport McMoRan serves the Sycamore Springs Mobile Home Park from 2 wells. Commercial customers include shopping centers and a school. Turf includes a nine-hole golf course, a park and school playing fields. Treated effluent is reportedly used for industrial purposes at the mine.

Lake Havasu City

Lake Havasu City is the largest community in the planning area and a popular tourist destination with a 2006 population of almost 56,000.

In 2006, it reported 14,534

acre-feet of Colorado River water withdrawn primarily from one well. Approximately 65% of this was delivered to single family residential customers, 6% to multi-family, 11% to commercial, 9% to turf and 8% to other. Its total gallon per capita per day rate in 2005 was 240 (Lake Havasu City, 2006). Lake Havasu City is engaged in an aggressive wastewater system expansion program to convert the majority of residences within the city limits to a conventional sewer system. This expansion included construction of the Northwest Regional WWTP, completed in 2007. The three treatment plants treated about 3,300 acre-feet in 2008 (Table 4.5-8). In 2005, approximately 2,400 acre-feet of effluent was used to irrigate two golf courses and landscaping and in 2006, effluent deliveries began to the Refuge Golf Course. The City is seeking additional sources of water to meet future demands since its Colorado River entitlement is insufficient. It has secured additional water supplies from the AWBA and MCWA and is exploring options to acquire more. Water conservation and effluent recharge and recovery are considered potential future supplies.

Table 4.0-12 Golf courses in the Upper Colorado River Planning Area (c. 2008)

Facility	Basin	# of Holes	Demand (acre-feet)	Water Supply
Mesa View Golf Club	Bill Williams	9	120	Groundwater
Cerbat Cliffs Golf Course	Hualapai Valley	18	423	Groundwater
Valle Vista Country Club	Hualapai Valley	18	423	Groundwater
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
Refuge Golf Course	Lake Havasu	18	441	Groundwater/Effluent
Chaparral Country Club	Lake Mohave	9	172/48	Groundwater/Effluent
Desert Lakes Golf Club*	Lake Mohave	18	441	Groundwater
El Rio Country Club*	Lake Mohave	18	441	Groundwater
Laughlin Ranch	Lake Mohave	18	425	Effluent
Riverview Golf Club	Lake Mohave	9	178	Effluent
Total Demand			5,180	

Source: ADWR 2008c, USBOR 2006c

Notes:

* These golf courses are served by their own wells and considered to be industrial users

Arizona American Water-Mohave Water

Arizona American Water is the largest of the three large systems that serve Bullhead City. It serves all but the southern and northern portions of the city. In 2006 it withdrew approximately 6,700 acre-feet of water from six wells. In that year it served almost 5,200 acre-feet to residential customers and 1,500 acre-feet to non-residential customers. The system has an emergency interconnection with the Bermuda Water Company.

Bermuda Water Company

Bermuda Water Company, the second largest system serving Bullhead City, serves the southern portion of the city, most of Fort Mojave Mesa and the northern portion of Mohave Valley. It withdrew 3,883 acre-feet of water from 8 wells in 2006. Of this total, 318 acre-feet was delivered to other utilities located at Fort Mojave and Mohave Valley. Within its service area it delivered 3,264 acre-feet to single family residences, 106 acre-feet to turf and 151 acre-feet to commercial customers.

North Mohave Valley Water

The third large system serving Bullhead City serves the northern part of the city. It withdrew 1,148 acre-feet of water from seven wells in 2006. Of this, 674 acre-feet was delivered to residential customers and 415 acre-feet to commercial and construction customers.

Golden Shores Water Company

Golden Shores Water Company (GSWC) serves the Town of Golden Shores located in the far southern portion of the Lake Mohave Basin. The water system has approximately 1,516 connections in an eight square mile service area. In 2006 it withdrew 492 acre-feet from four of its five wells to serve primarily residential customers.

Willow Valley Water Company

The Willow Valley Water Company consists of two systems that are not interconnected: the larger King Street System and the Lake Cimarron System. The systems are about three miles apart. The water company service area covers 2,700 acres of non-contiguous sections dispersed within Fort Mojave Indian Reservation lands. In 2006 the systems withdrew approxi-

mately 395 acre-feet of water from 3 of 6 company wells. Of this, 342 acre-feet was delivered to residential customers and 28 acre-feet to non-residential customers.

City of Kingman

The second largest water provider in the planning area, the City of Kingman Municipal system serves Kingman and New Kingman-Butler. The community straddles the Sacramento Valley/Hualapai Valley basin boundary. Kingman/New Kingman-Butler is a rapidly growing area with a number of large master planned communities planned in the area. It has a service area of over 46 square miles and provides water service to over 44,000 residents. Kingman has a contract with Mohave County to provide water service to over 9,000 connections outside the city limits (City of Kingman, 2007).

In 2006, Kingman reported groundwater withdrawals of 9,078 acre-feet from 14 wells. Of this, 5,123 acre-feet was delivered to residential customers and 3,381 acre-feet to non-residential customers. Most of the water is pumped from a well field in the southern part the Hualapai Valley Basin. A smaller portion, approximately 400-500 AFA, is pumped from wells completed in volcanic rock of the Sacramento Valley Basin. Although Kingman had a Colorado River water entitlement of 18,500 AFA, it transferred the allocation to the Mohave County Water Authority since the costs of physically transferring the water was not economically feasible. In exchange for the transfer, the City of Kingman receives revenue for development of its groundwater resources (City of Kingman, 2003).

The City of Kingman operates the Hilltop and Downtown Wastewater Treatment Plants that together produce over 2,000 acre-feet of effluent per year, primarily from the Hilltop plant in the Hualapai Valley Basin. Presently, effluent is not reused and is disposed of in a watercourse, evaporation pond and wetland (Tables 4.4-7 and 4.9-9)

Valley Pioneers Water Company

Valley Pioneers Water Company (VPWC) serves approximately 2,200 residential connections and 70 non-residential customers in Golden Valley, located east of Kingman along Highway 68. In 2006 it withdrew 688 acre-feet of water from three wells and served almost 500 acre-feet to residential customers and 160 acre-feet to commercial customers. In 2007 VPWC withdrew 930 acre-feet of water and delivered 218 acre-feet of water to the Mineral Park Mine in addition to deliveries to its residential and commercial customers. If needed, an emergency water supply is available from Golden Valley Improvement District #1, located west of Valley Pioneers (VPWC, 2007).

Agricultural Demand

Average agricultural demand for 2001-2005 was about 99,550 AFA; 56% of the total cultural water demand. Ninety-six percent of the agricultural demand occurred in the Lake Mohave Basin where principal crops include cotton, alfalfa, hay and wheat. Relatively small amounts of agricultural water demand were 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 4.0-13. As shown, total agricultural demand declined by 9,500 acre-feet between 1991 and 2005. About 65% of the ag-



Agriculture in the Bill Williams Basin

4.0-13 Agricultural demand in the Upper Colorado River Planning Area

	1991-1995	1996-2000	2001-2005
	Water Use (acre-feet)		
<i>Big Sandy</i>			
Groundwater	<300	<300	<300
<i>Bill Williams</i>			
Groundwater	15,600	4,200	4,100
<i>Lake Mohave</i>			
Surface Water	56,600	68,100	64,900
Groundwater	36,700	35,600	30,400
TOTAL	109,050	108,050	99,550

Source: USGS 2007, ADWR 2005

agricultural demand was met with surface water during the period 2001-2005.

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).

Agricultural demand in the Lake Mohave Basin has increased substantially since the early 1970s when less than 20,000 AFA was used. Since 1990, annual agricultural demand has remained relatively constant, with up to 103,700 AFA 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 AFA during the 1991-1995 period to just 4,100 AFA during the 2001-2005 time period. 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

Industrial demand averaged approximately 22,100 AFA during the period 2001-2005; 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. If these use categories are served by a municipal water system they are accounted for as municipal demand. Industrial demand is summarized in Table 4.0-14 for selected time-periods.

Mining is the largest industrial user in the planning area, primarily due to activities at the Freeport McMoRan (formerly Phelps Dodge) Bagdad Mine in the Bill Williams Basin. Most of the water used at the mine is 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 relatively small volume of surface water (probably <500 AFA) from Francis Creek springs and wells in the vicinity of Bagdad may

Table 4.0-14 Industrial demand in the Upper Colorado River Planning Area

	1991-1995	1996-2000	2001-2005
Type	Water Use (acre-feet)		
Mining Total	16,740	17,800	16,610
<i>Big Sandy</i>			
Groundwater	16,200	16,800	15,600
<i>Bill Williams</i>			
Groundwater	<300	<300	<300
<i>Hualapai Valley</i>			
Groundwater	<300	<300	<300
<i>Lake Havasu</i>			
Groundwater	30	130	70
<i>Lake Mohave</i>			
Groundwater	60	70	90
<i>Peach Springs</i>			
Groundwater	<300	<300	<300
<i>Sacramento Valley</i>			
Groundwater	<300	350	400
Power Plant Total	0	0	4,900
<i>Lake Mohave</i>			
Surface Water	0	0	3,700
<i>Sacramento Valley</i>			
Groundwater	0	0	1,200
Golf Course Total	0	440	530
<i>Lake Mohave</i>			
Groundwater	0	440	530
Dairy/Feedlot Total	0	0	80
<i>Sacramento Valley</i>			
Groundwater	0	0	80

Source: ADWR 2008d, USGS 2007

also be used at the mine site or 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.

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. Estimated water use has increased from approximately 2,000 AFA in the early 1970s to an estimated 15,600 AFA 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. (Freeport McMoRan, 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. 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). Mercator Minerals commenced crushing and stacking ore in late 2008 and shipped the first molybdenum concentrates from the mine in 2009 to a roasting facility in Tucson (Reuters, 2009). Current water use is about 220 AFA, delivered from Valley Pioneers Water Company.

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, relatively little water is consumed at these sites.

Four power plants operate 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 4.0-14. 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 4,700,000 megawatt hours (MWh) (USBOR, 2006b). Davis Dam was authorized under provisions of the Recla-

mation Project Act of 1939. Power generated from this 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 969,000 MWh (USBOR, 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 2001-2005 was estimated at about 3,700 AFA 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,



Bagdad Mine, Bill Williams Basin. Mining is the largest industrial water user in the planning area.

2006 to LS Power Equity Partners. An estimated 1,200 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 including solar and wind. As of May 2009 there were plans for four solar plants in the planning area. The two largest are a 340-megawatt plant northwest of Kingman and a 200-megawatt facility south of Kingman. Two smaller facilities have been proposed in the Yucca area and in the Detrital Valley Basin. (Associated Press, 2009)

LS Power has proposed construction of a 175-megawatt gas-fired peaking plant adjacent to the Griffith plant. 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 two “industrial” golf courses in the planning area, both 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 and El Rio Country Club (opened in 2005) are considered industrial facilities. Industrial groundwater demand was 530 AFA during the period 2001-2005. The Riverview Golf Club was an industrial facility but now uses municipal effluent as shown in Table 4.0-12.

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.



South Point power plant, Lake Mohave Basin.

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. Planning and conservation efforts, watershed groups and studies and results from water provider surveys are discussed in this section.

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 although it has not adopted the provision, authorized through legislation in 2007 (SB 1575), that would require a demonstration of adequacy. 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 for a number of years credited with reducing per capita water use. 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 is an incentive program to retrofit existing homes and commercial buildings with low-flow plumbing fixtures (USBOR, 2006c). 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

There are two groups in the planning area that have been formed to address a variety of water resource issues, the Northwest Arizona Water Council and the Mohave County Water Authority (MCWA). 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 (see Section 4.0.6). A complete description of participants, activities and issues is found in Appendix D.

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 and Colorado River water supplies

Legal:

- Concerns regarding proposed development that may use Colorado River water

Water Quality:

- Concerns related to mining activities
- Concerns regarding hexavalent chromium



Lake Havasu City.

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

In addition, the large number of exempt wells and the lack of control or regulation of exempt wells have been identified as a concern in Mohave County. Related to this are the large number of “Legacy Lots”, formed many years ago in the Sacramento Valley basin that lack service from a water company and are served by private wells or hauled water.

In response to concerns by local governments, water 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). To date, several reports have been completed including preliminary estimates of groundwater in storage for the Detrital Valley Basin (Mason and others, 2007) and the Sac-



Hoover Dam bypass bridge under construction. There is concern in the planning area about large master-planned communities planned as a result of completion (2010) of the bypass bridge.

ramento Valley Basin (Conway and Ivanich, 2008). In addition the USGS released a report in 2007 on groundwater occurrence, movement and water level changes in all three basins (Anning and others, 2007).

The Natural Resources Conservation Service (NRCS) has produced a rapid watershed assessment (RWA) for the Detrital Wash Watershed. An RWA is a concise report containing information on natural resource conditions and concerns at the 8-digit HUC level. They are intended to provide sufficient information and analysis to generate an appraisal of the conservation needs of the watershed as well as serve other uses. (Reports are available online at <http://www.az.nrcs.usda.gov/technical/rwa.html>).

Arizona NEMO (Non-point Education for Municipal Officials) has produced a watershed based plan for the Bill Williams Watershed that characterizes and classifies watershed features. The goal of NEMO is to educate land use decision makers to make choices and take actions that will lessen nonpoint source pollution and protect natural resources. (Plans are available online at <http://www.snr.arizona.edu/nemo/>).

As mentioned previously, all community water systems in Arizona are required to submit a water system plan as part of the State's Drought Preparedness Plan. The system water plan includes a water supply plan, water conservation plan, and drought preparedness plan. Water providers are required to develop the plan to ensure they reduce their vulnerability to drought and prepare to respond to potential water shortage conditions.

As part of implementation of the State Drought Plan, Local Drought Impact Groups (LDIGs) are being formed, as necessary, at the county level and a Mohave County group has been established. LDIGs are voluntary groups that will coordinate drought public awareness, provide impact assessment information to local and state leaders and implement and initiate local drought mitigation and response actions. These groups are coordinated by local representatives of Arizona Cooperative Extension and County Emergency Management and supported by ADWR's Statewide Drought program. Information on LDIGs may be found at the department's website.

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 was also intended to gather information on drought impacts for incorporation into the Arizona Drought Preparedness Plan, adopted in 2004. Questionnaires were sent to almost 600 water providers, jurisdictions, counties and tribes. The Department completed a report of the findings from the survey in 2004 (ADWR, 2004).

There were 18 water provider and jurisdiction respondents in the Upper Colorado River Planning Area, and 11 numerically ranked issues. Respondents were asked to rank 18 issues. Insufficient future water supplies was the primary concern of most respondents as shown in Table 4.0-15. Infrastructure issues, which include aging infrastructure and inadequate capital to pay for infrastructure improvements, were ranked among the top five issues by many respondents.

Table 4.0-15 Water resource issues ranked by survey respondents in the Upper Colorado River Planning Area

Issue	Percent of 2003 respondents that ranked issue as one of the top 5 (of 18)	Percent of 2004 respondents reporting issue was a moderate or major concern
Inadequate storage capacity to meet peak demand	27%	30%
Inadequate well capacity to meet peak demand	9	26
Inadequate water supplies to meet current demand	18	13
Inadequate water supplies to meet future demand	64	35
Infrastructure in need of replacement	45	39
Inadequate capital to pay for infrastructure improvements	36	44
Drought related water supply problems	18	39

Source: ADWR, 2004

Note: 2003 respondents consist of 10 water providers and 1 jurisdiction. 2004 respondents included 23 water providers

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

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 indicate that concerns regarding inadequate supplies to meet future demands and infrastructure problems rank high among all respondents.

4.0.9 Groundwater Basin Water Resource Characteristics

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

Geographic Features

Geographic feature maps are included to provide 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 has implications for land and water use. Large amounts of private land typically translate into opportunities for land development and associated water demand, whereas public lands are typically maintained for a specific purpose or multi-use with little associated water use. State owned land may be sold or traded, and is often leased for grazing and farming. 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 specified purposes, which are identified for each basin (ASLD, 2006).

Climate

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

Surface Water Conditions

Depending on physical and legal availability, surface water may be an important water supply in some basins. 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.

Criteria for including stream gage stations in the basin table 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 areas where flooding has been or may be a problem. Large reservoir storage information includes data on the amount of surface water stored in large reservoirs, its uses and ownership. The number and capacity of small reservoirs is also provided as well as the number of stockponds in each basin. The number of stockponds is a general indicator of small-scale surface water capture and livestock demand. Runoff contours reflect the average annual runoff that can be expected in tributary streams over a particular area.

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 reflect current conditions in some cases. Spring data was 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 the 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 and 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 studies are 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, Appendix A. The data indicate areas where water quality exceedences have previously occurred, 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 is 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 are primarily from a 2004 USGS land cover study using older satellite imagery that may not represent recent changes. The cultural demand maps provide only general information about the location of water users.

Effluent generation data was 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 the 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. 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 may apply for an Analysis of Adequate Water Supply (AAWS). This type of application is generally used 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 further adequacy reviews) only for the specific property that is the subject of the AAWS.

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Section 4.1

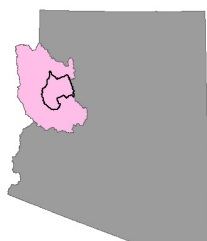
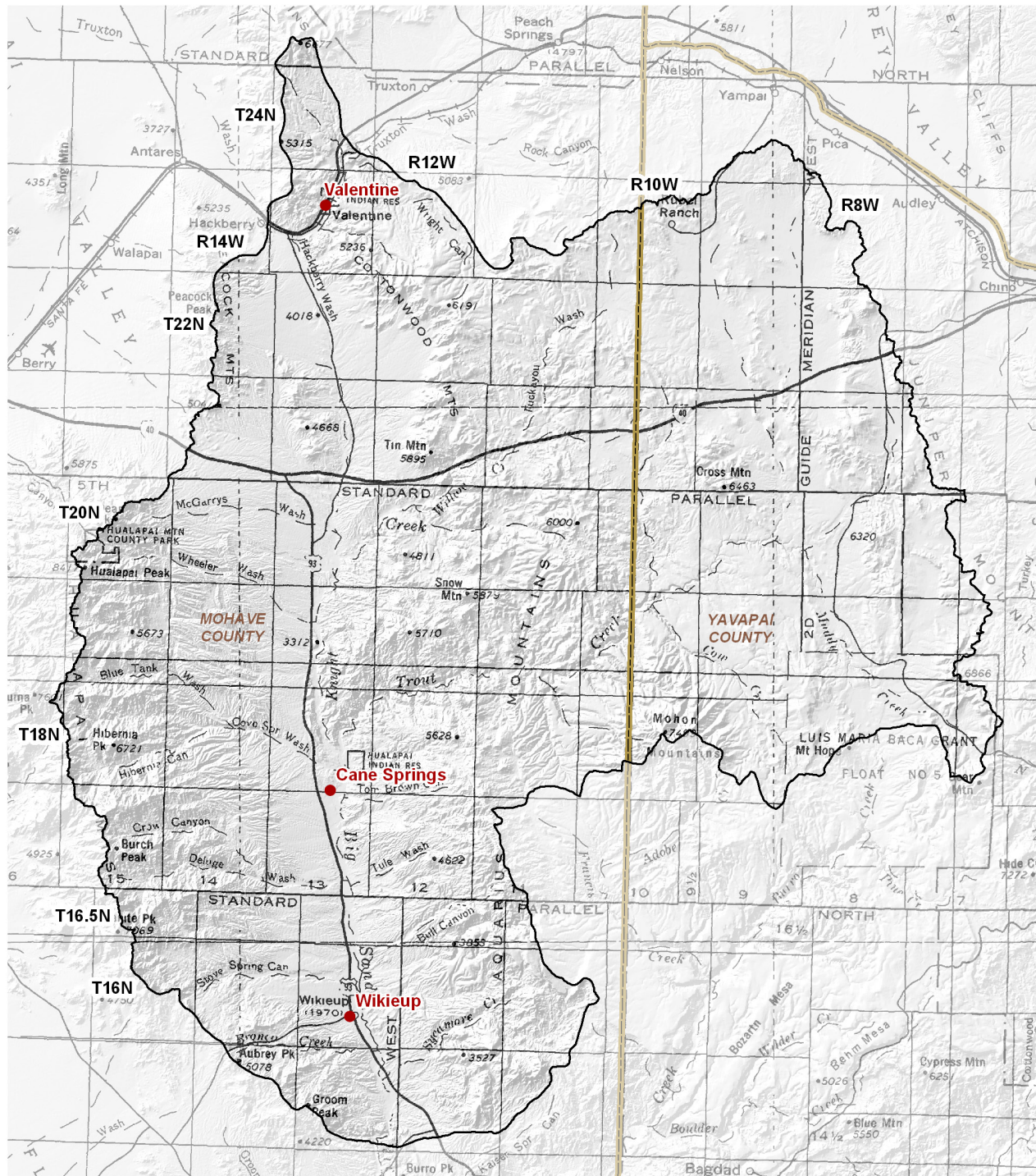
Big Sandy Basin



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 mid-elevation mountain ranges and plateaus. Vegetation types include Arizona upland Sonoran desertscrub, Plains and Great Basin and semi-desert grasslands, interior chaparral, Rocky Mountain and madrean montane forest and Great Basin conifer woodland (see Figure 4.0-9). Riparian vegetation is found along some 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:
 - Big Sandy River running north to south through Cane Springs and Wikieup
 - 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.
 - The lowest point in the basin, about 1,650 feet, is south of Wikieup where the Big Sandy River exits the basin



Base Map: USGS 1:500,000, 1981



Figure 4.1-1
Big Sandy Basin
Geographic Features

COUNTY
City, Town or Place



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, Appendix A. More detailed information on protected areas is found in Section 4.0.4. Land ownership categories are discussed below in the order from largest to smallest percentage in the basin.

Private

- 40.6% of the land is private.
- The majority of the private land is interspersed with 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 BLM.
- 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

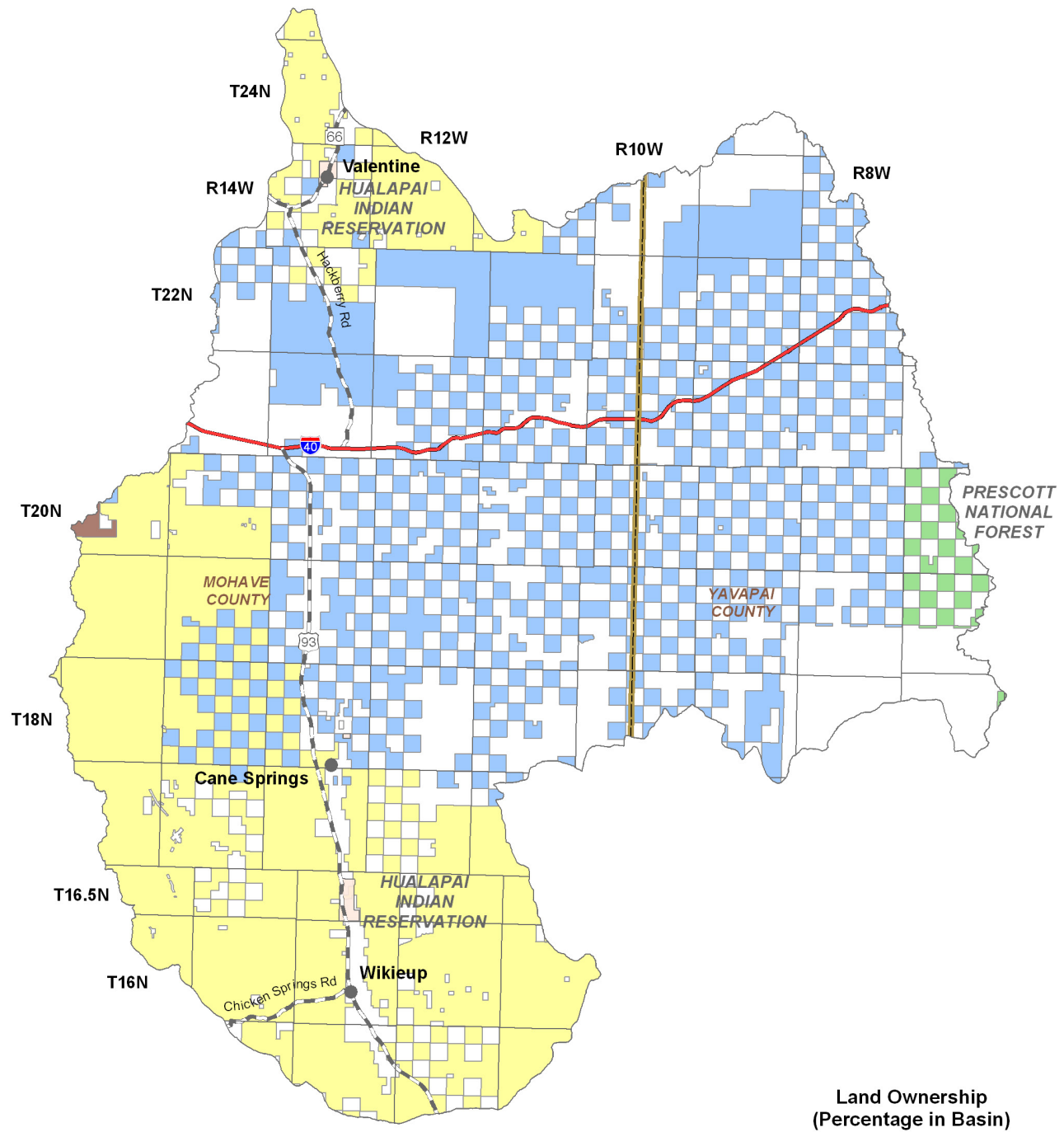
- 0.9% of the land is federally owned and managed by the United States Forest Service (USFS).
- All forest lands in the basin are part of the Prescott National Forest.
- All forest lands are intermingled with private land.
- Land uses include grazing, timber production and recreation.

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



**Land Ownership
(Percentage in Basin)**

- Private (40.6%)
- U.S. Bureau of Land Management (29.7%)
- State Trust (28.5%)
- National Forest (0.9%)
- Indian Reservation (0.2%)
- Other (0.1%)

- COUNTY**
- Interstate Highway
 - Major Road
 - City, Town or Place



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

Source: ALRIS, 2004



4.1.3 Climate of the Big Sandy Basin

Climate data from NOAA/NWS Co-op Network stations are compiled 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. More detailed information on climate in the planning area is found in Section 4.0.3. A description of the climate data sources and methods is found in Volume 1, Appendix A.

NOAA/NWS Co-op Network

- Refer to Table 4.1-1A
- There are two NOAA/NWS Co-op network climate stations in the basin. The average monthly maximum temperature occurs in July at both stations and ranges between 86.4°F at Wikieup to 80.5°F at Truxton Canyon. The average monthly minimum temperature occurs in January and ranges between 48.4°F at Wikieup to 40.9°F at Truxton Canyon.
- Highest average seasonal rainfall occurs in the winter (January - March) at the Wikieup station, while the Truxton Canyon station reports comparable precipitation in the summer (July-September) and winter. For the period of record, the highest annual rainfall is 11.56 inches at Truxton Canyon and the lowest is 9.88 inches at Wikieup.

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.

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, 2005

Notes:

¹Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

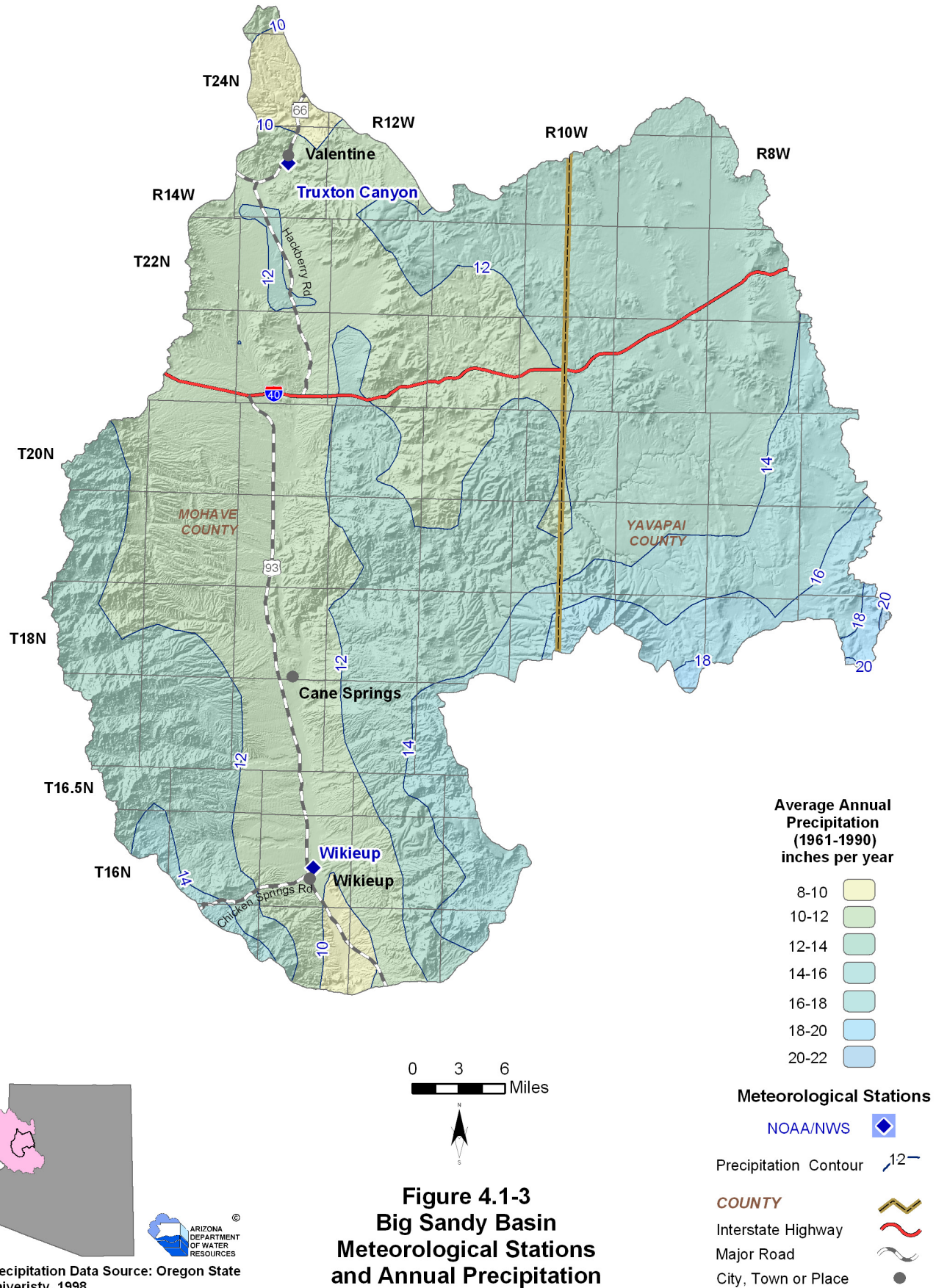
Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

C. AZMET:

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

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record	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								



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 identified by USGS number, flood ALERT equipment, USGS runoff contours and large reservoirs are shown on Figure 4.1-4. Descriptions of stream, reservoir and stockpond data sources and methods are found in Volume 1, Appendix A.

Streamflow Data

- Refer to Table 4.1-2.
- Data from two stations on two watercourses are shown in the table and on Figure 4.1-4. One station has been discontinued and the other is a real-time station.
- The average seasonal flow is highest in the summer (July-September) and lowest in the spring (April-June) and the fall (October-December).
- Maximum annual flow in the basin was 8,326 acre-feet in 1976 at the Cottonwood Wash station and minimum annual flow was 22 acre-feet in 2002 at the Truxton Wash station.

Flood ALERT Equipment

- Refer to Table 4.1-3.
- As of October 2005 there were four stations in the basin, all in Mohave County.

Reservoirs and Stockponds

- Refer to Table 4.1-4.
- The basin contains one large reservoir with a maximum capacity of 2,284 acre-feet which 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.
- There are 426 registered stockponds in this basin.

Runoff Contour

- Refer to Figure 4.1-4.
- Average annual runoff is one inch per year, or 53.5 acre-feet per square mile, in the in the south-central portion of the basin near Cow Creek decreasing to 0.1 inches, or 5.35 acre-feet per square mile, 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)	Gage Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Annual Flow Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9404343	Truxton Wash near Valentine	380	3,770	3/1993-current (real time)	26	8	61	5	22 (2002)	543	875	2,527 (1995)	9
9424200	Cottonwood Wash No. 1 near Kingman	143	4,545	2/1964-9/1978 (discontinued)	37	7	44	12	601 (1975)	2,867	3,026	8,326 (1976)	13

Source: USGS (NWIS) 2005 & 2008

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

In Period of Record, current equals November 2008

Seasonal and annual flow data used for the statistics was retrieved in 2005

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

Source: ADWR 2005b

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

Source: Compilation of databases from ADWR & others

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

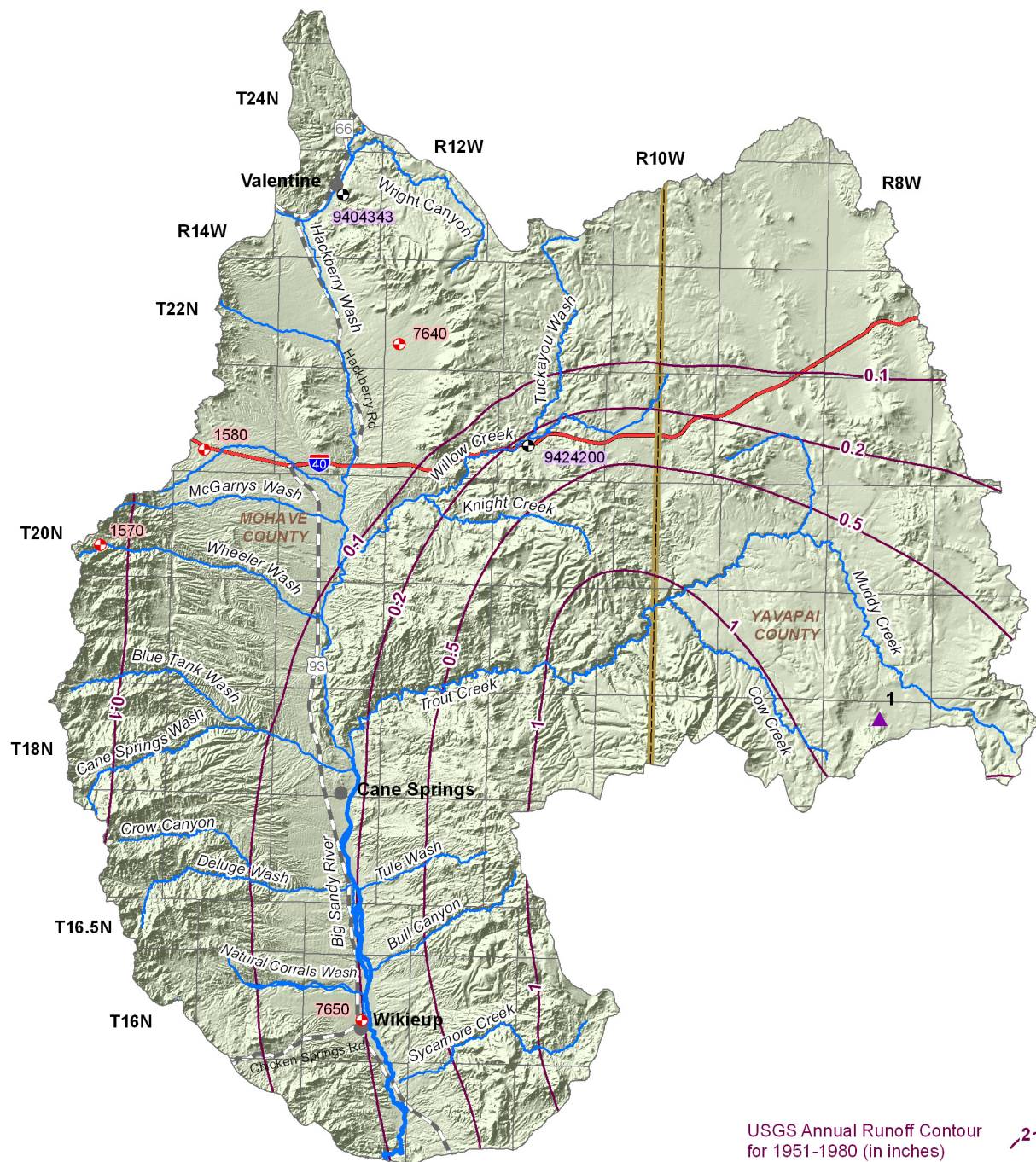
E. Stockponds (up to 15 acre-feet capacity)

Total number: 426 (from water right filings)

Notes:

¹ P=fire protection, stock or farm pond

²Capacity data not available to ADWR



Stream Data Source: ALRIS, 2005

Figure 4.1-4
Big Sandy Basin
Surface Water Conditions

- USGS Annual Runoff Contour for 1951-1980 (in inches) 2—
- Stream Channel (width of line reflects stream order) ~
- Large Reservoir ▲ 1
- Stream Gages**
- USGS Gage and Station ID 9999999
- Flood ALERT Equip. and Station ID 9999
- COUNTY**
- Interstate Highway —
- Major Road —
- City, Town or Place ●

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. Descriptions of data sources and methods for intermittent and perennial reaches and springs are found in Volume 1, Appendix A.

- There are five perennial streams located in the basin, Cottonwood Creek, Willow Creek, Fort Rock Creek, Trout Creek and the Big Sandy River.
- Numerous intermittent streams are located throughout the basin with a relatively large emanating from the western basin boundary.
- There are six major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time. The largest discharge is 1,600 gpm at an unnamed spring near the Big Sandy River south of Cane Springs.
- 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.
- Listed discharge rates may not be indicative of current conditions. All of the measurements were taken during or prior to 1982.
- 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

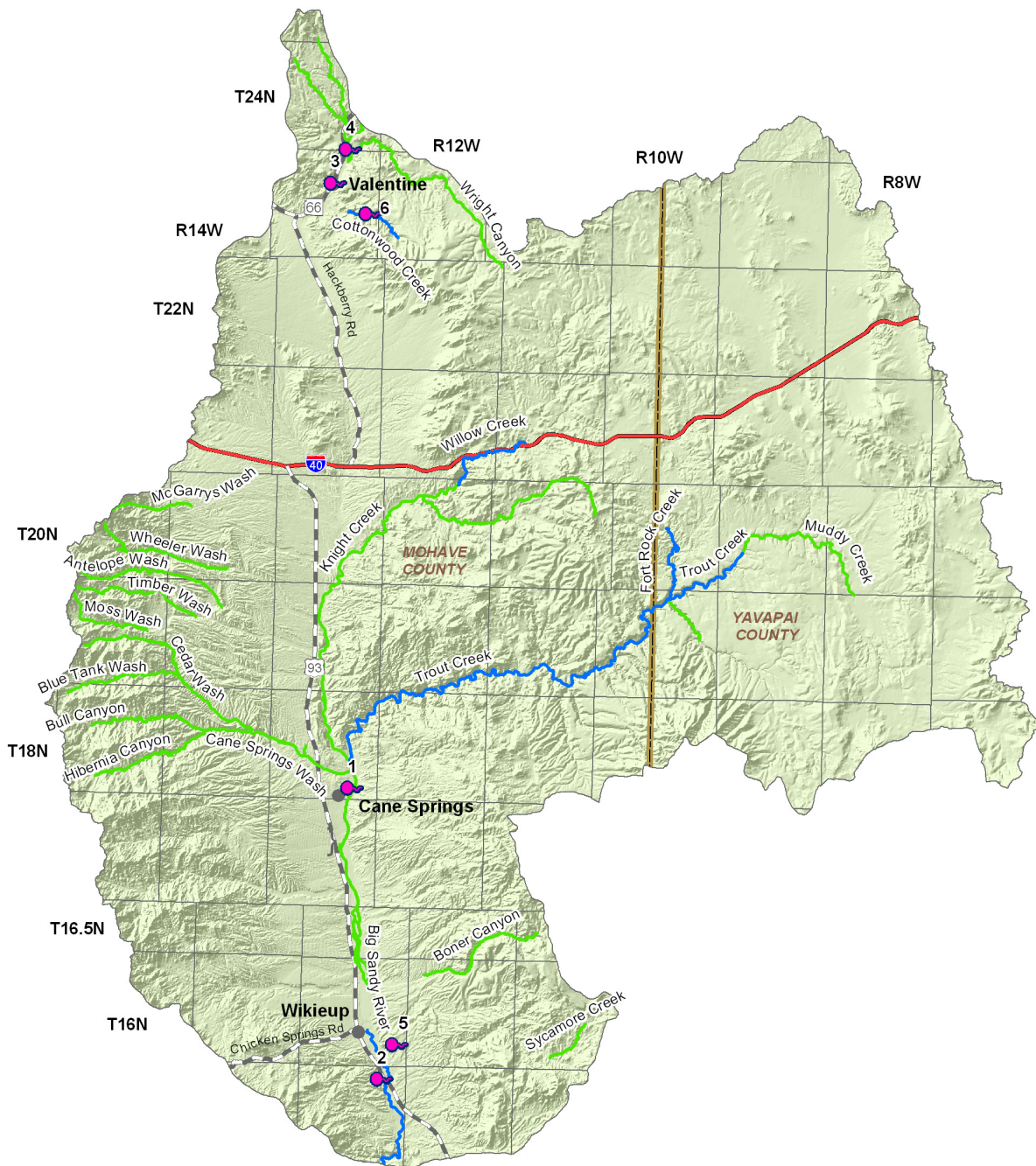
Source: Compilation of databases from ADWR & others

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

Notes:

¹Most recent measurement identified by ADWR

²Spring is not displayed on current USGS topo maps



Stream Data Source: AGFD, 1993 & 1997

0 3 6
Miles



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

- Springs
- Intermittent Streams
- Perennial Streams
- COUNTY
- Interstate Highway
- Major Road
- City, Town or Place

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 as well as well data sources and methods, including water-level changes and well yields are found in Volume 1, Appendix A.

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 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.

Natural Recharge

- Refer to Table 4.1-6.
- The estimated natural recharge for this basin is 22,000 acre-feet per year (AFA).

Water in Storage

- Refer to Table 4.1-6.
- Storage estimates range from 9.5 million acre-feet (maf) to 21 maf to a depth of 1,200 feet.

Water Level

- Refer to Figure 4.1-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures 18 index wells in this basin. Hydrographs for four of these wells are shown in Figure 4.1-7.
- 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.

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 (GWSI) and/or USGS
	Range 1-2,250 Median 300 (87 wells reported)	Reported on registration forms for large (>10-inch) diameter wells (Wells55)
	Range 30-1,000	ADWR (1990 and 1994b)
	Range 0-500	Anning and Duet (1994)
Estimated Natural Recharge, in acre-feet/year:	22,000	Freethy 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)	Freethy and Anderson (1986)
	21,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
Current Number of Index Wells:	18	
Date of Last Water-level Sweep:	2008 (104 wells measured)	

Notes:

¹Predevelopment Estimate

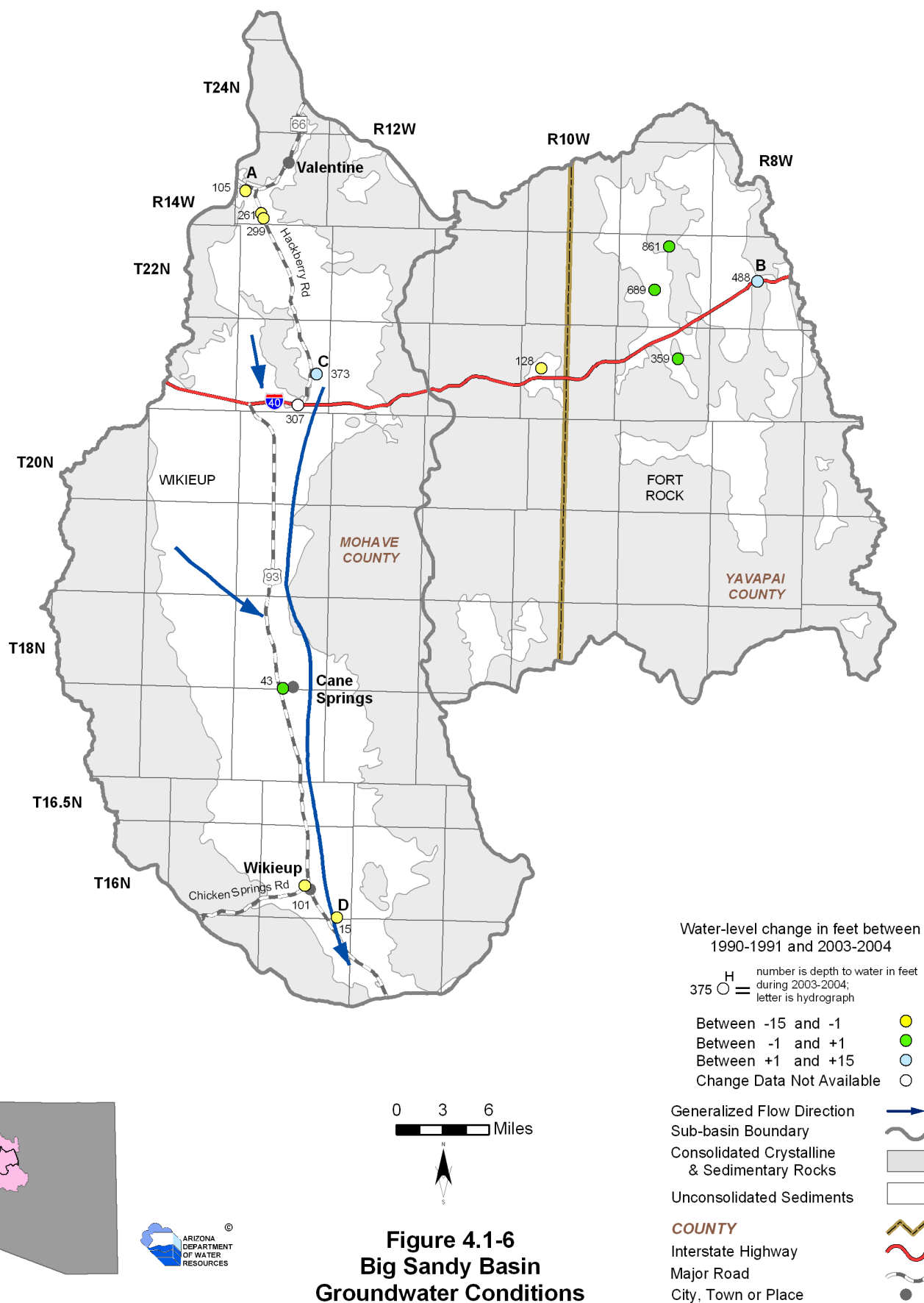
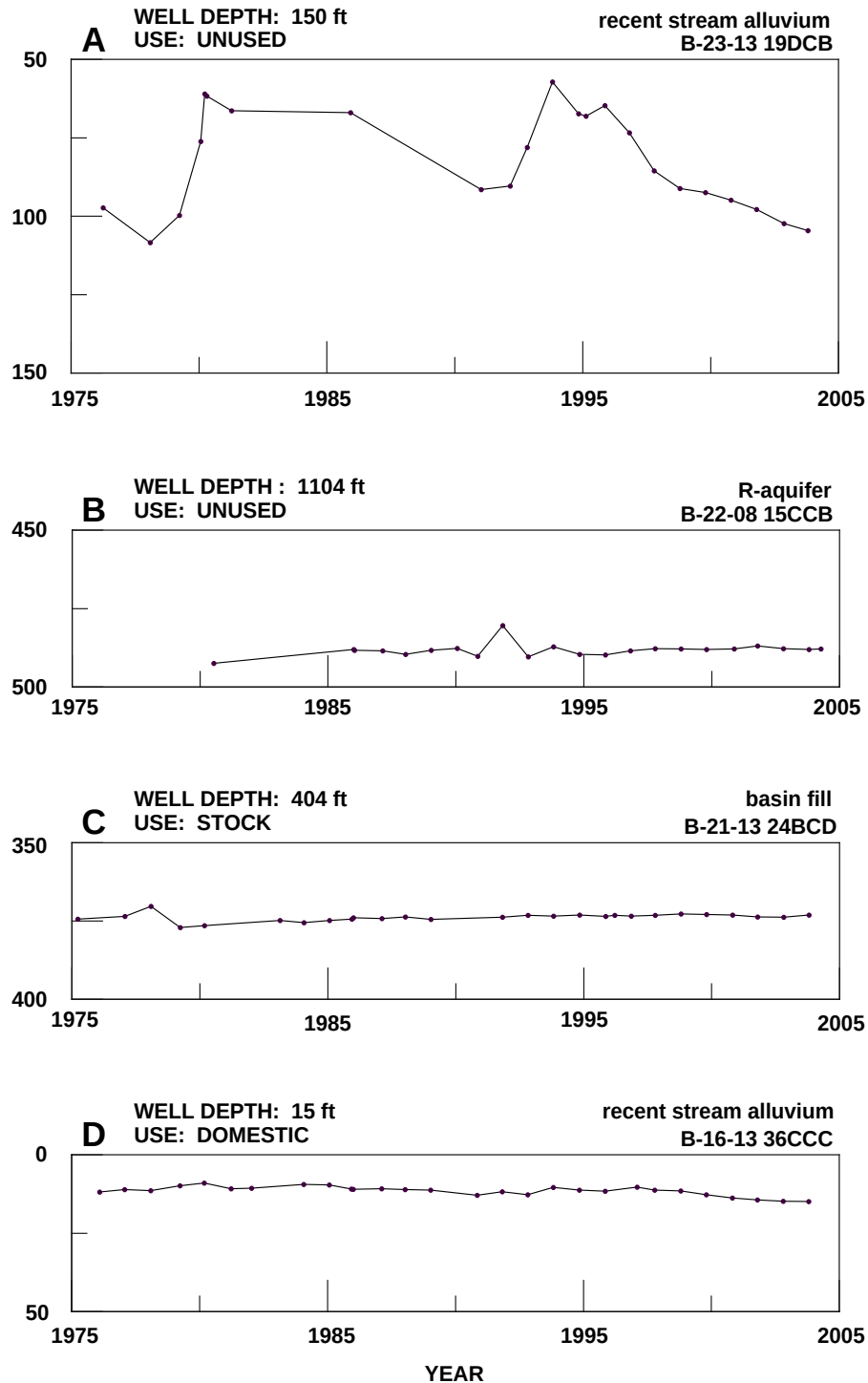
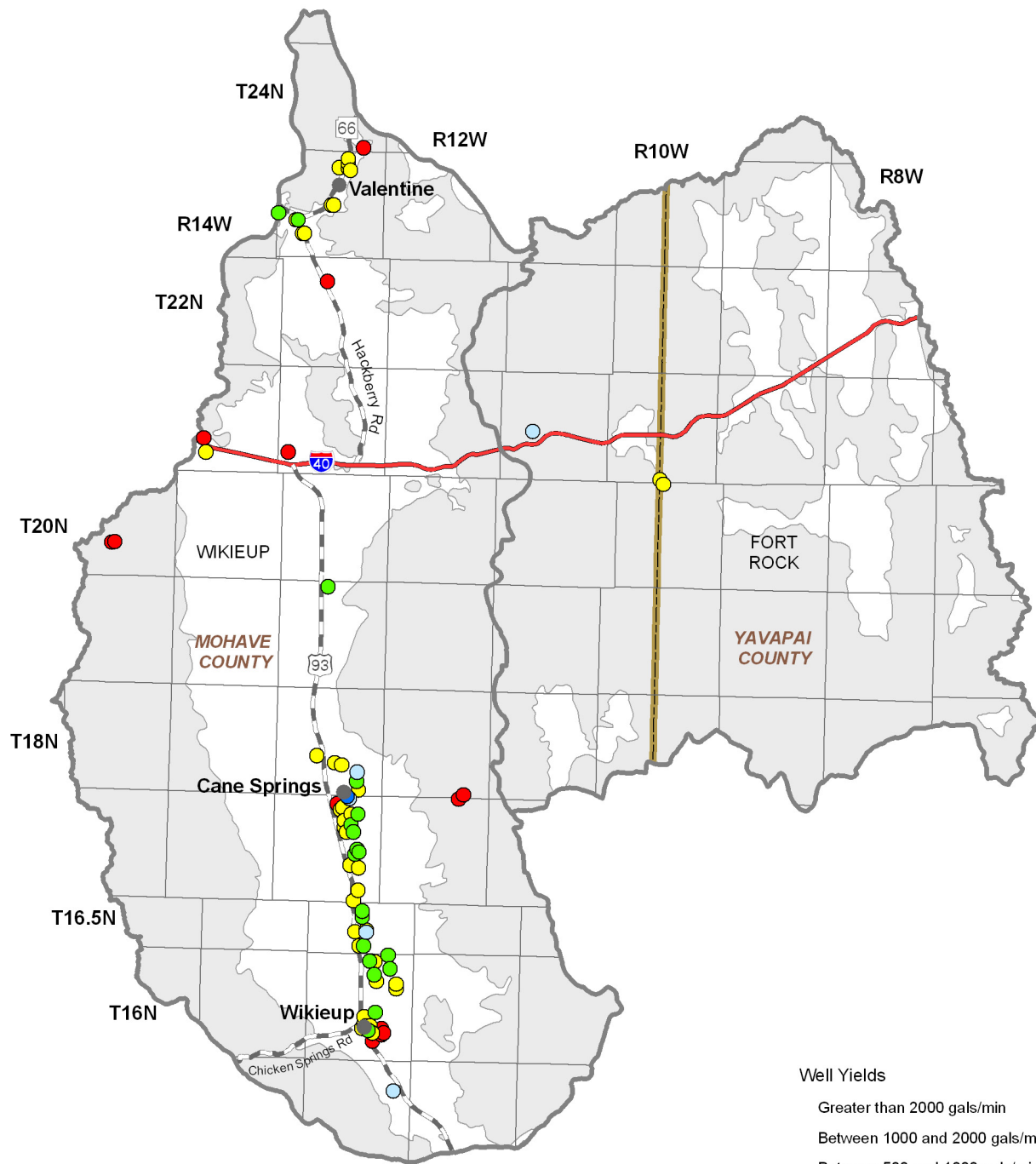


Figure 4.1-7
Big Sandy Basin
Hydrographs Showing Depth to Water in Selected Wells

Depth To Water In Feet Below Land Surface





**Figure 4.1-8
Big Sandy Basin
Well Yields**

4.1.7 Water Quality of the Big Sandy Basin

Sites with parameter concentrations that have equaled or exceeded drinking water standard(s) (DWS), including location and parameter(s) 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. Not all parameters were measured at all sites; selective sampling for particular constituents is common. A description of water quality data sources and methods is found in Volume 1, Appendix A.

Well, Mine or Spring sites that have equaled or exceeded drinking water standards (DWS)

- Refer to Table 4.1-7A.
- Sixty-four sites have parameter concentrations that have equaled or exceeded DWS.
- Frequently equaled or exceeded parameters include radionuclides, fluoride and lead
- Other parameters commonly equaled or exceeded in the sites measured in this basin were arsenic, antimony, beryllium and cadmium.

Table 4.1-7 Water Quality Exceedences in the Big Sandy Basin¹

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded 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

Source: Compilation of databases from ADWR & others

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

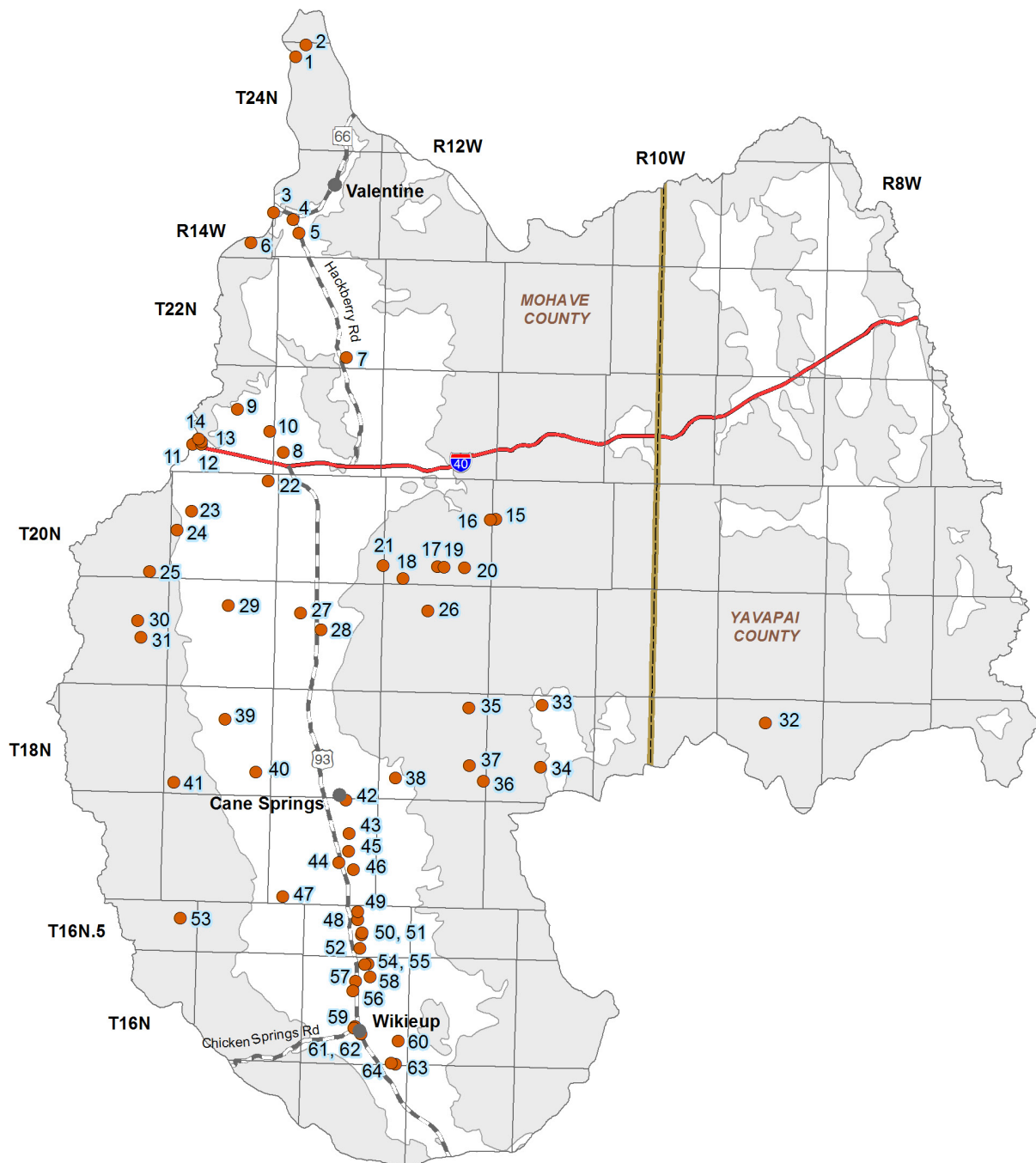


Figure 4.1-9
Big Sandy Basin
Water Quality Conditions

Well, Spring or Mine Site that has
Equaled or Exceeded DWS



Consolidated Crystalline
& Sedimentary Rocks



Unconsolidated Sediments



COUNTY

Interstate Highway

Major Road

City, Town or Place



4.1.8 Cultural Water Demand 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, Appendix A. More detailed information on cultural water demand is found in Section 4.0.7.

Cultural Water Demand

- Refer to Table 4.1-8 and Figure 4.1-10.
- Population in this basin is relatively small but has almost tripled since 1980, increasing from 434 in 1980 to 1,142 in 2000.
- All water use in this basin is groundwater. Groundwater demand has increased, with an average of 2,500 AFA in 1971-1975 to an average of approximately 15,900 AFA in 2001-2005.
- Agricultural demand is minimal, with less than 300 AFA from 1991-2005. Agricultural demand centers are small acreages 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 AFA on average. Municipal demand centers are located in the vicinity of Wikieup and at Cane Springs along Highway 93.
- There is significant industrial groundwater demand in this basin. 15,600 AFA on average during 2001-2005 was pumped and transported via pipeline to the Bagdad Mine in the Bill Williams Basin.
- As of 2005 there were 1,240 registered wells with a pumping capacity of less than or equal to 35 gpm and 222 wells with a pumping capacity of more than 35 gpm.

Table 4.1-8 Cultural Water Demand in the Big Sandy Basin¹

Year	Estimated and Projected 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 ²	Agricultural	Municipal	Industrial	Agricultural		
1971		420 ²	155 ²	2,500			NR			ADWR (1994a)	
1972											
1973				7,000			NR				
1974											
1975											
1976											
1977											
1978				10,000			NR				
1979											
1980	434										
1981	445										
1982	456										
1983	467										
1984	479										
1985	490	80	5	14,400			NR				
1986	501										
1987	512										
1988	523										
1989	534										
1990	546										
1991	605										
1992	665	112	9	<300	16,200	<300 ³	NR				
1993	725										
1994	784										
1995	844										
1996	903										
1997	963										
1998	1,023										
1999	1,082	246	16	<300	16,800	<300 ³	NR				
2000	1,142										
2001	1,198										
2002	1,254										
2003	1,311										
2004	1,367										
2005	1,423										
2010	1,704	306	15	<300	15,600	<300 ³	NR				
2020	2,166										
2030	2,541										
WELL TOTALS:		1,240	222								

Notes:

NR = Not reported

¹ Does not include evaporation losses from stockponds and reservoirs, or effluent.

² Groundwater withdrawn in the Big Sandy Basin is delivered to the Bill Williams Basin for industrial use at the Bagdad Mine.

³ Agricultural water use in this basin is based on ADWR registered wells used for agricultural purposes.



Primary Data Source: USGS National Gap Analysis Program, 2004

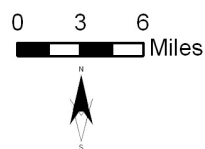


Figure 4.1-10
Big Sandy Basin
Cultural Water Demand

Demand Centers

- Agriculture
- M&I - Low Intensity
- Indian Reservation
- Small Mine\Quarry
- Indian Reservation Boundary
- COUNTY
- Interstate Highway
- Major Road
- City, Town or Place



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 4.1-9. 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 C. Adequacy determination data sources and methods are found in Volume 1, Appendix A.

- All lots receiving an adequacy determination are in Mohave County. Four water adequacy determinations have been made in this basin through December 2008.
- Data on the number of lots with an adequate determination was not available to the Department. Three determinations of inadequacy with a total of 608 lots have been made; all located in the northern portion of the basin.
- All inadequacy determinations were because the applicant chose not to submit necessary information and/or available hydrologic data was insufficient to make a determination.

Table 4.1-9 Adequacy Determinations in the Big Sandy Basin¹

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	52-300043	Inadequate	A1	08/23/95	Dry Lot Subdivision
2	Mountain Shadow Estates Tract 3806	Mohave	20 North	14 West	8	54.0	52-400466	Inadequate	A1	02/20/01	Subdivision wells
3	Orchards, The Tract 3800	Mohave	16 North	13 West	27	NA	NA	Adequate		08/31/92	Dry Lot Subdivision
4	Silverado Acre Estates Unit 1, Tract 3805	Mohave	20 North	13 West	17	340.0	52-300264	Inadequate	A1	02/13/97	Dry Lot Subdivision

Source: ADWR 2008a

Notes:

¹Each 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. Between 1995-2006 all applications for adequacy were given a file number with a 22 prefix. In 2006 a 53 prefix was assigned to all water adequacy reports and applications regardless of their issue date.

³ A. Physical/Continuous

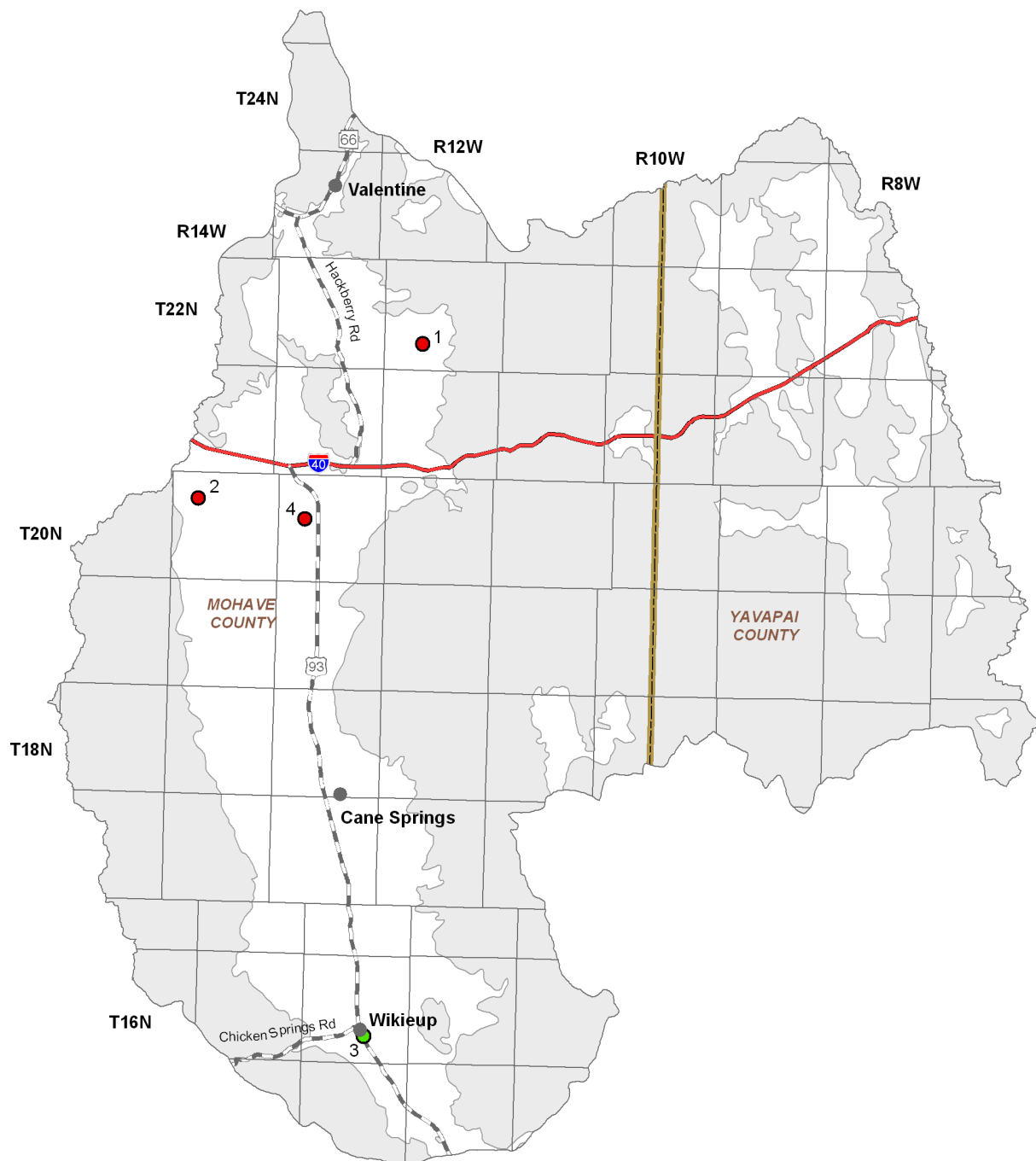
- 1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
- 2) Insufficient Supply (existing water supply unreliable or physically unavailable; for groundwater, depth-to-water exceeds criteria)
- 3) Insufficient Infrastructure (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



0 3 6
Miles



Figure 4.1-11
Big Sandy Basin
Adequacy Determinations

Adequacy Determinations

Adequate ●
Inadequate ●

Consolidated Crystalline
& Sedimentary Rocks

Unconsolidated Sediments

COUNTY

Interstate Highway

Major Road

City, Town or Place

Big Sandy Basin

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A

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Section 4.2

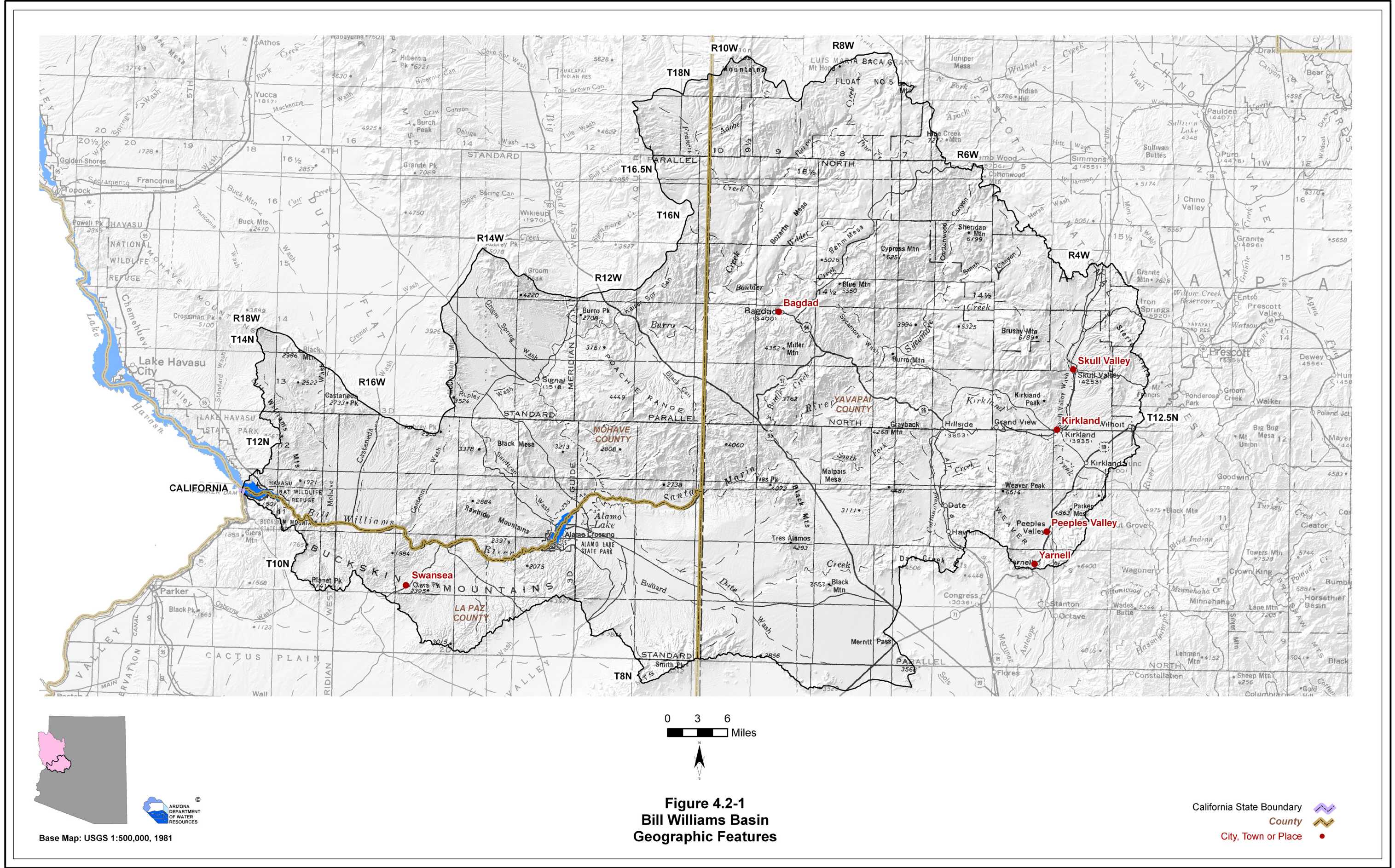
Bill Williams Basin



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 and 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 Arizona upland and Lower Colorado River Sonoran desertscrub, Mohave desertscrub, semi-desert grassland, interior chaparral, Great Basin conifer woodland and montane conifer forest. (see Figure 4.0-9) 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:
 - 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
 - Poachie Range in the middle of the Basin
 - Black Mountains, including Tres Alamos Peak, west of highway 93 in Yavapai County
 - 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



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, Appendix A. More detailed information on protected areas is found in Section 4.0.4. Land ownership categories are discussed below in the order from largest to smallest percentage 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 BLM.
- The majority of the BLM lands are contiguous and located in the western portion of the basin.
- The basin contains six BLM wilderness areas totaling 227,510 acres. The wilderness areas are: the 38,470-acre Rawhide Mountains Wilderness, the 16,400-acre Swansea Wilderness, 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, the 15,400-acre Aubrey Peak Wilderness and the 27,440-acre Upper Burro Creek Wilderness (see Figure 4.0-12).
- 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 and Peeples Valley and along the northern basin boundary.
- Land uses include domestic, commercial, ranching and farming.

National Forest

- 7.6% of the land is federally owned and managed by the United States Forest Service (USFS).
- All forest lands in the basin are part of the Prescott National Forest and are located along the northeastern basin boundary.

- Land uses include grazing, timber production and recreation.

U.S. Military

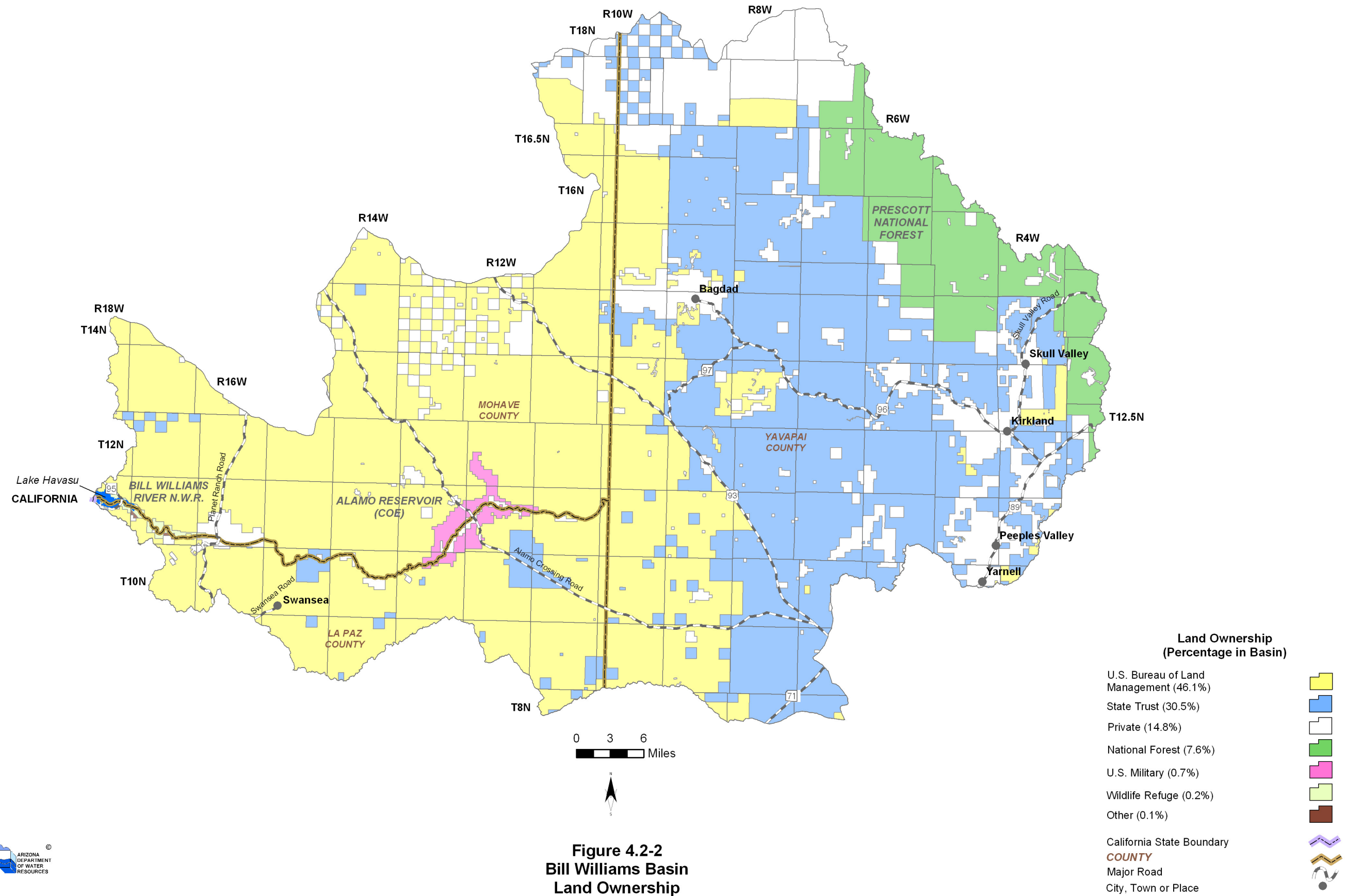
- 0.7% of the land is federally owned and managed by the Army Corps of Engineers for flood control. The land is also managed by the Arizona State Parks for recreation.
- All military lands are located around the boundary between La Paz County and Mohave County and include Alamo Lake.
- Primary land uses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



4.2.3 Climate of the Bill Williams Basin

Climate data from NOAA/NWS Co-op Network stations are compiled 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. More detailed information on climate in the planning area is found in Section 4.0.3. A description of the climate data sources and methods is found in Volume 1, Appendix A.

NOAA/NWS Co-op Network

- Refer to Table 4.2-1A
- There are four NOAA/NWS Co-op network climate stations in the basin. The average monthly maximum temperature occurs in July and ranges between 78.3°F at Hillside 4 NNE and 92.5°F at Alamo Dam. The average monthly minimum temperature occurs in January or December and ranges between 41.3°F at Bagdad 8 NE and 50.6°F at Alamo Dam.
- Highest average seasonal rainfall occurs in the winter (January - March), summer (July – September) or fall (October-December). For the period of record used, the highest annual rainfall is 15.84 inches per year at the Hillside 4 NNE station and the lowest is 8.59 inches per year at Alamo Dam.

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 and 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, 2005

Notes:

¹Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

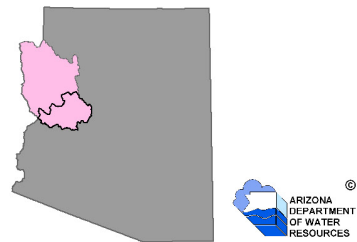
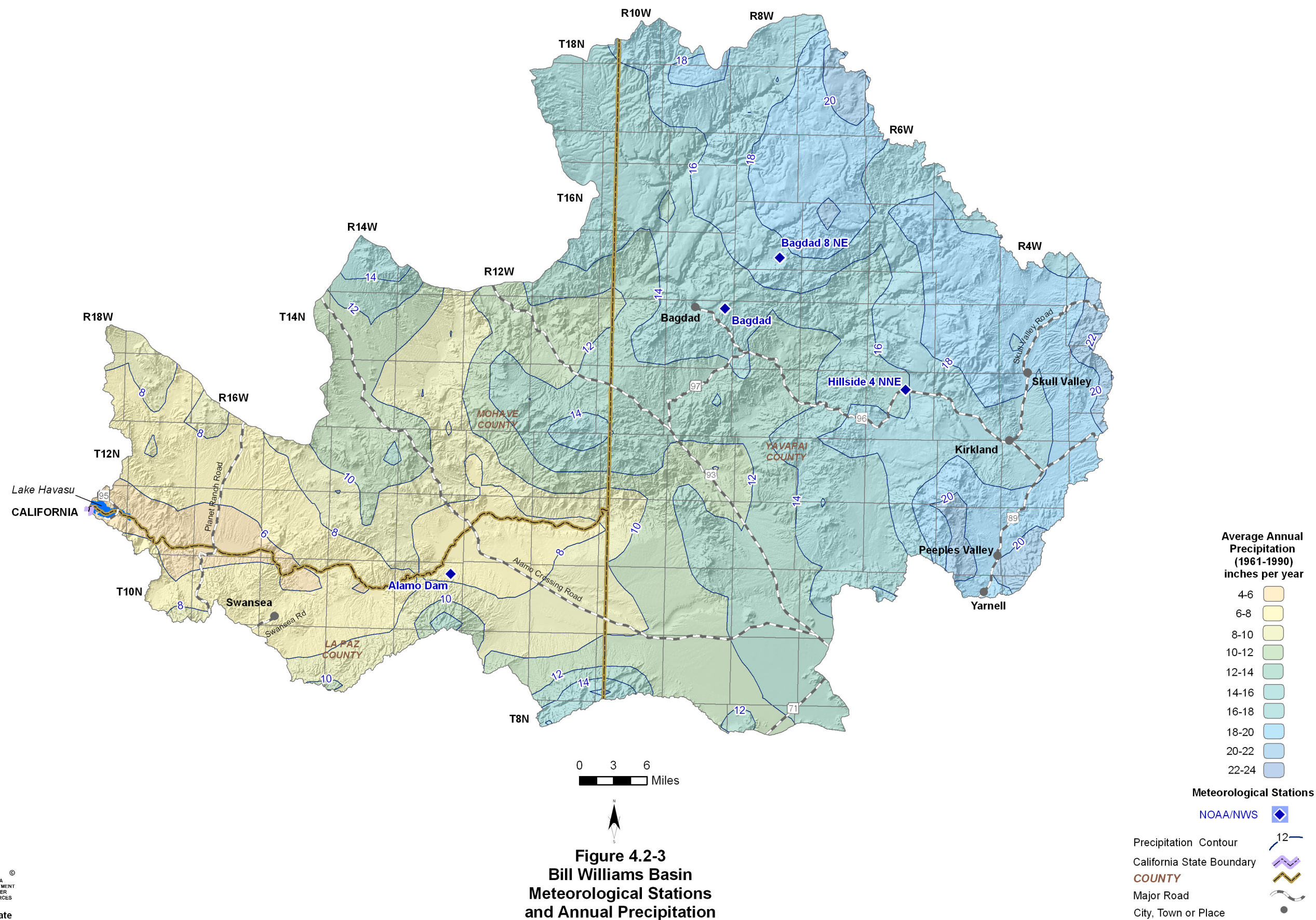
Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

C. AZMET:

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

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record	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								



Precipitation Data Source: Oregon State University, 1998

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 identified by USGS number, flood ALERT equipment, USGS runoff contours and large reservoirs are shown on Figure 4.2-4. Descriptions of stream, reservoir and stockpond data sources and methods are found in Volume 1, Appendix A.

Streamflow Data

- Refer to Table 4.2-2.
- Data from ten stations on seven watercourses are shown in the table and on Figure 4.2-4. Five stations have been discontinued, the remaining five are real-time stations.
- The average seasonal flow for all stations is highest in the winter (January-March) and lowest 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 and 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.

Reservoirs and Stockponds

- Refer to Table 4.2-4.
- The basin contains two large reservoirs. The largest is Alamo Lake, with a maximum capacity of 1,409,000 acre-feet, although normal capacity is less than 500 acre-feet. Uses include flood control and recreation. Lake Havasu, created by Parker Dam in the Parker Basin, has a maximum capacity of 651,000 acre-feet. Storage for this reservoir is primarily in the Lake Havasu and Sacramento Basins.
- Surface water is stored or could be stored in 19 small reservoirs in the basin.
- There are 796 registered stockponds in this basin.

Runoff Contour

- Refer to Figure 4.2-4.
- Average annual runoff is one inch per year, or 53.3 acre-feet per square mile, in the north and center of the basin and decreases to 0.1 inches, or 5.33 acre-feet per square mile, 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)	Gage Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Annual Flow Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9424432	Francis Creek near Bagdad	134	3,260	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	611	1,888	7/1980-current (real time)	80	3	7	11	3,410 (1989)	47,638	49,750	155,655 (1983)	12
9424450	Big Sandy River near Wikieup	2,742	1,400	3/1966-current (real time)	80	5	4	10	2,448 (2002)	27,011	58,901	421,461 (1993)	36
9424470	Kirkland Creek near Kirkland	109	3,900	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	1,360	4/1966-current (real time)	74	6	5	15	0 (1996, 2002)	15,063	40,551	168,005 (1980)	32
9425000	Date Creek near Congress	127	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	1,124	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	4,633	967	10/1939-current (real time)	54	16	16	14	1,275 (1975)	33,963	82,317	701,711 (1993)	63
9426500	Bill Williams River at Planet	5,054	556	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	5,337	500	10/1988-current (real time)	78	14	5	3	645 (1990)	4,421	69,097	626,398 (1993)	14

Source: USGS (NWIS) 2005 & 2008

Notes:

NA = Not available to ADWR

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

In Period of Record, current equals November 2008

Seasonal and annual flow data used for the statistics was retrieved in 2005

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

Source: ADWR 2005b

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
None	Havasu (Parker) ³	Bureau of Reclamation	651,000 ⁴	H,I,S	Federal

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

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					

Source: Compilation of databases from ADWR & others

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)⁵

Total number: 16

Total surface area: 203 acres

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

Total number: 796 (from water right filings)

Notes:

¹C=flood control; R=recreation; H=hydroelectric power; I=irrigation; S=supply

²Normal capacity < 500 acre-feet

³Dam is located in Parker Basin but lake storage is in the Lake Havasu, Sacramento Valley and Bill Williams Basins

⁴Includes 28,600 acre-feet of dead storage

⁵Capacity data not available to ADWR



Figure 4.2-4
Bill Williams Basin
Surface Water Conditions

Stream Data Source: ALRIS, 2005

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. Descriptions of data sources and methods for intermittent and perennial reaches and springs are found in Volume 1, Appendix A.

- There are numerous streams with perennial reaches located throughout the basin including sections of the Bill Williams River, Santa Maria River, Big Sandy River and Burro Creek.
- Numerous intermittent streams are located throughout the basin with the largest concentration in the northeastern portion of the basin.
- There are six major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time. The largest discharge is 228 gpm at Genung spring.
- 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.
- Listed discharge rates may not be indicative of current conditions. All of the measurements were taken prior to 1983.
- 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 Cruz	343448	1134230	1	5/9/1979
Unnamed	342653	1124132	1	4/17/1973

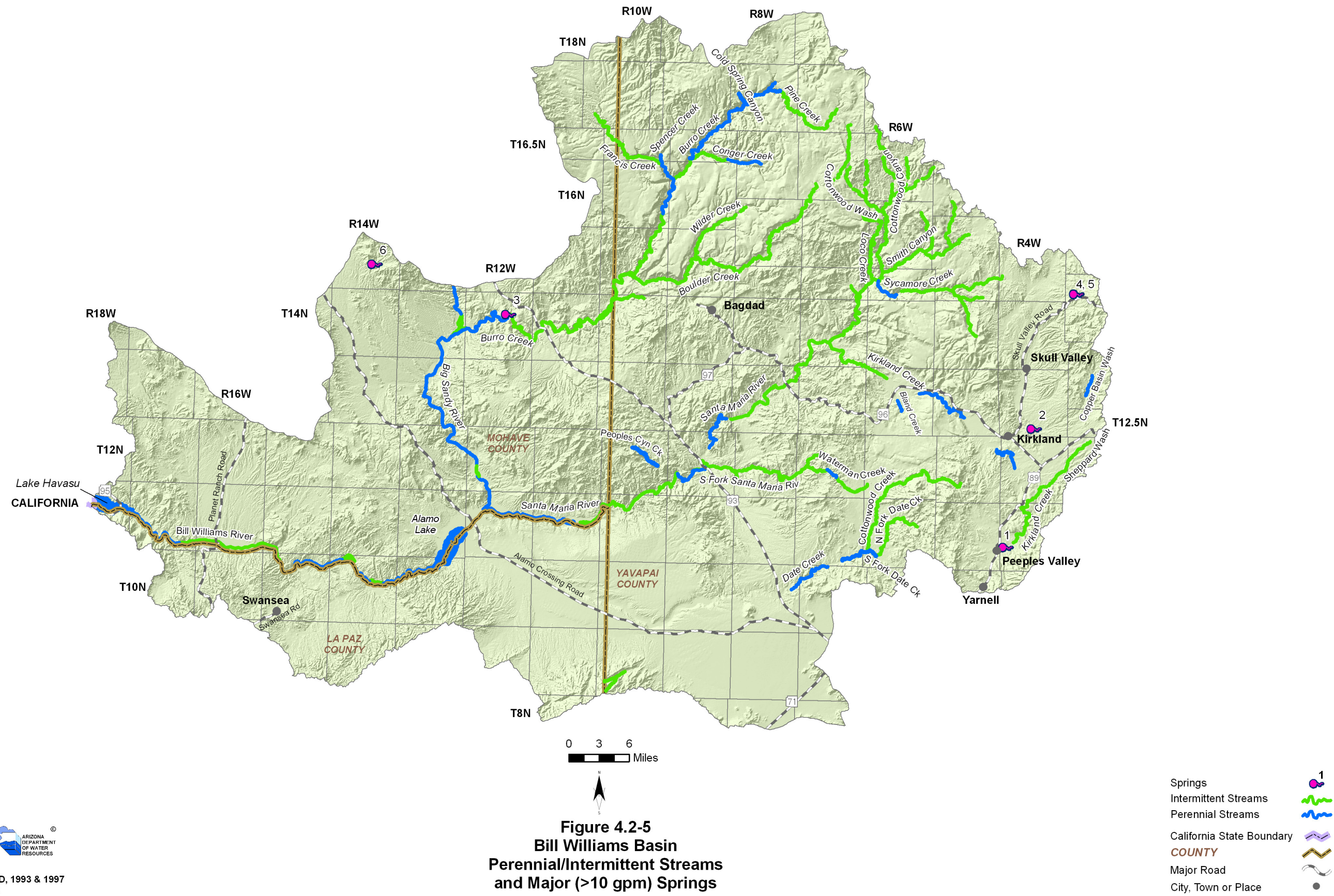
Source: Compilation of databases from ADWR & others

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

Notes:

¹Most recent measurement identified by ADWR

²Spring is not displayed on current USGS topo maps



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 as well as well data sources and methods, including water-level changes and well yields are found in Volume 1, Appendix A.

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 Peebles Valley area, in the Skull Valley Sub-basin.
- Flow direction varies.

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.
- Storage estimates for this basin range from 10 million acre-feet to 23 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 24 index wells in this basin. Hydrographs for seven of these wells are shown in Figure 4.2-7.
- The deepest recorded water level in the basin is 642 feet in Yavapai County east of the La Paz County line and the shallowest is five feet north of Peebles Valley. This is the shallowest recorded water level in the planning area.

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 (GWSI) and/or USGS
	Range 5-5,000 Median 280 (195 wells reported)	Reported on registration forms for large (>10-inch) diameter wells (Wells55)
	Range 10-4,000	ADWR (1990 and 1994b)
	Range 0-500	Anning and Duet(1994)
Estimated Natural Recharge, in acre-feet/year:	32,000	Freethy 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)	Freethy and Anderson (1986)
	20,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
Current Number of Index Wells:	24	
Date of Last Water-level Sweep:	1979 (117 wells measured)	

Notes:

¹Predevelopment 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

Depth To Water In Feet Below Land Surface

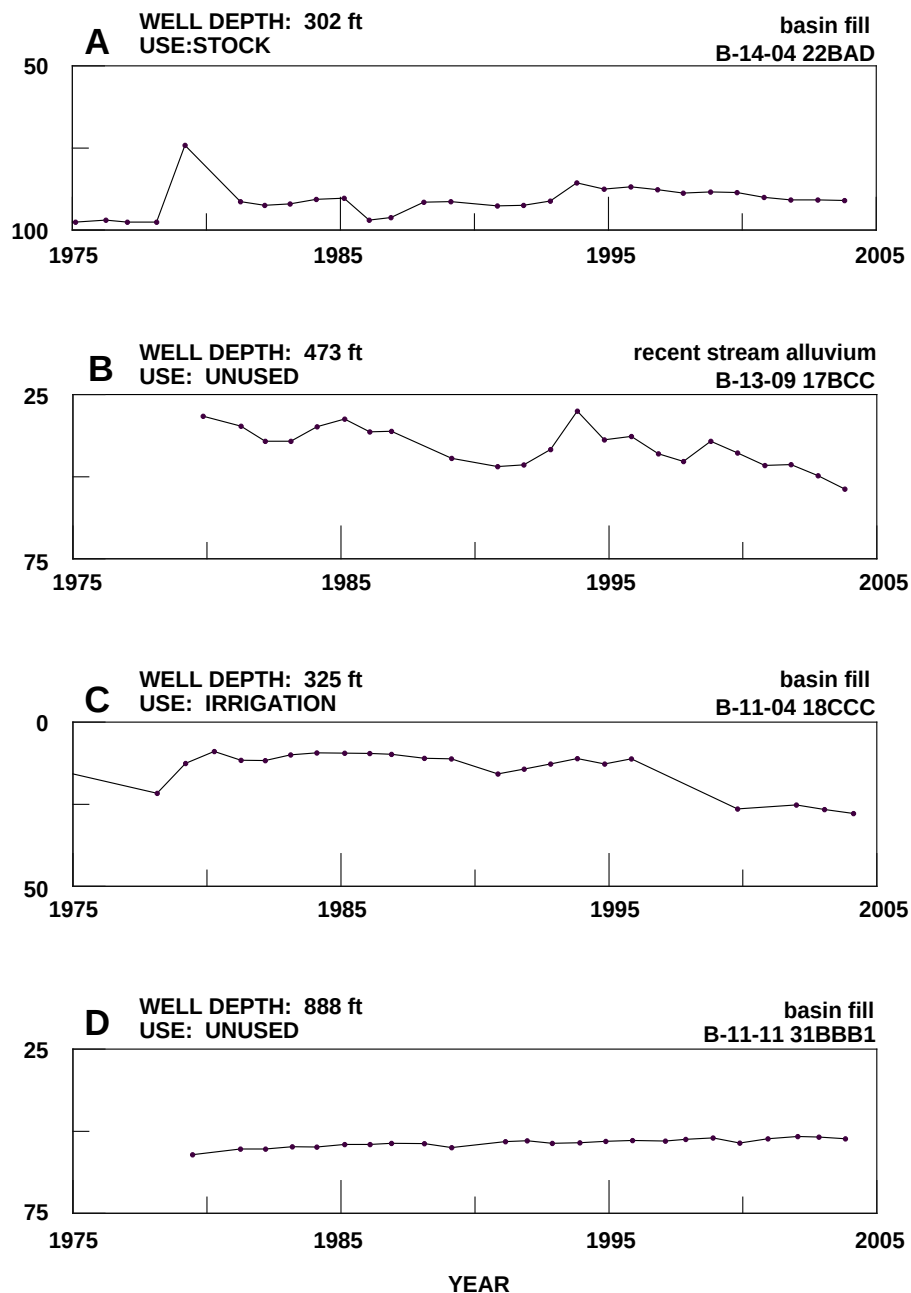
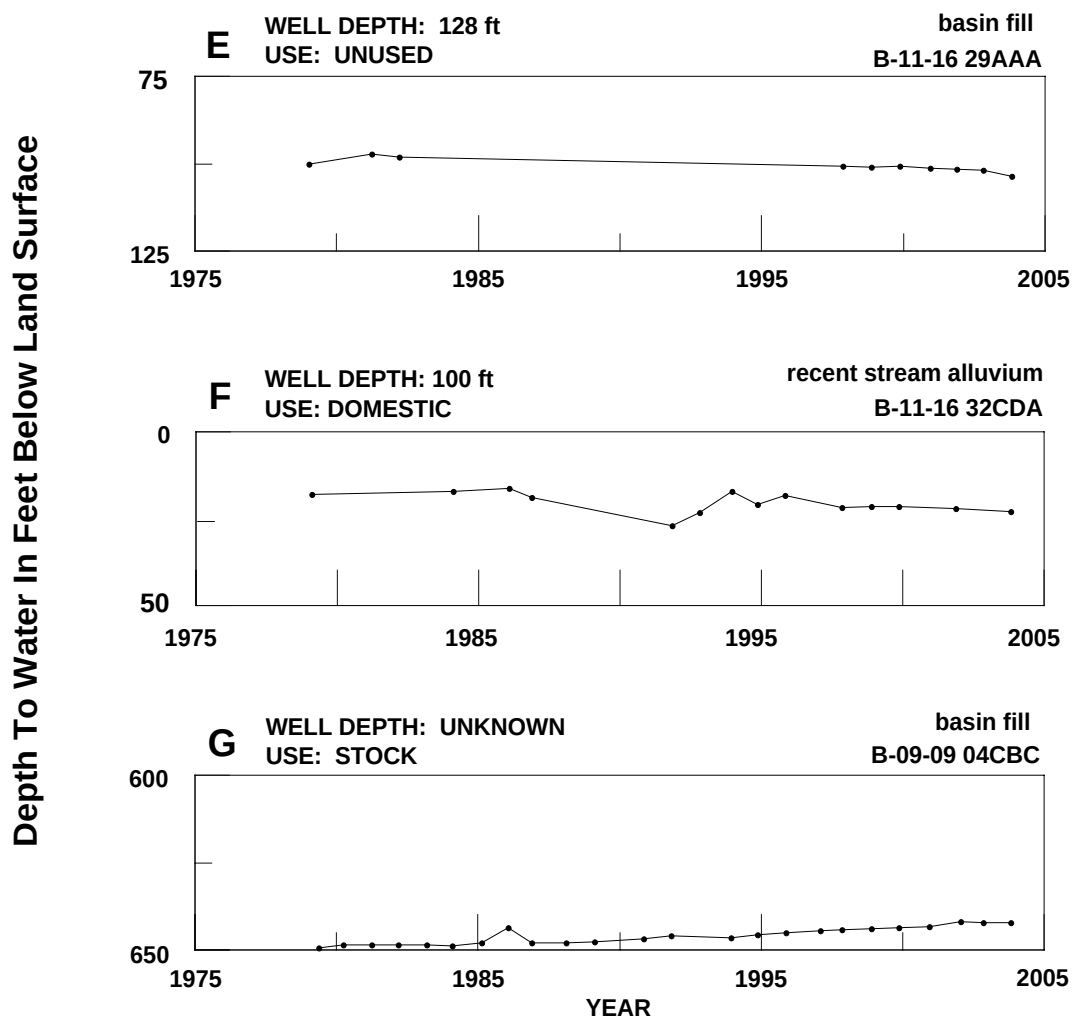


Figure 4.2-7 (Cont)
Bill Williams Basin
Hydrographs Showing Depth to Water in Selected Wells



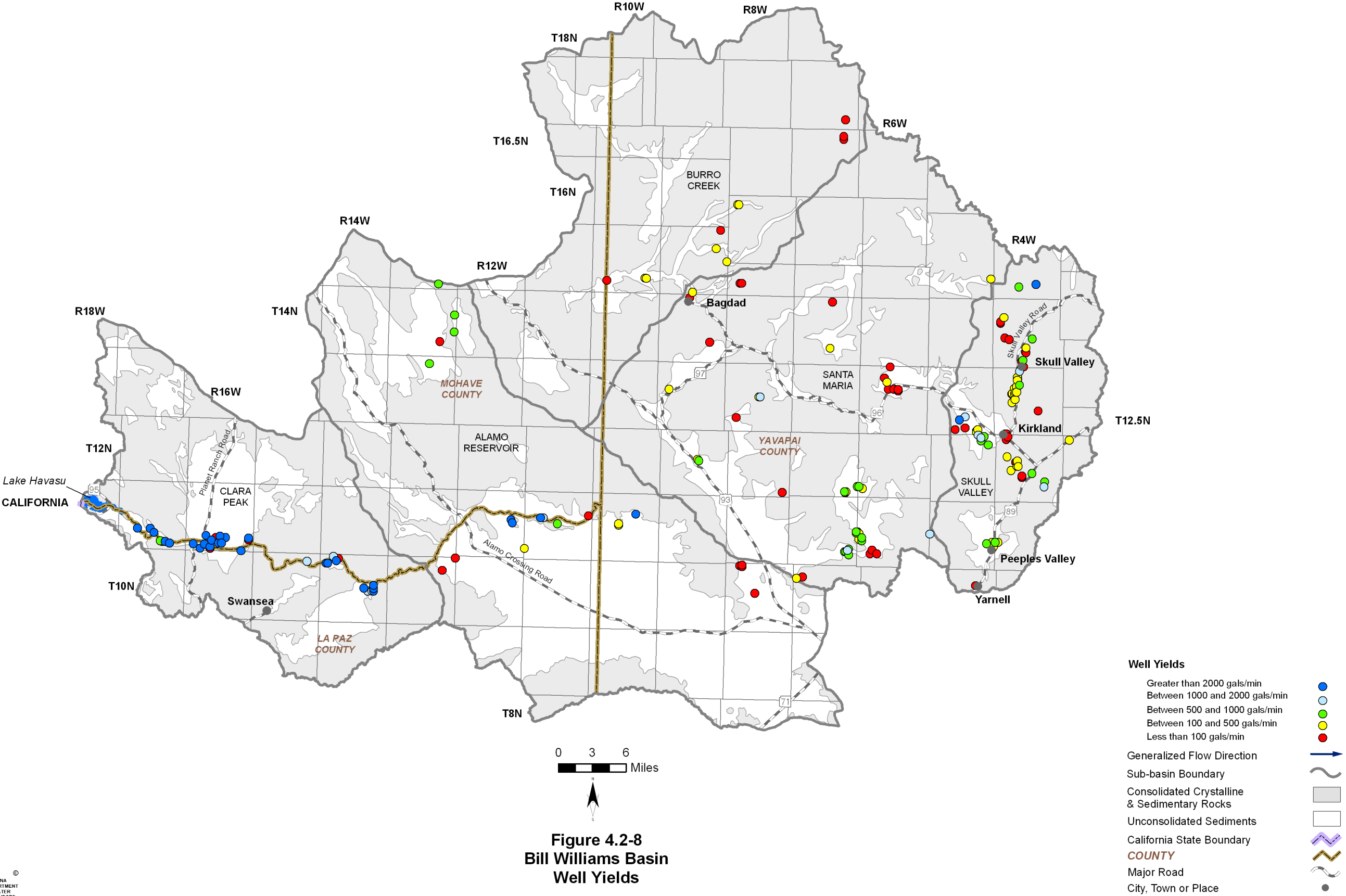


Figure 4.2-8
Bill Williams Basin
Well Yields

4.2.7 Water Quality of the Bill Williams Basin

Sites with parameter concentrations that have equaled or exceeded drinking water standard(s) (DWS), including location and parameter(s) 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. Not all parameters were measured at all sites; selective sampling for particular constituents is common. A description of water quality data sources and methods is found in Volume 1, Appendix A.

Well, Mine or Spring sites that have equaled or exceeded drinking water standards (DWS)

- Refer to Table 4.2-7A.
- Sixty sites have parameter concentrations that have equaled or exceeded DWS.
- Frequently equaled or exceeded parameters include fluoride and arsenic.
- Other parameters equaled or exceeded in the sites measured in this basin were cadmium, mercury, copper, lead, nitrates, total dissolved solids and radionuclides.

Lakes and Streams with impaired waters

- 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.
- 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 Basin¹

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded 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)¹

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded 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

Source: Compilation of databases from ADWR & others

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 tributary 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	NA	A&W	Hg

Source: ADEQ 2005c

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

TDS = Total Dissolved Solids

Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium

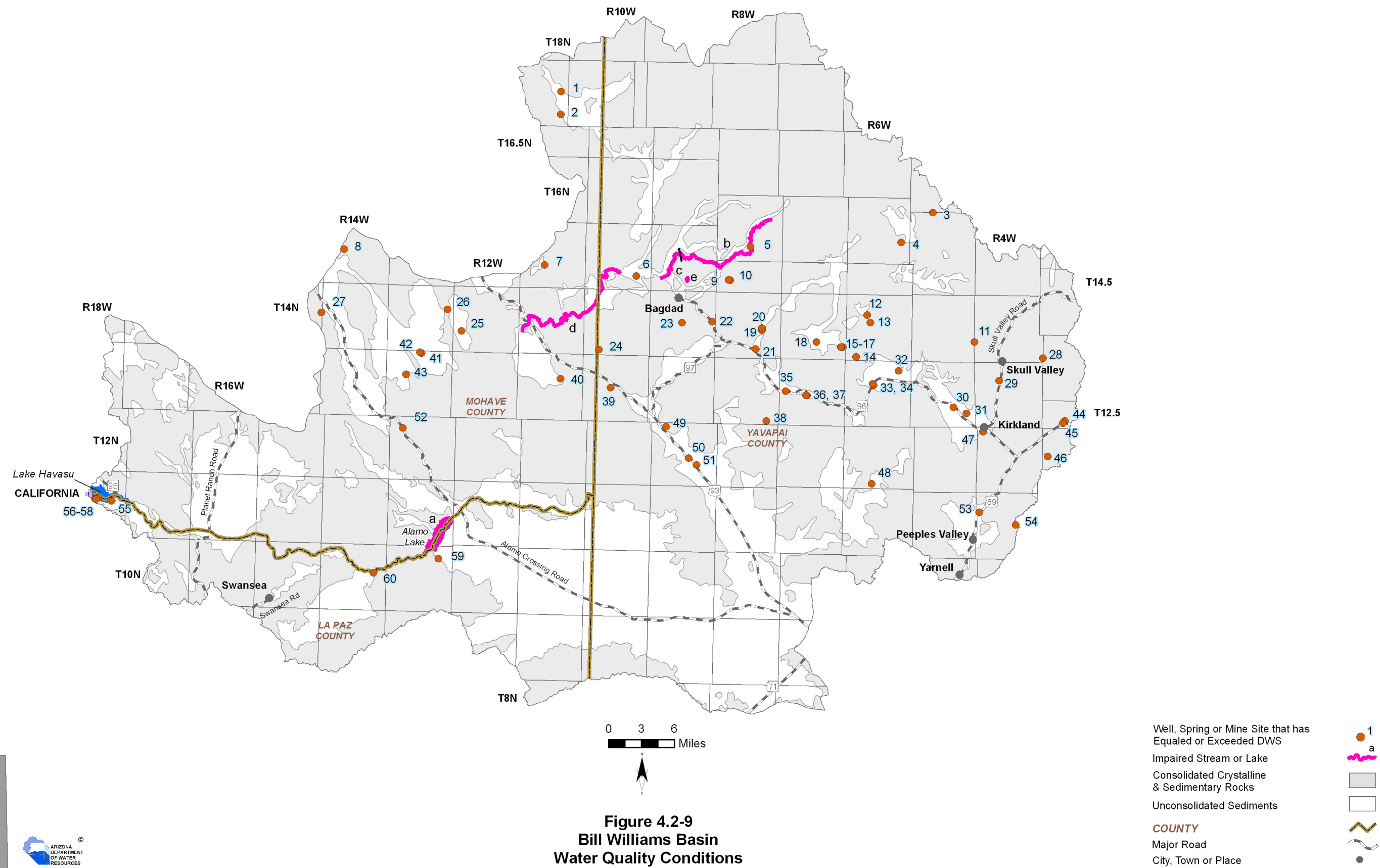
Zn = Zinc

³ A&W = Aquatic and Wildlife

AgL = Agricultural Livestock Watering

FBC = Full Body Contact

FC = Fish Consumption



4.2.8 Cultural Water Demand 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, Appendix A. More detailed information on cultural water demand is found in Section 4.0.7.

Cultural Water Demand

- Refer to Table 4.2-8 and Figure 4.2-10.
- Population in this basin has decreased from 5,532 in 1980 to 4,691 in 2000.
- 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 approximately 5,150 acre-feet pumped per year from 2001-2005.
- A small amount of surface water is diverted for municipal use in the Town of Bagdad, 500 acre-feet per year on average from 1991 to 2005. Some of this water demand may include industrial demand at the Bagdad Mine.
- Municipal groundwater demand is minimal, 900 acre-feet per year on average from 2001 to 2005.
- Principal municipal demand centers are located in the vicinity of Peebles Valley, Kirkland, Yarnell 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 largest water demand sector in this basin is agricultural, located primarily in the eastern portion of the basin around Skull Valley, Kirkland and Peebles Valley. This demand has declined substantially from approximately 18,000 acre-feet per year on average in 1971 to 4,100 acre-feet per year on average from 2001-2005.
- As of 2005 there were 1,627 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 445 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 approximately 1,500 people in the Town of Bagdad. Information on the volume of effluent generation was not available.
- Treated effluent is used for industrial purposes.

Table 4.2-8: Cultural Water Demand in the Bill Williams Basin¹

Year	Estimated and Projected Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)						
				Well Pumpage			Surface-Water Diversions ²			Data Source
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial ³	Agricultural	Municipal	Industrial	Agricultural	
1971		978 ⁴	294 ⁴	18,000			700			ADWR (1994a) ADWR (2007)
1972										
1973				18,000			800			
1974										
1975				18,000			800			
1976										
1977				18,000			800			
1978										
1979		18,000			800					
1980	5,532									
1981	5,393	89	33	18,000			600			
1982	5,253									
1983	5,114									
1984	4,974									
1985	4,835									
1986	4,695	125	31	22,000			500			
1987	4,556									
1988	4,416									
1989	4,277									
1990	4,138									
1991	4,193	112	31	800	<300	15,600	500	NR	NR	USGS (2007) ADWR (2008b) ADWR (2008c) Malcom Pirnie (2006)
1992	4,248									
1993	4,304									
1994	4,359									
1995	4,414									
1996	4,470	142	28	1,000	<300	4,200	500	NR	NR	
1997	4,525									
1998	4,580									
1999	4,636									
2000	4,691									
2001	4,850	181	28	900	<300	4,100	500	NR	NR	
2002	5,008									
2003	5,166									
2004	5,324									
2005	5,482									
2010	6,272									
2020	7,068									
2030	7,700									
WELL TOTALS:		1,627	445							

Notes:

NR = Not reported

¹ Does not include effluent or 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.

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	1,500	NA	Used for Industrial purposes							NA		

Source: Compilation of databases from ADWR & others

Notes;

PBDI:Phelps Dodge Bagdad Inc.

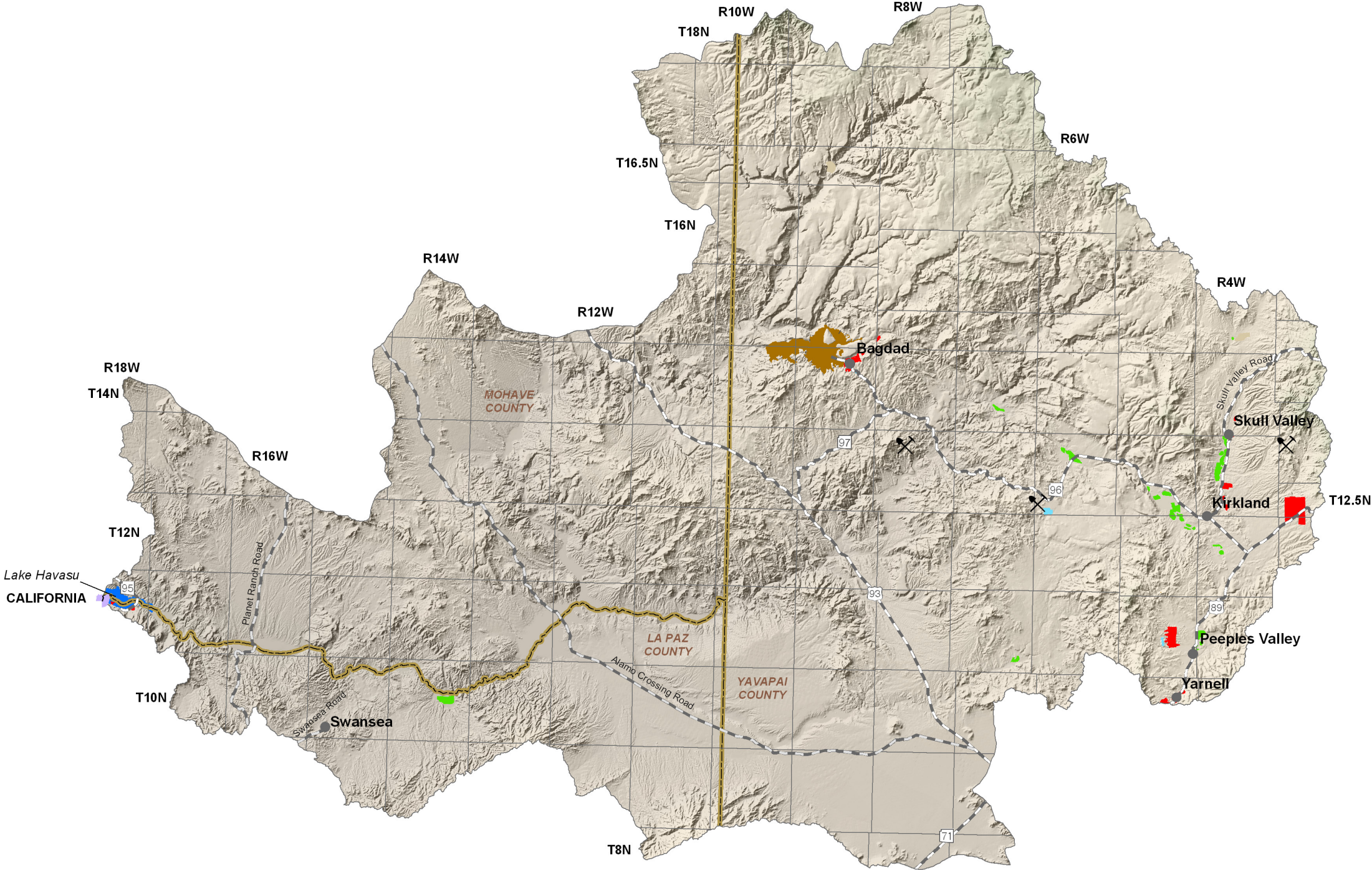


Figure 4.2-10
Bill Williams Basin
Cultural Water Demand

Demand Centers

- Agriculture
- M&I - High Intensity
- M&I - Low Intensity
- Large Mine
- Small Mine/Quarry
- California State Boundary
- COUNTY
- Major Road
- City, Town or Place

Primary Data Source: USGS National Gap Analysis Program, 2004

ARIZONA
DEPARTMENT
OF WATER
RESOURCES

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 C. Adequacy determination data sources and methods are found in Volume 1, Appendix A.

- All lots receiving an adequacy determination are in Yavapai County. Eight water adequacy determinations for more than 264 lots have been made in this basin through December 2008. All lots received an adequate determination.

Table 4.2-10 Adequacy Determinations in the Bill Williams Basin¹

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	33, 34	14	53-500204	Adequate		12/16/1974	Subdivision wells
2	Peeples Valley #2	Yavapai	11 North	5 West	22, 23	NA	53-501138	Adequate		12/3/1987	Subdivision wells
3	Pinon Estates #1	Yavapai	11 North	5 West	14, 15	49	53-501187	Adequate		7/16/1980	Peeples Valley Water Company
4	Pinon Estates #1	Yavapai	11 North	5 West	14, 15	49	53-501188	Adequate		3/21/1986	Peeples Valley Water Company
5	Pinon Estates #2	Yavapai	11 North	5 West	14, 15	59	53-501189	Adequate		3/10/1986	Peeples Valley Water Company
6	Rolling Hills	Yavapai	13 North	5 West	25, 26, 35, 36	41	53-300123	Adequate		3/20/1996	Dry Lot Subdivision
7	Shawnee Hills	Yavapai	11 North	5 West	23	17	53-300210	Adequate		10/24/1996	Peeples Valley Water Company
8	Springs Del Sol Condominiums	La Paz	11 North	18 West	15	35	53-401879	Adequate		1/18/2006	Springs Del Sol Domestic Water Improvement District

Source: ADWR 2008a

Notes:

¹Each 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. Between 1995-2006 all applications for adequacy were given a file number with a 22 prefix.

In 2006 a 53 prefix was assigned to all water adequacy reports and applications regardless of their issue date.

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)

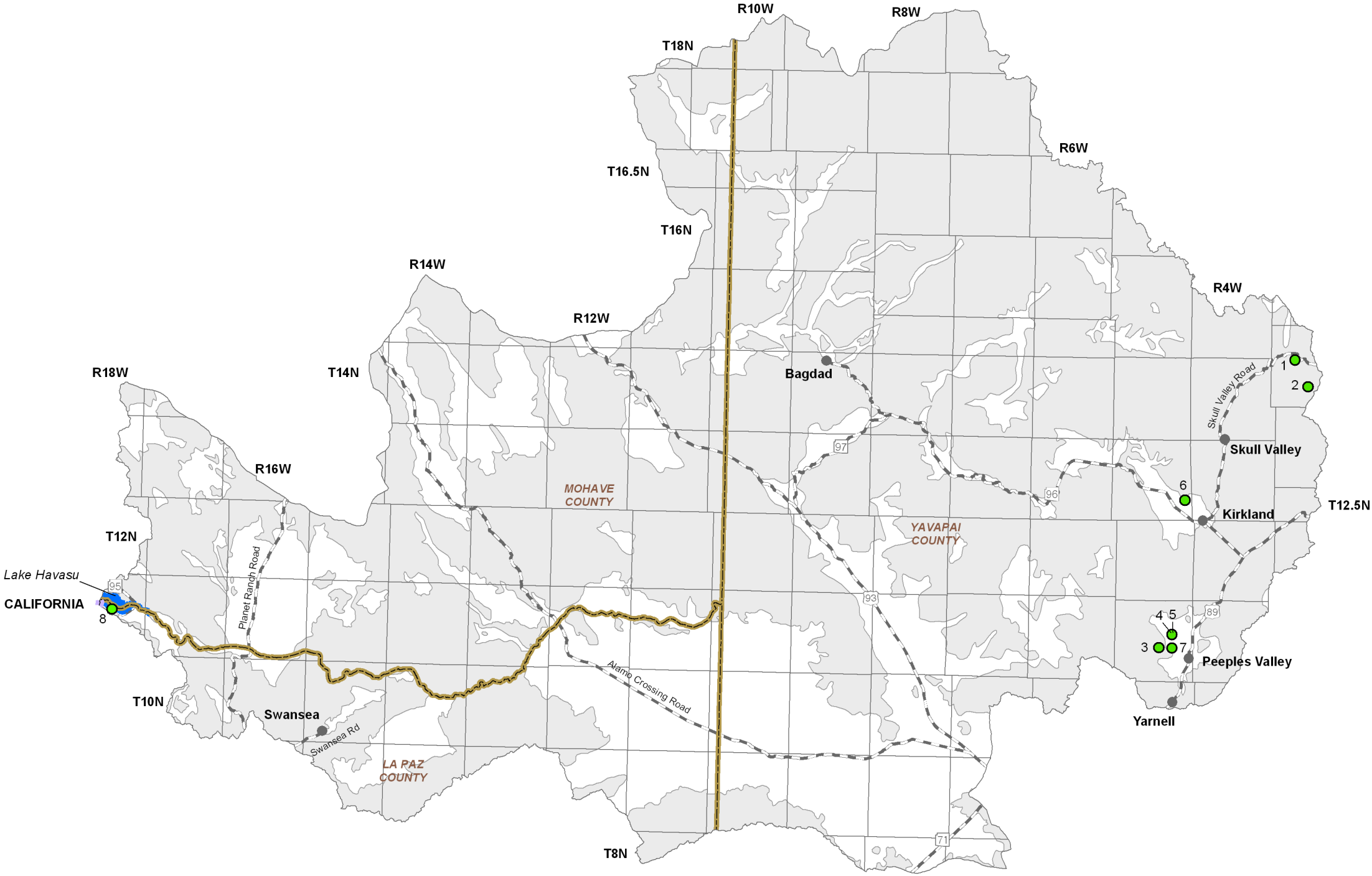
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)

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



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Miles



Figure 4.2-11
Bill Williams Basin
Adequacy Determinations

Adequacy Determinations

- Adequate
- Consolidated Crystalline & Sedimentary Rocks
- Unconsolidated Sediments
- California State Boundary
- COUNTY
- Major Road
- City, Town or Place



Bill Williams Basin

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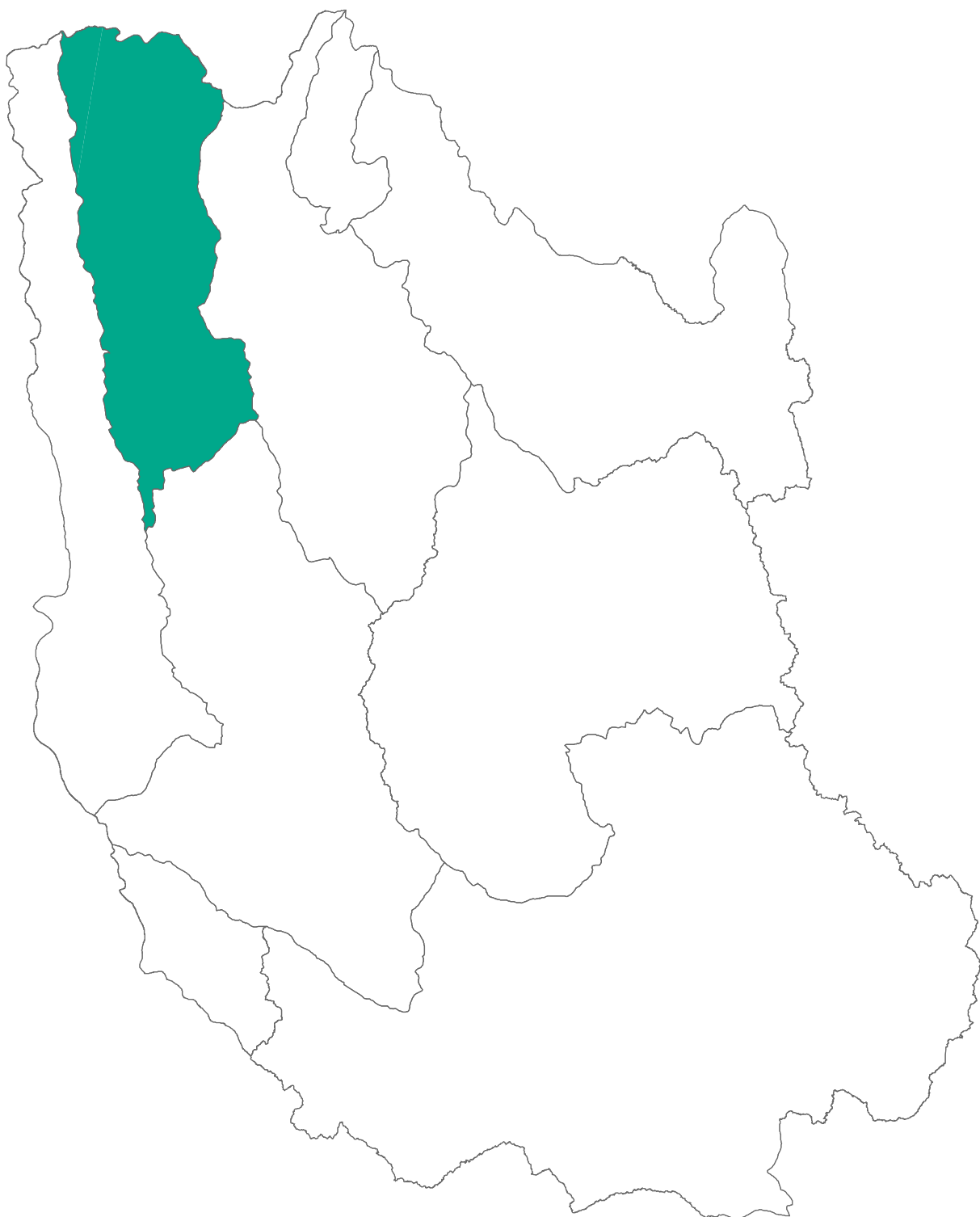
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Section 4.3

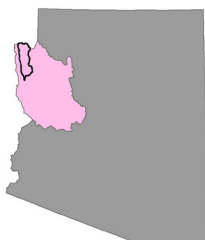
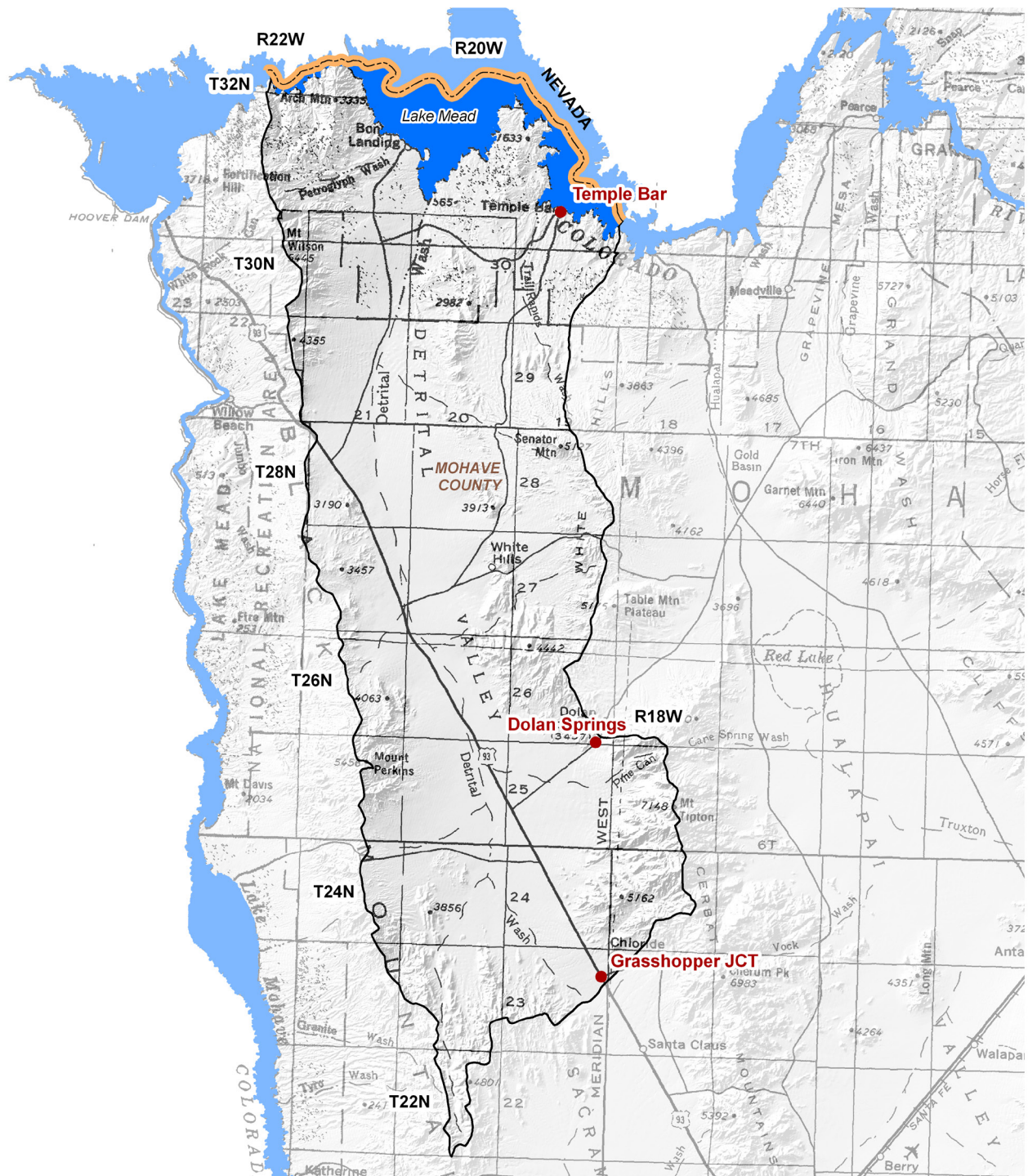
Detrital Valley Basin



4.3.1 Geography of the Detrital Valley Basin

The Detrital Valley Basin is small 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 is almost exclusively Mohave desertscrub with small areas of semi-desert grassland, interior chaparral, Great Basin conifer woodland and montane conifer forest. (see Figure 4.0-9)

- Principal geographic features shown on Figure 4.3-1 are:
 - 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
 - White Hills on the east central basin boundary
 - Cerbat Mountains north of Grasshopper Junction
 - Black Mountains along the western basin boundary with Mt. Wilson, the highest point in the basin at 5,445 in the northwest part of the basin



Base Map: USGS 1:500,000, 1981



0 3 6
Miles



Figure 4.3-1
Detrital Valley Basin
Geographic Features

Nevada State Boundary
City, Town or Place



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, Appendix A. More detailed information on protected areas is found in Section 4.0.4. Land ownership categories are discussed below in the order from largest to smallest percentage 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 BLM.
- 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 and most of the 23,900-acre Mt. Wilson Wilderness (see Figure 4.0-12).
- Primary land uses are recreation and grazing.

National Park Service (NPS)

- 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

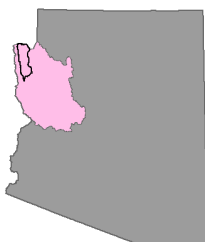
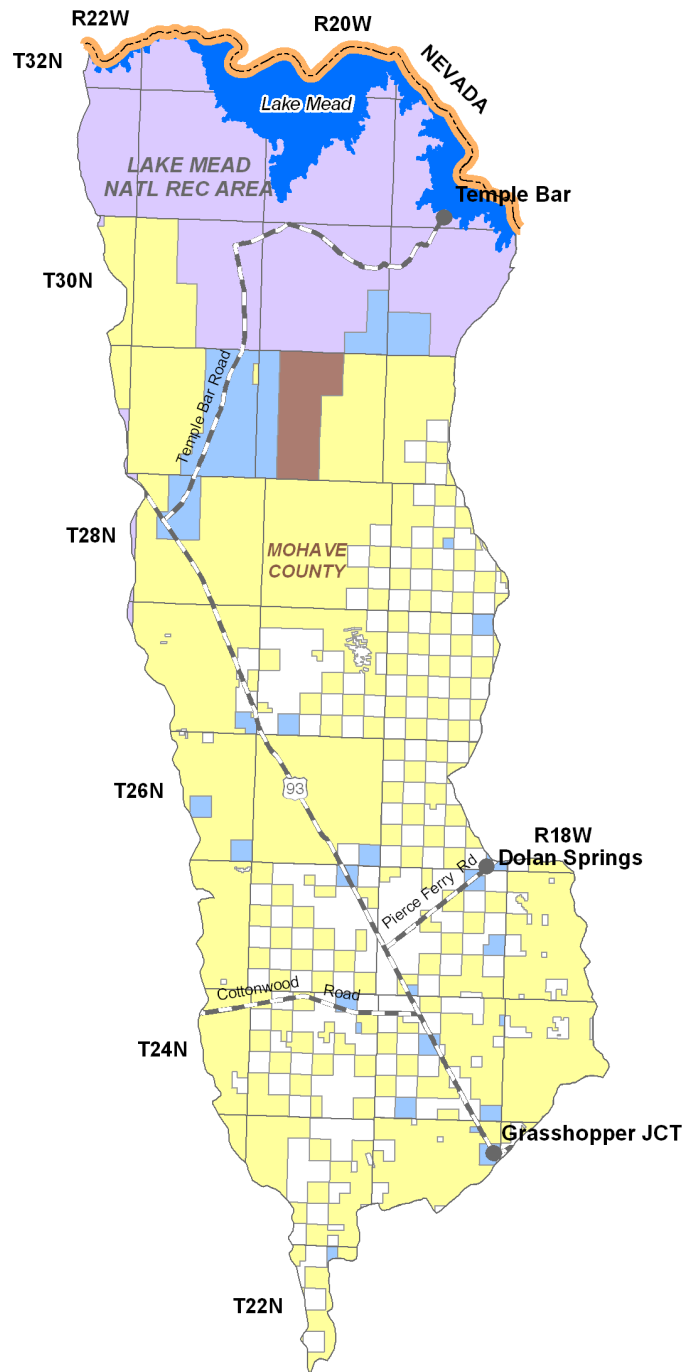
- 18.9% of the land is private.
- Most private land is interspersed in a checkerboard pattern throughout BLM and state trust lands.
- Primary land uses are domestic and grazing.

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



0 3 6
Miles

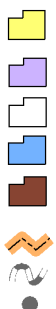


Figure 4.3-2
Detrital Valley Basin
Land Ownership

Land Ownership
(Percentage in Basin)

- U.S. Bureau of Land Management (49.1%)
- National Park Service (24.8%)
- Private (18.9%)
- State Trust (5.6%)
- Other (1.6%)

- Nevada State Boundary
- Major Road
- City, Town or Place



4.3.3 Climate of the Detrital Valley Basin

Climate data from a NOAA/NWS Co-op Network station are compiled 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. More detailed information on climate in the planning area is found in Section 4.0.3. A description of the climate data sources and methods is found in Volume 1, Appendix A.

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 average monthly maximum temperature occurs in July and is 94.2°F and average minimum temperature occurs in January and is 47.2°F.
- Highest average seasonal rainfall occurs in the winter (January – March). For the period of record used the annual rainfall is 4.15 inches.

SCAS Precipitation Data

- See Figure 4.3-3
- Additional 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.
- 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

Source: WRCC, 2005

B. Evaporation Pan:

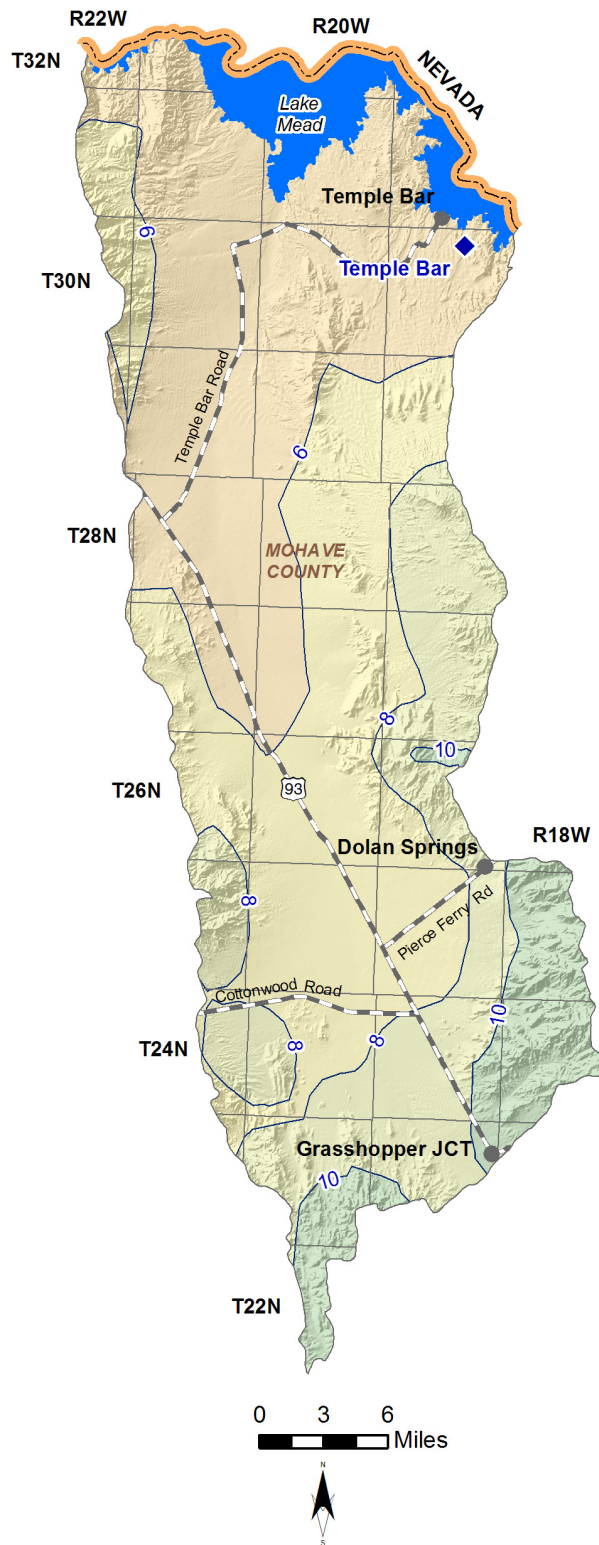
Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

C. AZMET:

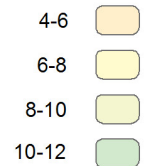
Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evapotranspiration, in inches (Number of years to calculate averages)
None			

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record	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								



**Average Annual
Precipitation
(1961-1990)
inches per year**



Meteorological Stations

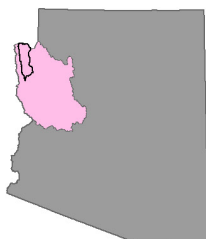
NOAA/NWS

Precipitation Contour

Nevada State Boundary

Major Road

City, Town or Place



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 4.3-2. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.3-3. The location of flood ALERT equipment, USGS runoff contours and large reservoirs are shown on Figure 4.3-4. Descriptions of stream, reservoir and stockpond data sources and methods are found in Volume 1, Appendix A.

Flood ALERT Equipment

- Refer to Table 4.3-2.
- As of October 2005 there were three stations in the basin.

Reservoirs and Stockponds

- Refer to Table 4.3-3.
- 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.
- There are no small reservoirs in the basin.
- There are 43 registered stockponds in this basin.

Runoff Contour

- Refer to Figure 4.3-4.
- Average annual runoff is 0.5 inches per year, or 26.65 acre-feet per square mile, in the center of the basin and decreases to 0.1 inches, or 5.33 acre-feet per square mile, on the edges of the basin.

Table 4.3-2 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

Source: ADWR 2005b

Notes:

FCD = Flood Control District

NA = Not available

Table 4.3-3 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,R	Federal

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

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					

Source: Compilation of databases from ADWR & others

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)

Total number: 0

Total surface area: 0 acres

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

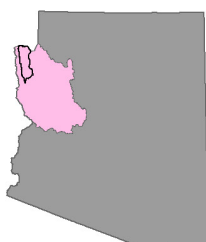
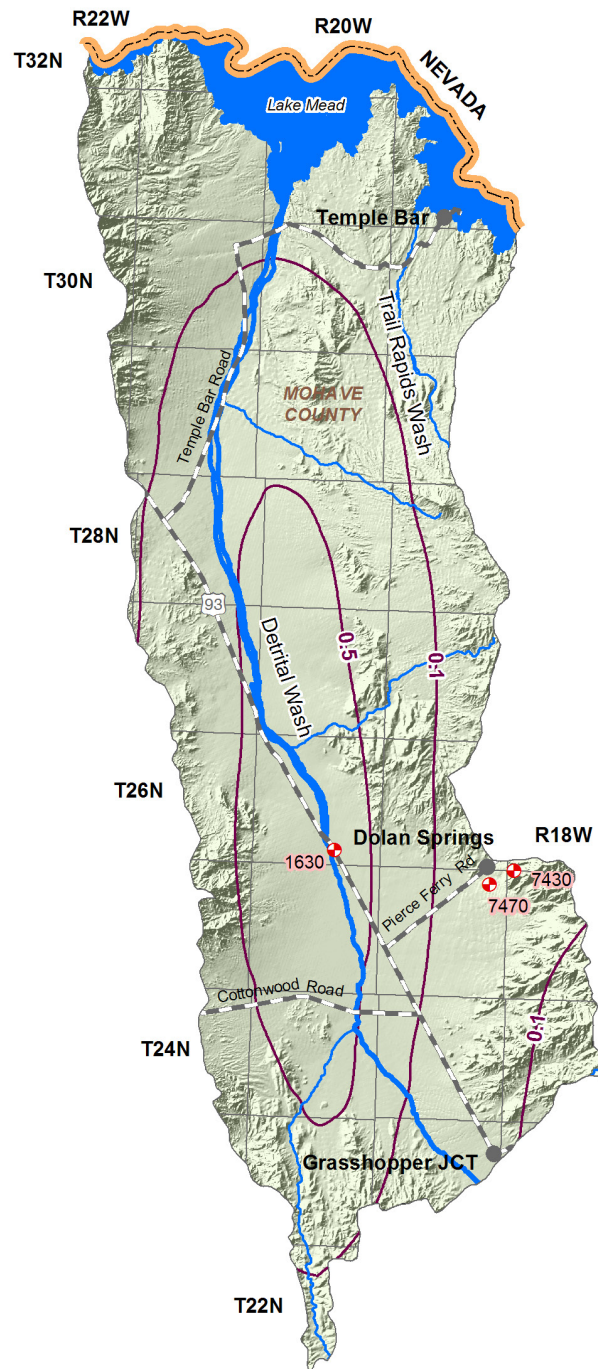
Total number: 43 (from water right filings)

Notes:

¹C=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.



Stream Data Source: ALRIS, 2005b

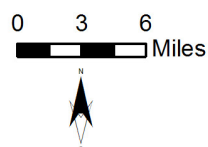


Figure 4.3-4
Detrital Valley Basin
Surface Water Conditions

USGS Annual Runoff Contour
for 1951-1980 (in inches)

Stream Channel (width of line
reflects stream order)

Stream Gages

Flood ALERT Equip. and
Station ID

Nevada State Boundary
Major Road
City, Town or Place



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 4.3-4. The locations of major springs are shown on Figure 4.3-5. Descriptions of data sources and methods for intermittent and perennial reaches and springs are found in Volume 1, Appendix A.

- There is one perennial stream, the Colorado River, located along the northern basin boundary.
- There is one major spring, Monkey Cove, with a measured discharge of 1,200 gallons per minute (gpm). 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 4.3-4B. There are four minor springs identified in this basin.
- Listed discharge rates may not be indicative of current conditions. The most recent measurements were taken during or prior to 1965.
- The total number of springs identified by the USGS varies from 24 to 27, depending on the database reference.

Table 4.3-4 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

Source: Compilation of databases from ADWR & others

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

Notes:

¹Most recent measurement identified by ADWR

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



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 4.3-5. 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 as well as well data sources and methods, including water-level changes and well yields are found in Volume 1, Appendix A.

Major Aquifers

- Refer to Table 4.3-5 and Figure 4.3-6.
- Major aquifers in the basin include recent stream alluvium, basin fill and sedimentary rock. The principal water-bearing aquifer is the basin fill.
- Flow direction is generally from the south to the north.

Well Yields

- Refer to Table 4.3-5 and Figure 4.3-8.
- As shown on Figure 4.3-8 well yields in this basin range from less than 100 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.

Natural Recharge

- Refer to Table 4.3-5.
- The estimate of natural recharge for this basin is 1,000 acre-feet per year (AFA).

Water in Storage

- Refer to Table 4.3-5.
- Storage estimates for this basin range from 1.0 million acre-feet (maf) to seven maf 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 11 index wells in this basin. Hydrographs for two index wells (A and C) and one other well are shown in Figure 4.3-7.
- The Department measures water levels four times daily at one automated groundwater monitoring site in the west-central portion of the basin.
- 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 4.3-5 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 (GWSI) and/or USGS
	Range 35-240 Median 35 (3 wells reported)	Reported on registration forms for large (>10-inch) diameter wells (Wells55)
	Range 30-100	ADWR (1990)
	Range 0-500	Anning and Duet (1994)
Estimated Natural Recharge, in acre-feet/year:	1,000	Freethy and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	1,480,000 to 3,940,000 ¹ (to 1200 ft)	Mason and others (2007)
	1,000,000	ADWR (1994b)
	1,000,000 ² (to 1200 ft)	Freethy and Anderson (1986)
	7,000,000 (to 1200 ft)	Arizona Water Commission (1975)
Current Number of Index Wells:	11	
Date of Last Well Sweep:	2006 (82 wells measured)	

Notes:

¹ Range based on assumed values for specific yield.

² Predevelopment estimate

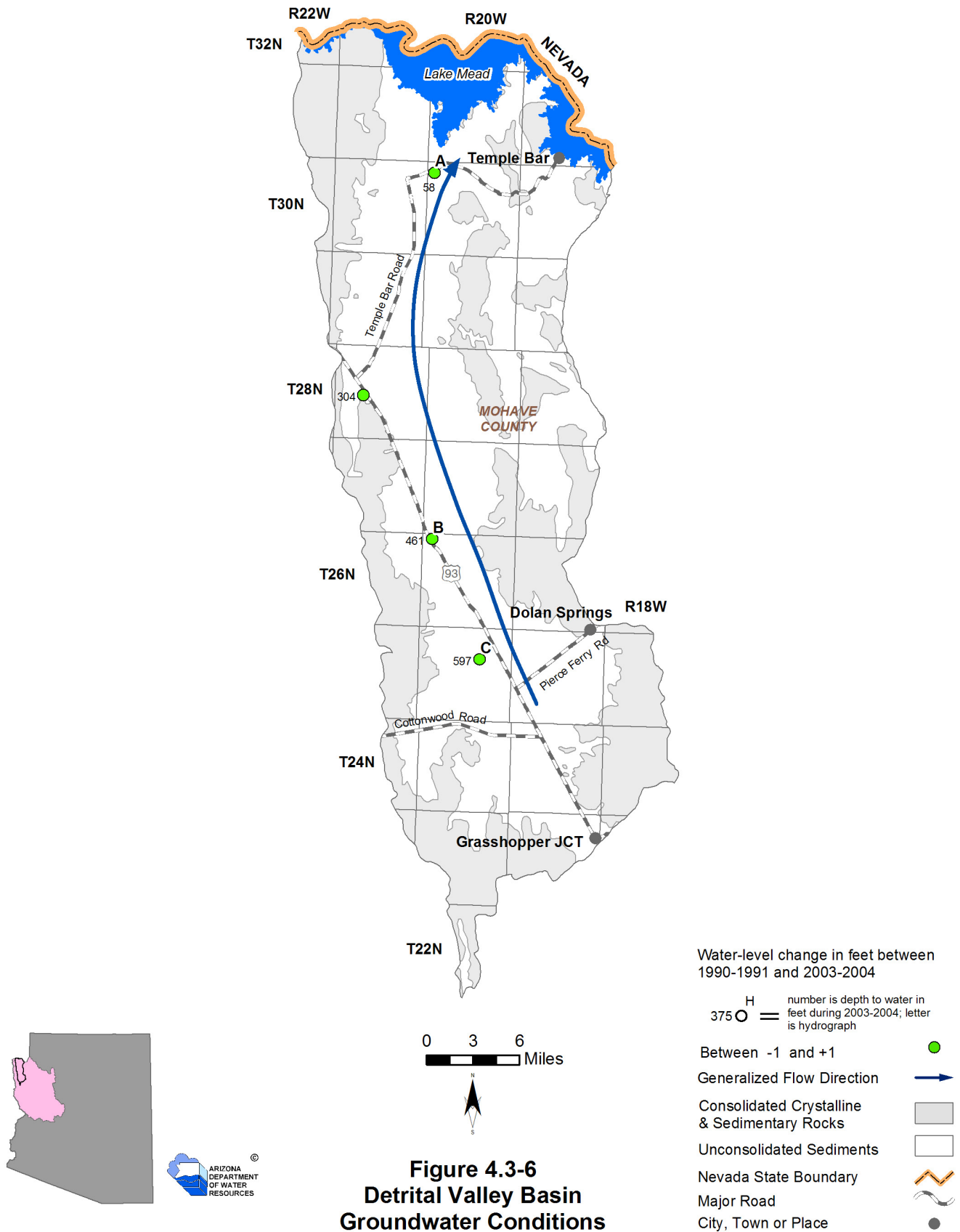
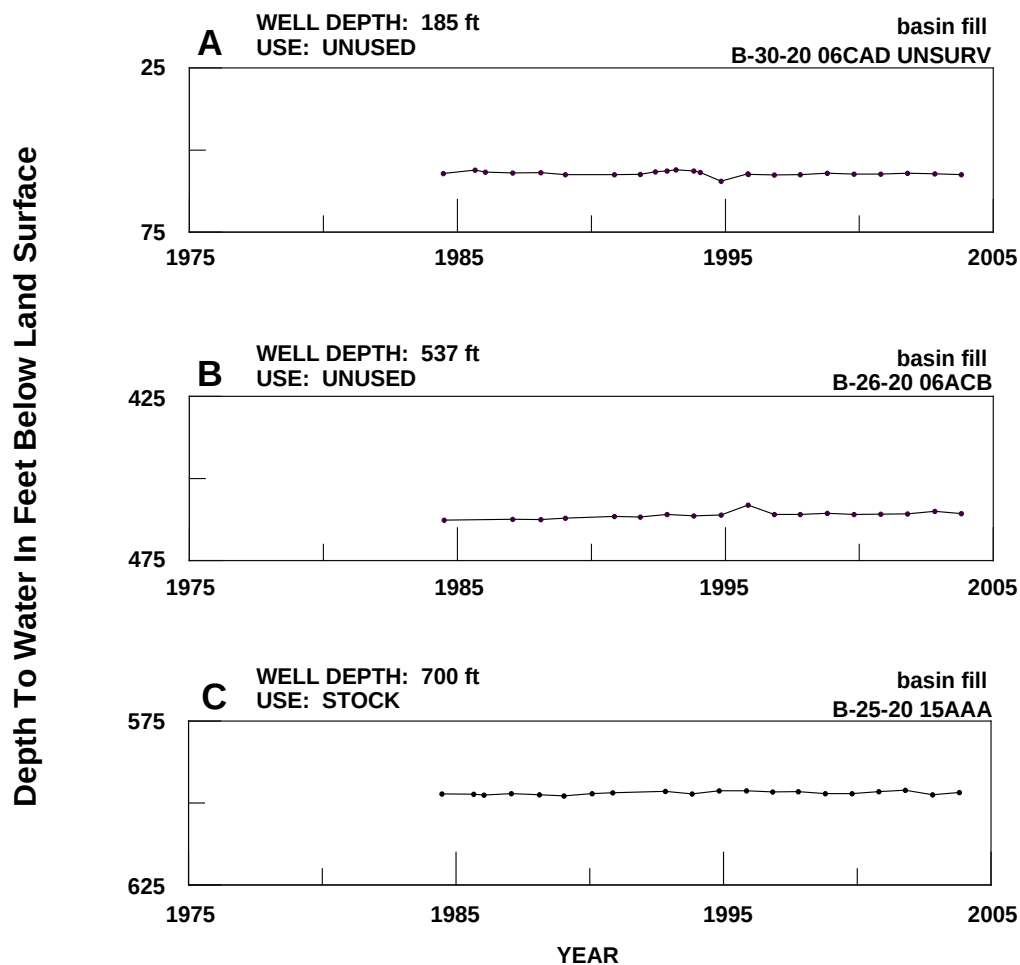
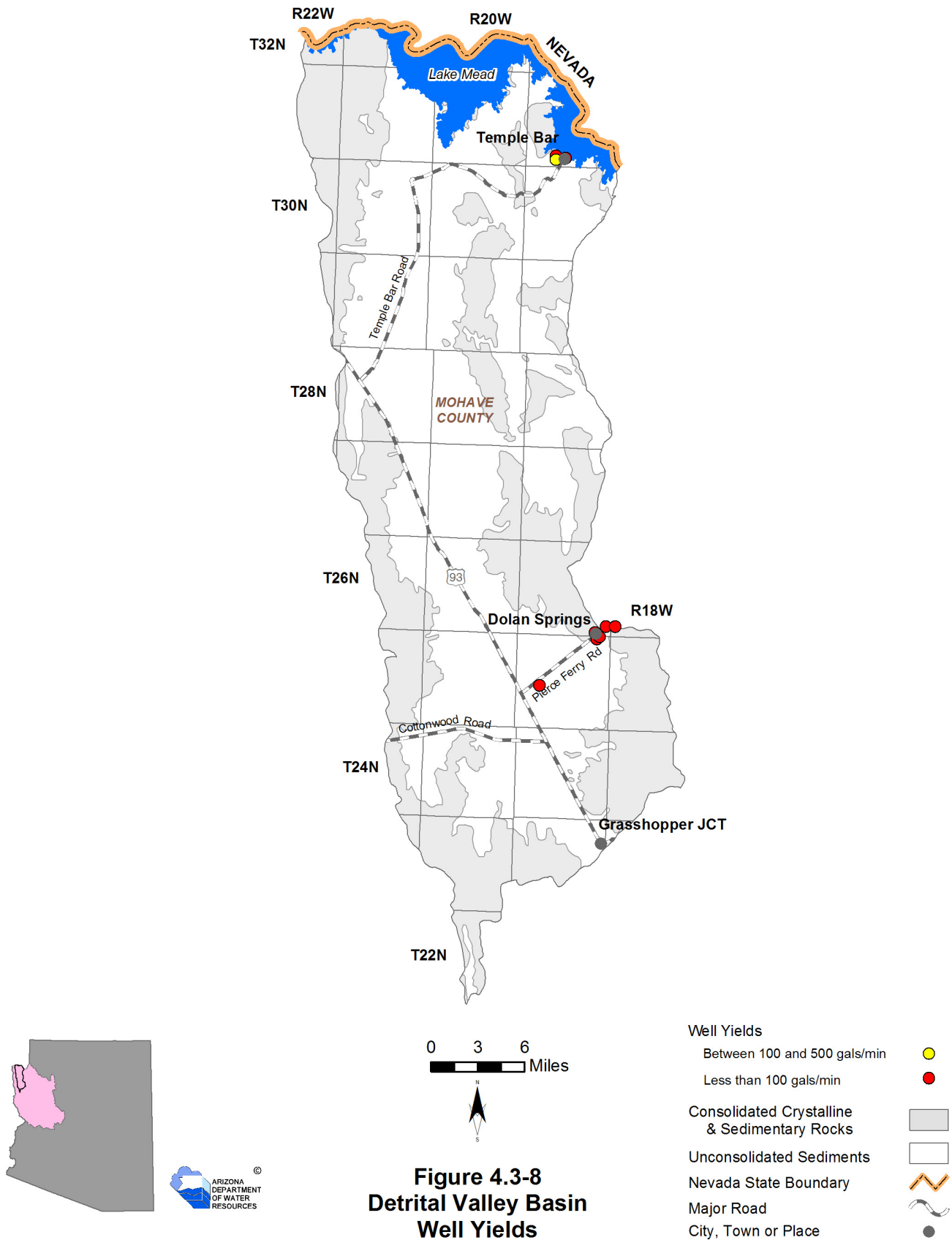


Figure 4.3-7
Detrital Valley Basin
Hydrographs Showing Depth to Water in Selected Wells





4.3.7 Water Quality of the Detrital Valley Basin

Sites with parameter concentrations that have equaled or exceeded drinking water standard(s) (DWS), including location and parameter(s) are shown in Table 4.3-6A. There are no impaired lakes or streams in this basin. Figure 4.3-9 shows the location of exceedences keyed to Table 4.3-6. Not all parameters were measured at all sites; selective sampling for particular constituents is common. A description of water quality data sources and methods is found in Volume 1, Appendix A.

Well, Mine or Spring sites that have equaled or exceeded drinking water standards (DWS)

- Refer to Table 4.3-6A.
- Twenty-three sites have parameter concentrations that have equaled or exceeded DWS.
- The most frequently equaled or exceeded parameters was arsenic.
- Other parameters equaled or exceeded in the sites measured in this basin were radionuclides, nitrates, lead and total dissolved solids.

Table 4.3-6 Water Quality Exceedences in the Detrital Valley Basin¹

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded 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

Source: Compilation of databases from ADWR & others

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

Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium

TDS = Total Dissolved Solids

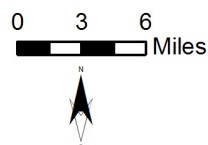
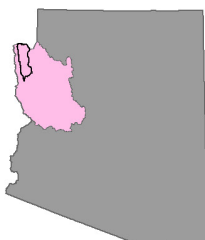
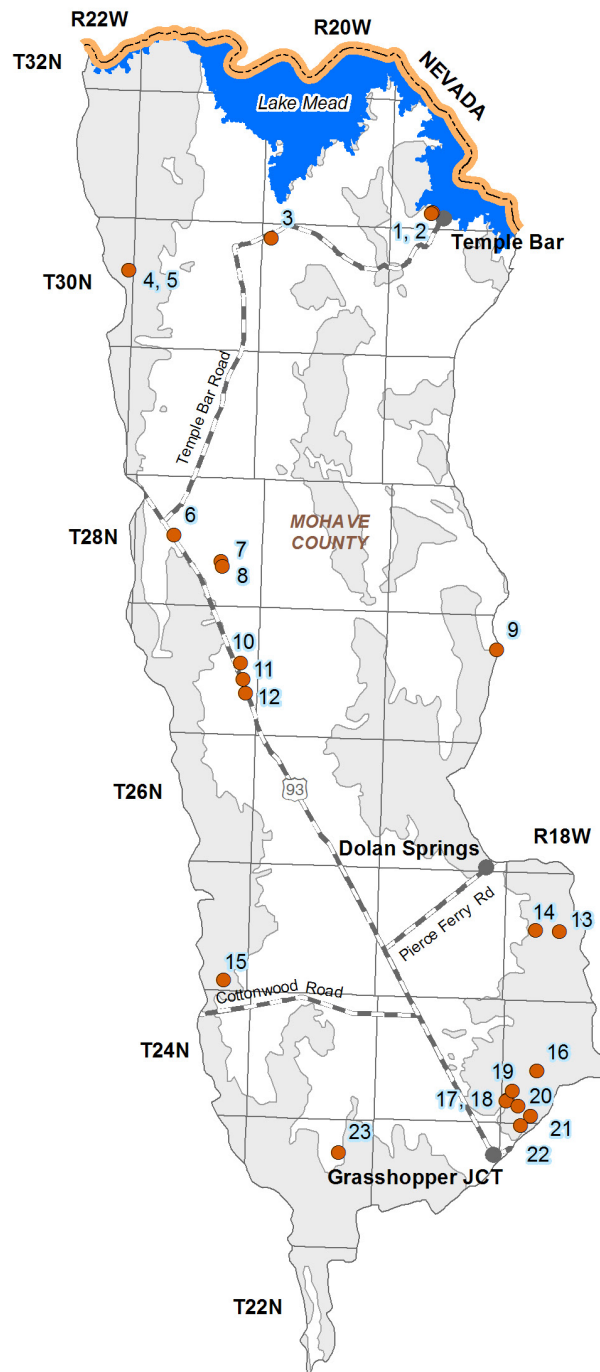


Figure 4.3-9
Detrital Valley Basin
Water Quality Conditions

Well, Spring or Mine Site that has
Equaled or Exceeded DWS



Consolidated Crystalline
& Sedimentary Rocks



Unconsolidated Sediments



Nevada State Boundary



Major Road



City, Town or Place



4.3.8 Cultural Water Demand 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 4.3-7. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 4.3-8. 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, Appendix A. More detailed information on cultural water demand is found in Section 4.0.7.

Cultural Water Demand

- Refer to Table 4.3-7 and Figure 4.3-10.
- Population in this basin is small but has almost doubled since 1980, increasing from 757 in 1980 to 1,373 in 2000. Projections suggest a similar rate of growth through 2030, although large developments are planned in the basin (see Table 4.3-9).
- Groundwater pumping is minimal in this basin. Current pumping is comparable to historic pumping with an annual average of less than 300 AFA for municipal use from 2001-2005. There are no recorded industrial or agricultural water demands in this basin. There is, however, a small mine or quarry north of Grasshopper Junction.
- All of the surface water diversions are for municipal use at Temple Bar within the Lake Mead National Recreation Area and are less than 300 AFA from 1991-2005.
- 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.
- As of 2005 there were 168 registered wells with a pumping capacity of less than or equal to 35 gpm and 50 wells with a pumping capacity of more than 35 gpm.

Effluent Generation

- Refer to Table 4.3-8.
- 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 4.3-7 Cultural Water Demand in the Detrital Valley Basin¹

Year	Estimated and Projected 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	Agricultural	Municipal	Industrial	Agricultural	
1971		71 ²	10 ²	<500			NR			ADWR (1994a)
1972										
1973										
1974										
1975				<500			NR			
1976										
1977										
1978										
1979		<500			NR					
1980	757									
1981	776									
1982	795									
1983	815	11	7	<500			NR			
1984	834									
1985	853									
1986	872									
1987	891	10	1	<500			NR			
1988	911									
1989	930									
1990	949									
1991	991	9	11	<300	NR	NR	<300	NR	NR	
1992	1,034									
1993	1,076									
1994	1,119									
1995	1,161	27	2	<300	NR	NR	<300	NR	NR	
1996	1,204									
1997	1,246									
1998	1,289									
1999	1,331	40	19	<300	NR	NR	<300	NR	NR	
2000	1,373									
2001	1,527									
2002	1,680									
2003	1,834									
2004	1,988									
2005	2,142									
2010	2,910									
2020	3,628									
2030	4,212									
WELL TOTALS:		168	50							

Notes:

NR = Not reported

¹ Does not include effluent or evaporation losses from stockponds and reservoirs.

² Includes all wells through 1980.

Table 4.3-8 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/Landscape	Wildlife Area	Discharge to Another Facility	Infiltration Basins			
Temple Bar WWTF	National Park Service	Park			NA									

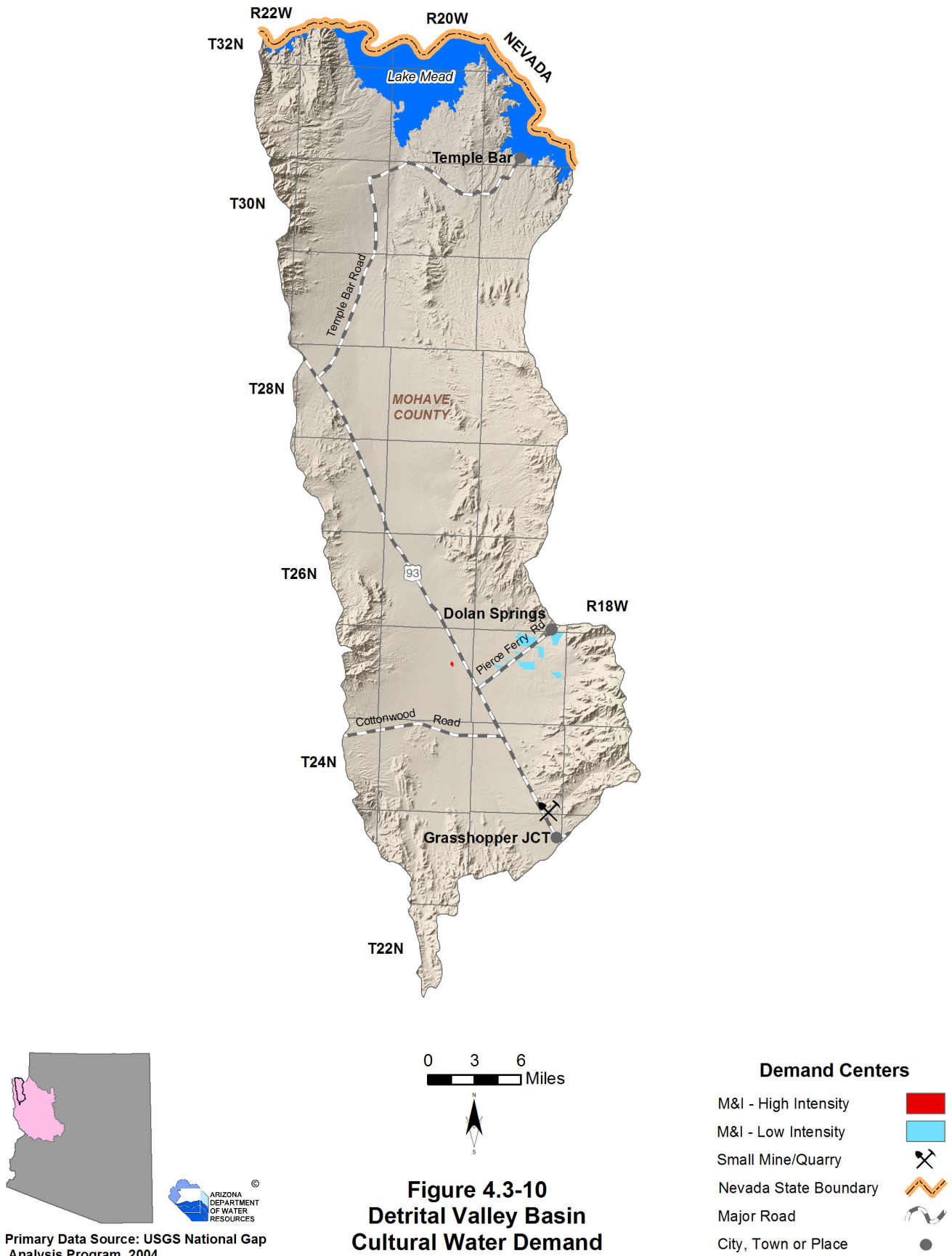
Source: Compilation of databases from ADWR & others

Notes:

Year of Record is for the volume of effluent treated/generated

NA: Data not currently available to ADWR

WWTF: Waste Water Treatment Facility



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 4.3-9A and B for water reports and analysis of adequate water supply. 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 C. Adequacy determination data sources and methods are found in Volume 1, Appendix A.

- All subdivisions receiving an adequacy determination are in Mohave County. Twenty-nine water adequacy determinations for more than 6,090 lots have been made in this basin through December 2008. No lots received an adequate water supply designation.
- The most common reason for an inadequacy determination was because the existing water supply is unreliable or physically unavailable.
- Two Analysis of Adequate Water Supply applications have been approved for this basin for a total of 50,953 lots.

Table 4.3-9 Adequacy Determinations in the Detrital Valley Basin¹

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	Equestrian Estates at White Hills, Tract 3816	Mohave	27 North	19 West	5	116	53-700573	Inadequate	A1	10/16/2008	Equestrian Estates White Hills Water Cooperative
2	Flannery & Allen	Mohave	27 North	20 West	31	55	53-400912	Inadequate	A1,A2	4/10/2003	Individual Wells
3	Gateway Acres, Tract One	Mohave	25 North	20 West	5	237	53-700289	Inadequate	A1	4/19/2007	Dry Lot Subdivision
4	Gateway Acres, Tracts, 1,2,7 & 8	Mohave	25 North	20 West	3, 5, 7, 11, 13, 14, 15, 17, 21, 23	352	53-401105	Inadequate	A1,A2	5/7/2004	None
5	Gateway Acres 3&4	Mohave	25 North	19 West	5,9, 7,17,29	205	53-500694	Inadequate	A2,A3	8/29/1985	Dry Lot Subdivision
6	Gateway Acres Tract 05	Mohave	24 North	20 West	23, 25	340	53-500695	Inadequate	A2,A3	8/27/1984	Dry Lot Subdivision
7	Gateway Acres Tract 06	Mohave	24 North	20 West	11	49	53-500696	Inadequate	A1,A2,A3	8/13/1982	Dry Lot Subdivision
8	Gateway Acres Tract 06A	Mohave	24 North	20 West	11		53-500697	Inadequate	A2,A3	3/14/1984	Dry Lot Subdivision
9	Gateway Acres 8	Mohave	25 North	19 West	1, 13	642	53-500692	Inadequate	A2,A3	11/23/1977	Dry Lot Subdivision
10	Gateway Acres 9	Mohave	25 North	19 West	5,7,9,17,19,21,29	NA	NA	Inadequate	A2,A3	11/24/1977	Dry Lot Subdivision
11	Gateway Acres Tract 11	Mohave	24 North	19 West	7	186	53-500698	Inadequate	A2,A3	3/14/1984	Dry Lot Subdivision
12	Gateway Acres Tract 11A	Mohave	24 North	19 West	9	NA	53-500699	Inadequate	A1,A2,A3	6/30/1992	Dry Lot Subdivision
13	Gateway Acres Tract 12	Mohave	24 North	19 West	19, 31	340	53-500700	Inadequate	A2,A3	8/27/1984	Dry Lot Subdivision
14	Gateway Acres 13	Mohave	25 North	20 West	31	NA	53-500693	Inadequate	D	7/29/1993	Dry Lot Subdivision
15	Golden Horseshoe Ranchos #1	Mohave	27 North	20 West	9	98	53-500718	Inadequate	A1	12/31/1992	Dry Lot Subdivision
16	Golden Horseshoe Ranchos #2	Mohave	27 North	19 West	7	540	53-300222	Inadequate	A1,A2	11/7/1996	Dry Lot Subdivision
17	Golden Horseshoe Ranchos Units 3 & 4	Mohave	27 North	19 West	9, 17	192	53-300196	Inadequate	A2	9/26/1996	Dry Lot Subdivision
18	Golden Horseshoe Ranchos Unit #5	Mohave	27 North	19 West	19	375	53-400274	Inadequate	A1,B,C	4/7/2000	White Hills Water Company
19	Golden Horseshoe Ranchos Unit 4 lots 17,27,240,242, 275,276	Mohave	27 North	19 West	17	6	53-700533	Inadequate	A1	6/20/2008	Dry Lot Subdivision
20	Golden Horseshoe Ranchos Unit 5	Mohave	27 North	19 West	19	283	53-401884	Inadequate	A1	10/6/2005	Dry Lot Subdivision

Table 4.3-9 Adequacy Determinations in the Detrital Valley Basin (Cont)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						
21	Golden Horseshoe Ranchos, Unit 1, Unit 3, Unit 4 and Unit 6	Mohave	27 North	19 West	9, 17, 21	376	53-700285	Inadequate	A1	6/19/2007	Dry Lot Subdivision
21	Golden Horseshoe Ranchos, Unit 1, Unit 3, Unit 4 and Unit 6	Mohave	27 North	20 West	9	376	53-700285	Inadequate	A1	6/19/2007	Dry Lot Subdivision
22	Lake Mohave Ranchos	Mohave	25 North	19 West	1, 11, 23, 27	NA	53-500885	Inadequate	A2,A3	11/23/1977	Dry Lot Subdivision
23	Lake Mohave Ranchos A	Mohave	25 North	18 West	7	NA	53-500884	Inadequate	A2,A3	11/23/1977	Dry Lot Subdivision
24	Lake Mohave Ranchos B&C	Mohave	26 North	20 West	35	642	53-500888	Inadequate	A2,A3	11/23/1977	Dry Lot Subdivision
25	Lake Mohave Ranchos Unit 16	Mohave	25 North	18 West	7	9	53-401802	Inadequate	A1	7/14/2005	Dry Lot Subdivision
26	Sunny Lakes Ranchos Unit 1	Mohave	28 North	20 West	13	546	53-402260	Inadequate	A2	8/25/2006	Dry Lot Subdivision
27	Sunset Vista	Mohave	25 North	19 West	4	10	53-401293	Inadequate	A1,A2	5/7/2004	NA
30	Triangle Air Park	Mohave	27 North	21 West	24	35	53-501581	Inadequate	A1,A2,A3	1/24/1984	Dry Lot Subdivision
31	Western Horizon Estates #2	Mohave	24 North	19 West	27	80	53-501670	Inadequate	A1,A2,A3	7/13/1992	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				
28	The Ranch At White Hills	Mohave	24 North	20 West	13, 33, 35	25,000 for the entire subdivision	43-401774	4/11/2006	Double Diamond Utilities
			25 North	19 West	6, 8, 18, 30				
			25 North	20 West	3, 5, 7, 9, 11-15, 17, 19, 21, 23				
			25 North	21 West	35				
			27 North	19 West	1, 3, 9, 11, 13, 15, 19, 21, 23, 25, 27, 29, 31, 33, 35				
			27 North	20 West	1, 9, 13, 25, 31, 35				
			27 North	21 West	13, 25				
			28 North	19 West	9, 15, 17, 19, 21, 27, 29, 31, 33, 35				
			28 North	20 West	23, 25, 35				
			29 North	19 West	21, 29, 33				

Table 4.3-9 Adequacy Determinations in the Detrital Valley Basin (Cont)¹

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				
29	The Villages at White Hills	Mohave	27 North	20 West	16, 20, 21, 23, 30	25,953	43-401674	7/18/2007	Undetermined
			27 North	21 West	25				

Source: ADWR 2008

Notes:

¹Each 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. Between 1995-2006 all applications for adequacy were given a file number with a 22 prefix. In 2006 a 53 prefix was assigned to all water adequacy reports and applications regardless of their issue date.

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)

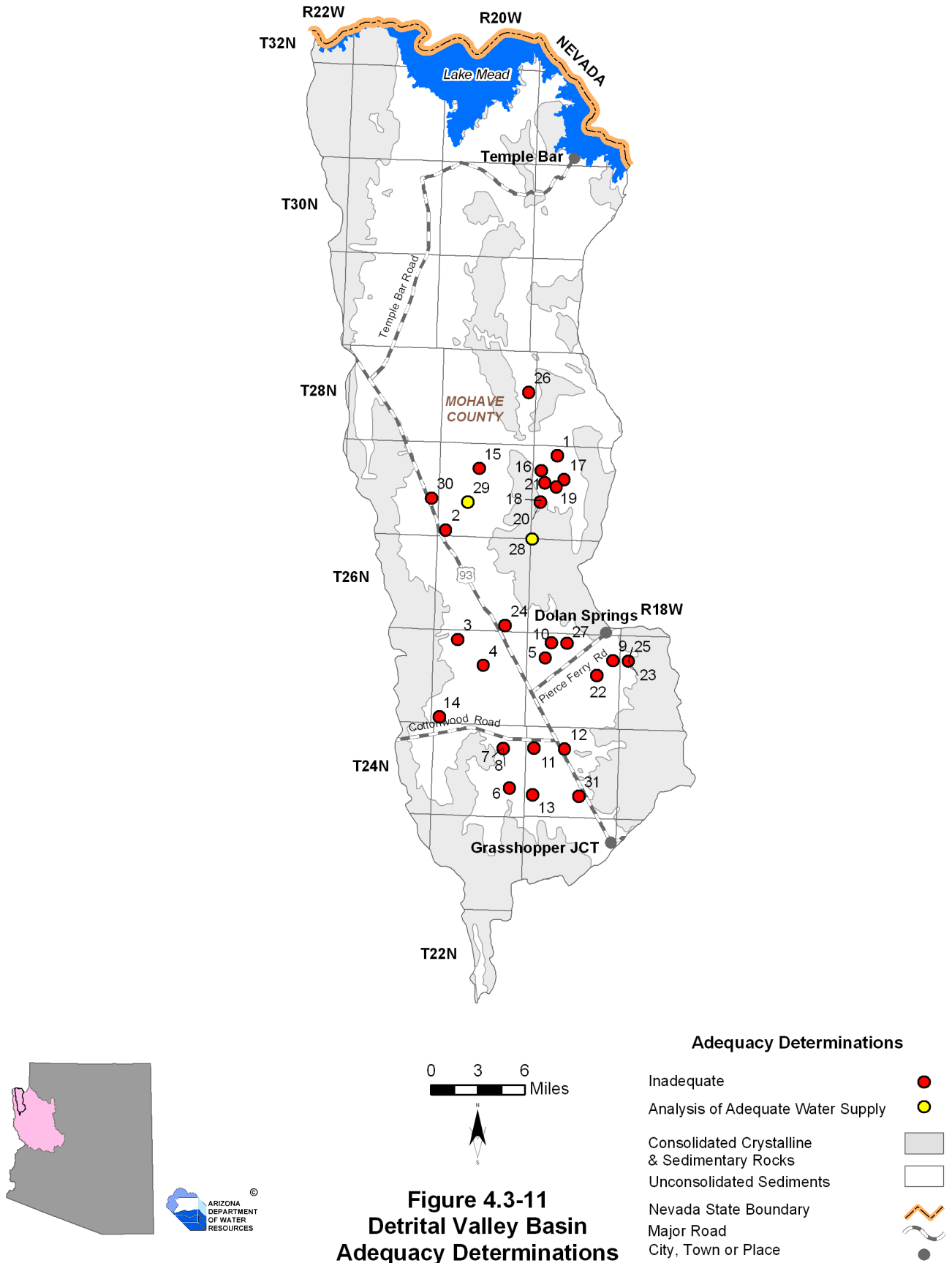
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)

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



Detrital Valley Basin

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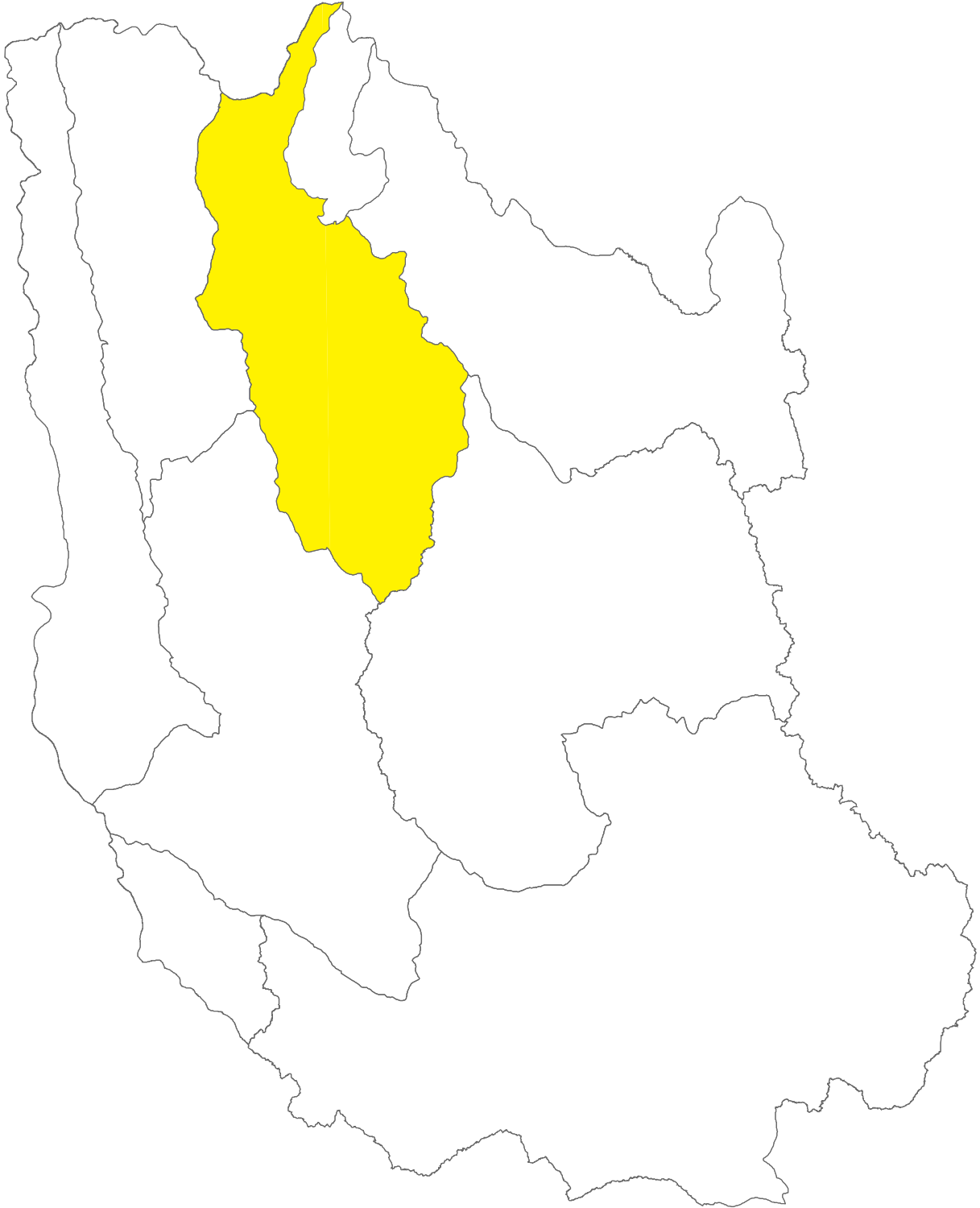
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Section 4.4

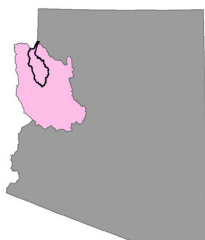
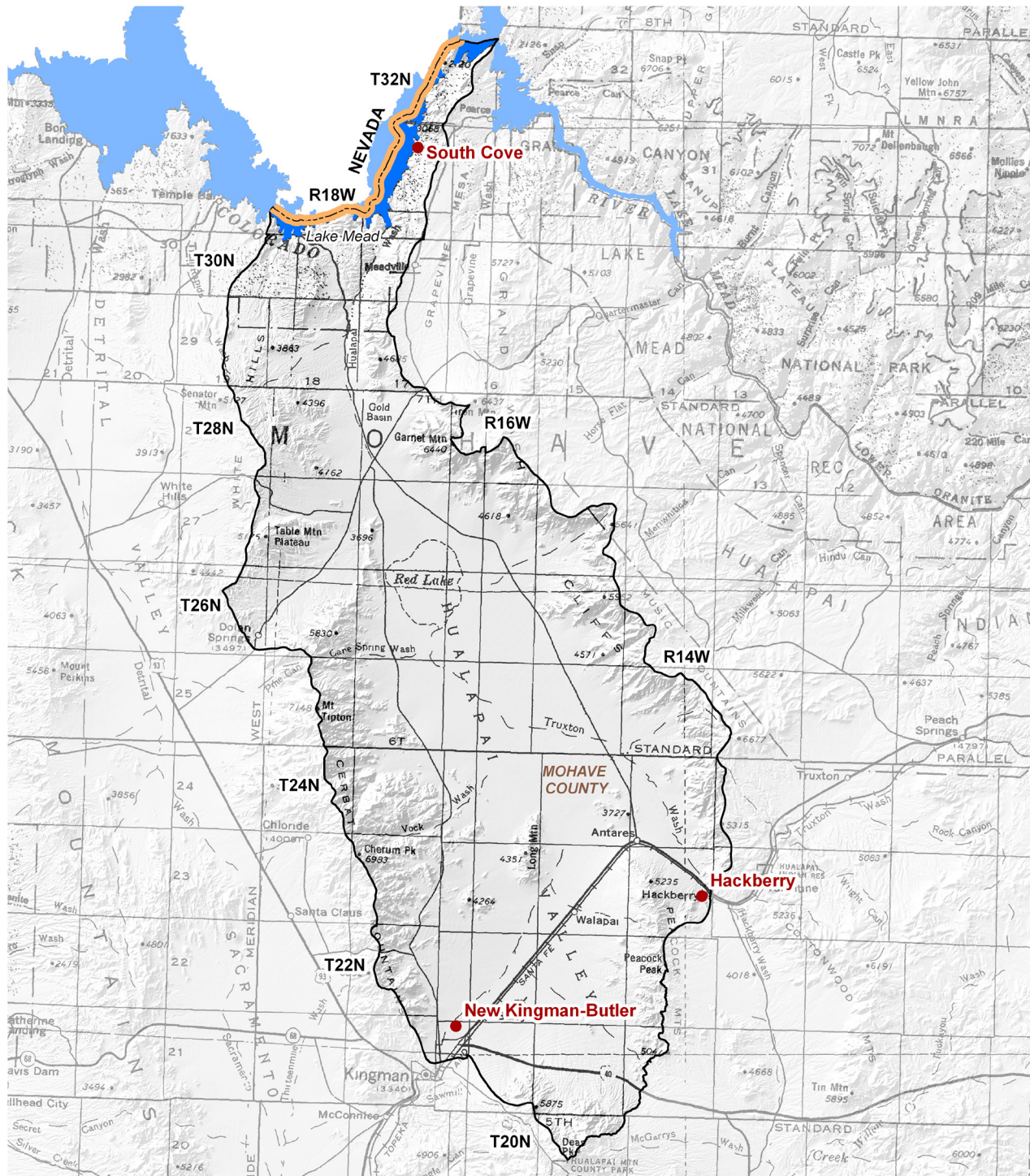
Hualapai Valley Basin



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, semi-desert grassland, interior chaparral, conifer woodlands and conifer forest. (see Figure 4.0-9)

- 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
 - Mt. Tipton on the western basin boundary in the Cerbat Mountains
 - 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



Base Map: USGS 1:500,000, 1981

0 3 6
Miles



Figure 4.4-1
Hualapai Valley Basin
Geographic Features

Nevada State Boundary
City, Town or Place



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, Appendix A. More detailed information on protected areas is found in Section 4.0.4. Land ownership categories are discussed below in the order from largest to smallest percentage 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 Park Service (NPS)

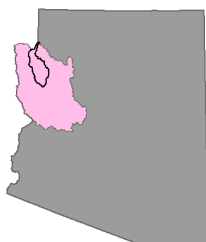
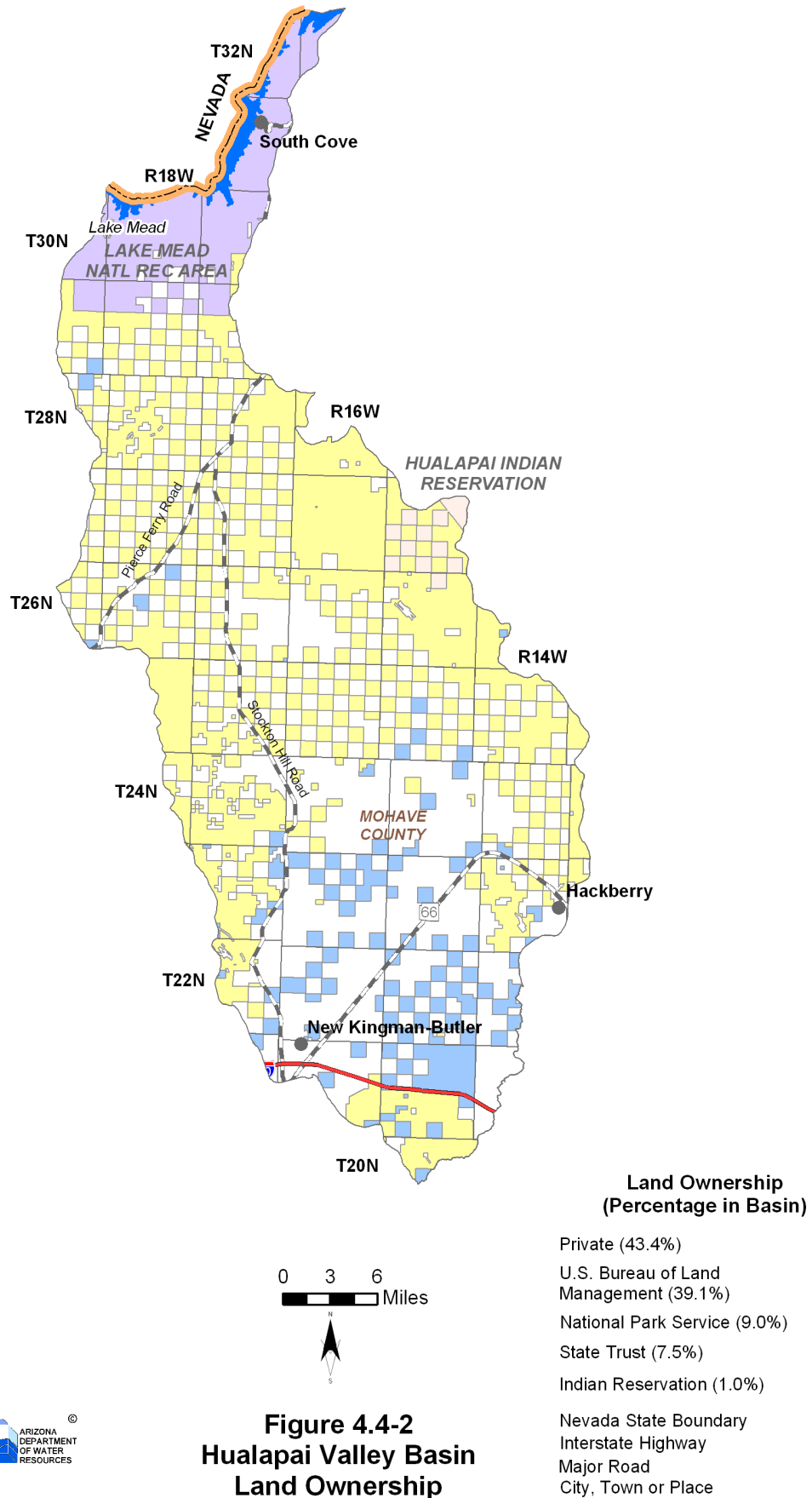
- 9.0% of the land is federally owned and managed by the National Park Service (NPS) as the Lake Mead National Recreation Area.
- All NPS lands are located along the northern basin boundary.
- Primary land use is recreation.

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, R15W and is interspersed with BLM lands.
- Primary land use is grazing.



Source: ALRIS, 2004



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. More detailed information on climate in the planning area is found in Section 4.0.3. A description of this and other climate data sources and methods is found in Volume 1, Appendix A.

SCAS Precipitation Data

- Average annual precipitation is as high as 14 inches at the southernmost tip of the basin in the Hualapai Mountains and as low as four inches in the northern portion of the basin along the boundary with Nevada.

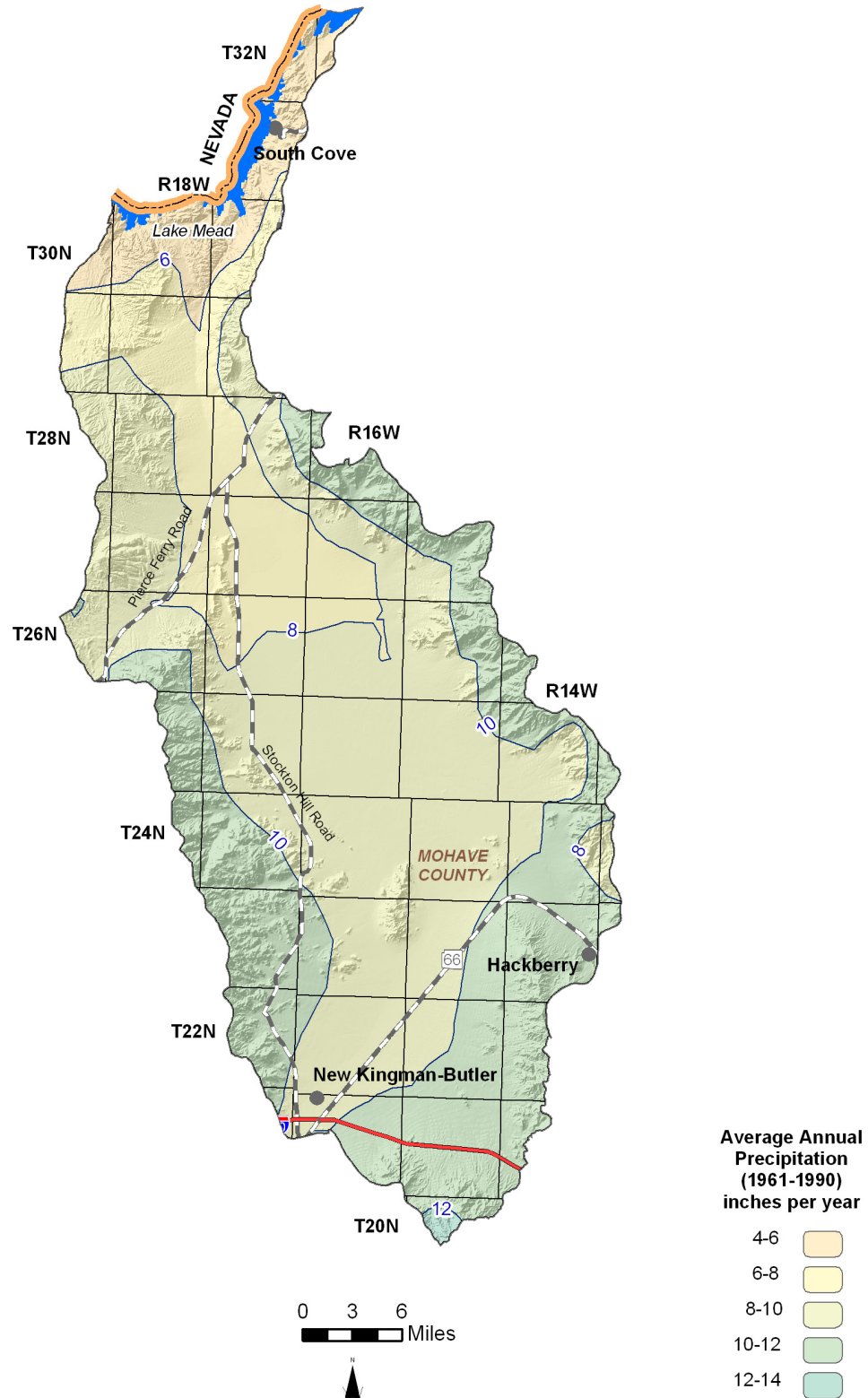


Figure 4.4-3
Hualapai Valley Basin
Meteorological Stations
and Annual Precipitation

Precipitation Data Source: Oregon State University, 1998



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 4.4-1. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.4-2. The location of flood ALERT equipment, USGS runoff contours and large reservoirs are shown on Figure 4.4-4. Descriptions of stream, reservoir and stockpond data sources and methods are found in Volume 1, Appendix A.

Flood ALERT Equipment

- Refer to Table 4.4-1.
- As of October 2005 there were six stations in the basin.

Reservoirs and Stockponds

- Refer to Table 4.4-2.
- 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.
- 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.
- There are 72 registered stockponds in this basin.

Runoff Contour

- Refer to Figure 4.4-4.
- Average annual runoff is 0.5 inches per year, or 26.65 acre-feet per square mile, in the southwest corner of the basin around New Kingman-Butler and decreases to 0.1 inches, or 5.33 acre-feet per square mile, in the center of the basin.

Table 4.4-1 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

Source: ADWR 2005b

Notes:

FCD = Flood Control District
NA = Not available

Table 4.4-2 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,R	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 ¹	JURISDICTION
1	Red ⁵	Bureau of Land Management/Private	13,412	U	Landowner

Source: Compilation of databases from ADWR & others

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)⁴

Total number: 1

Total surface area: 12 acres

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

Total number: 72 (from water right filings)

Notes:

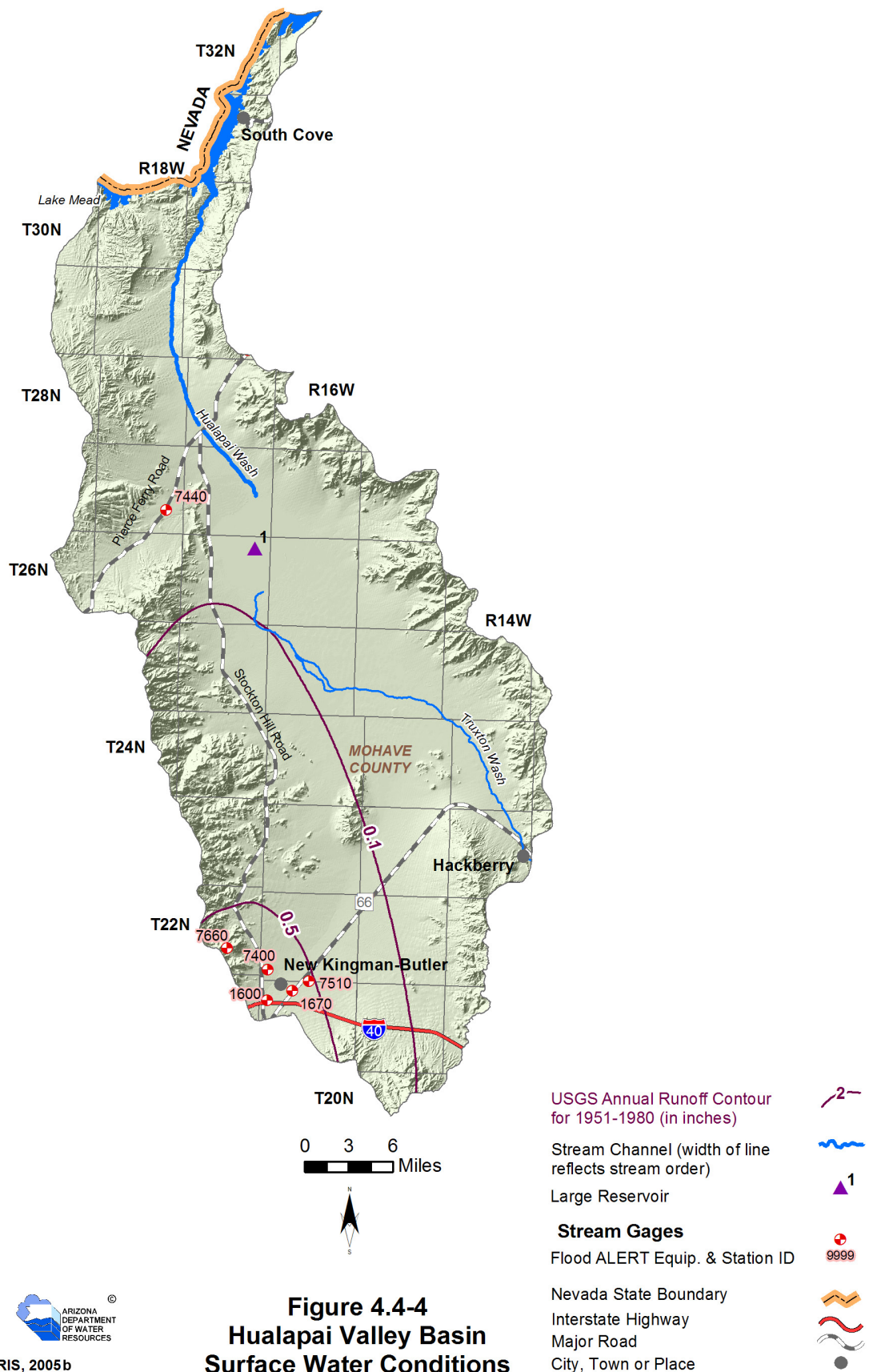
¹C=flood control; H=hydroelectric; I=irrigation; R=recreation; RR=river regulation; S=water supply; U=Unknown

²Dam is located in Lake Mohave Basin and lake storage is located in Lake Mohave, Detrital Valley, Hualapai Valley and Meadview Basins.

³Includes 2,378,000 acre-feet of dead storage.

⁴Capacity data not available to ADWR

⁵Dry lake



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 4.4-3. The locations of major springs as well as perennial and intermittent streams are shown on Figure 4.4-5. Descriptions of data sources and methods for intermittent and perennial reaches and springs are found in Volume 1, Appendix A.

- 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. The largest discharge rate is 25 gpm for an unnamed spring in the northern portion of the basin.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 4.4-3B. There are 19 minor springs identified in this basin.
- Listed discharge rates may not be indicative of current conditions. Only four springs have been measured since 1980.
- The total number of springs identified by the USGS varies from 70 to 72, depending on the database reference.

Table 4.4-3 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

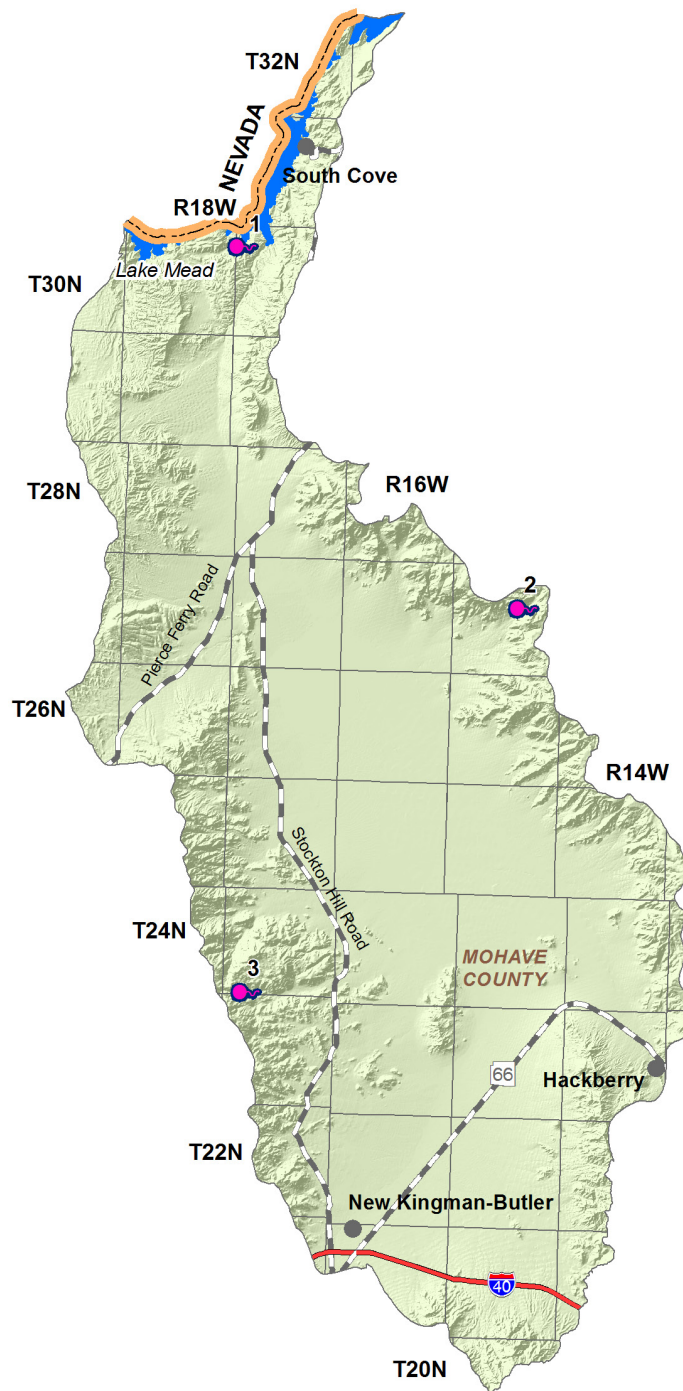
Source: Compilation of databases from ADWR & others

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

Notes:

¹Most recent measurement identified by ADWR

²Discharge measurements vary. Shown is greatest measured discharge; most recent measurement < 1 gpm



0 3 6
Miles



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

Springs
Nevada State Boundary
Interstate Highway
Major Road
City, Town or Place



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 4.4-4. 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 as well as well data sources and methods, including water-level changes and well yields are found in Volume 1, Appendix A.

Major Aquifers

- Refer to Table 4.4-4 and Figure 4.4-6.
- The major aquifers include basin fill, sedimentary rock and volcanic rock.
- 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 4.4-4 and Figure 4.4-8.
- As shown on Figure 4.4-8 well yields in this basin range from less than 100 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 4.4-4.
- Natural recharge estimates range from 2,000 acre-feet per year (AFA) to 3,000 AFA.
- Recharge to the aquifers comes principally from streambed infiltration.

Water in Storage

- Refer to Table 4.4-4.
- Storage estimates for this basin range from 3.0 million acre-feet to 5.3 million acre-feet 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.

Water Level

- Refer to Figure 4.4-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures 16 index wells in this basin, hydrographs for six of these wells are shown on Figure 4.4-7.
- The Department measures water levels four times daily at one automated groundwater monitoring site in the southern portion of the basin.
- 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.

Table 4.4-4 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)	
	Volcanic Rock	
Well Yields, in gal/min:	Range 20-2,128 Median 966.5 (10 wells measured)	Measured by ADWR (GWSI) and/or USGS
	Range 5-6,000 Median 900 (33 reported)	Reported on registration forms for large (>10-inch) diameter wells (Wells55)
	Range 30-1,500	ADWR (1990 and 1994b)
	Range 0-2,500	Anning and Duet (1994)
Estimated Natural Recharge, in acre-feet/year:	3,000	Freethy and Anderson (1986)
	2,000 - 2,500	Remick (1981) (HMS 4)
Estimated Water Currently in Storage, in acre-feet:	5,000,000 - 5,300,000 (to 1,200 ft)	ADWR (1990 and 1994b)
	5,000,000 ¹ (to 1,200 ft)	Freethy and Anderson (1986)
	3,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
	10,500,00 - 21,000,000 (to 1,500 ft)	Gillespie and Bentley (1971)
Current Number of Index Wells: 16		
Date of Last Water-level Sweep: 2006 (101 wells measured)		

Notes:

¹ Predevelopment Estimate

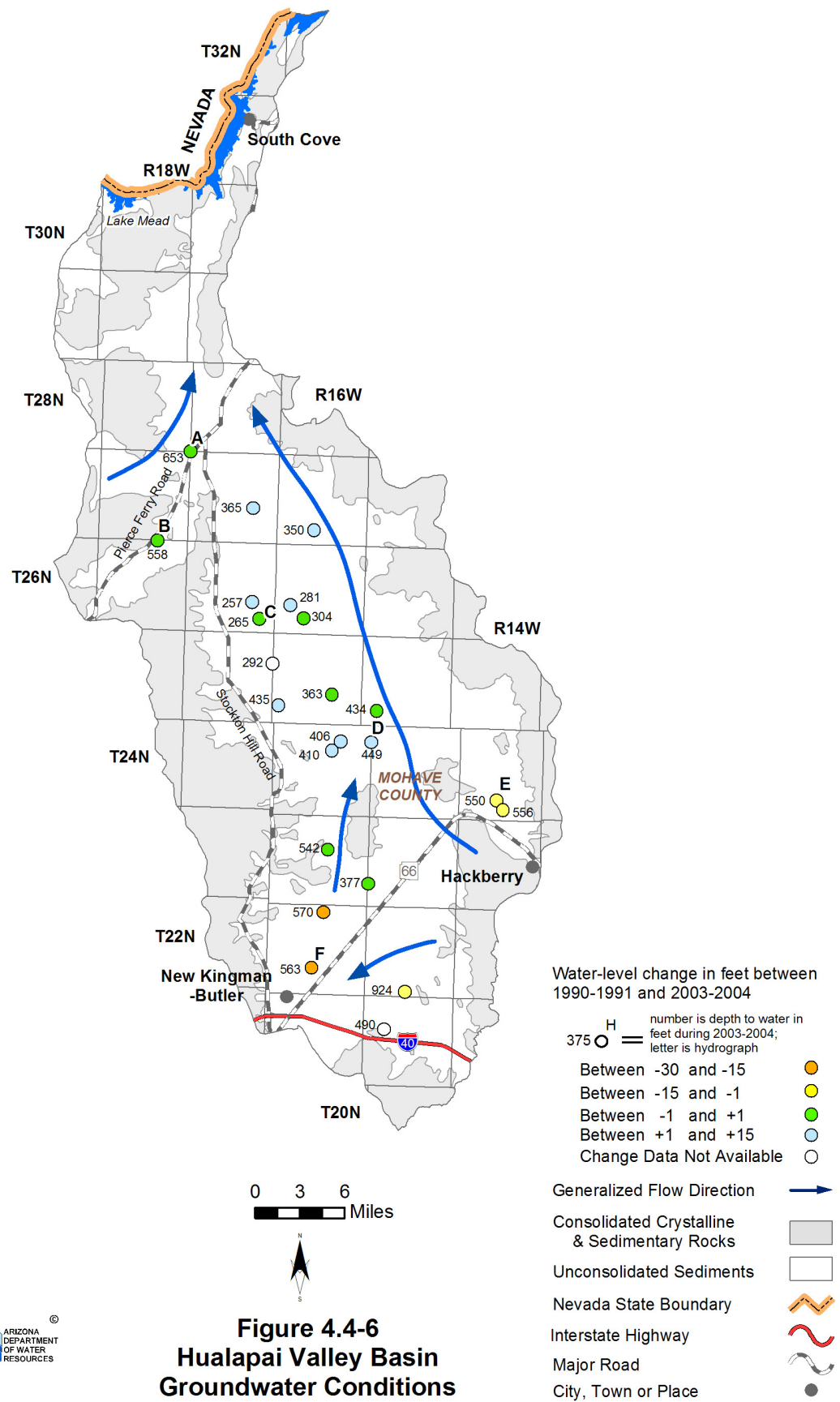


Figure 4.4-7
Hualapai Valley Basin
Hydrographs Showing Depth to Water in Selected Wells

Depth To Water In Feet Below Land Surface

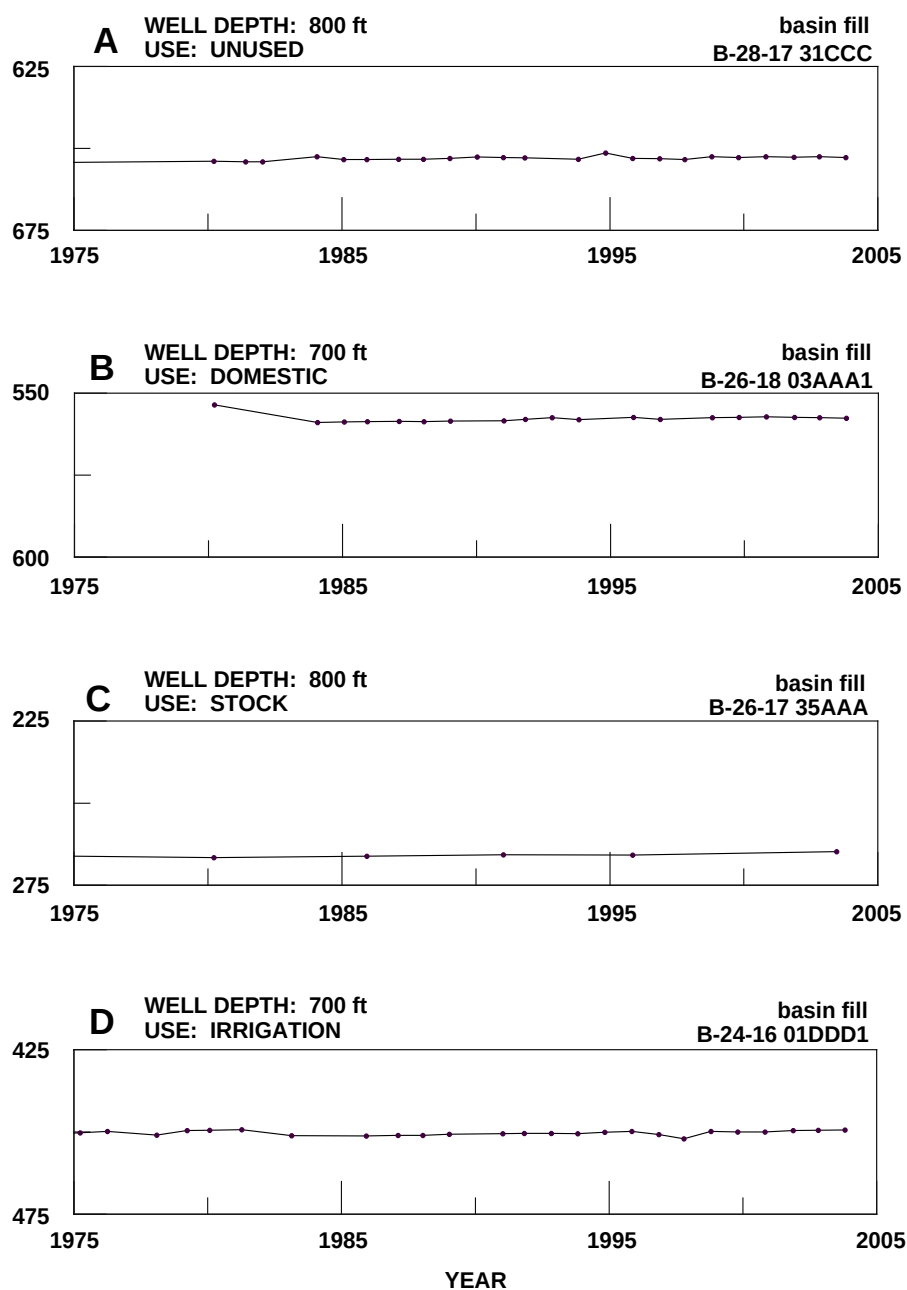
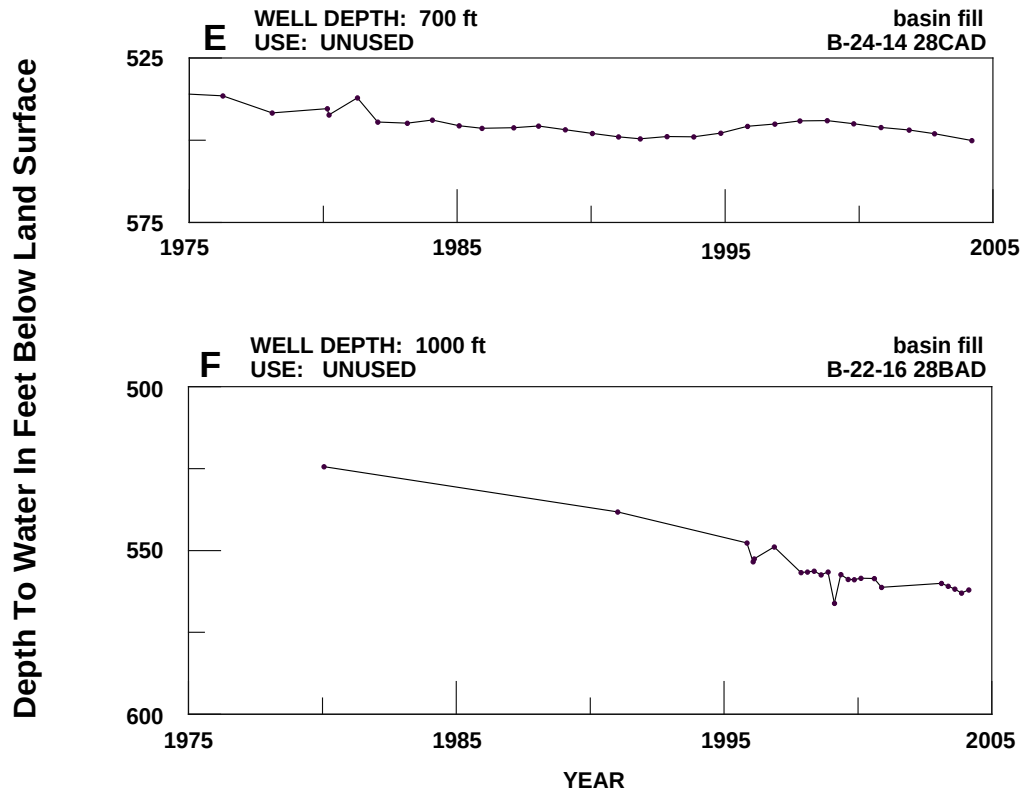
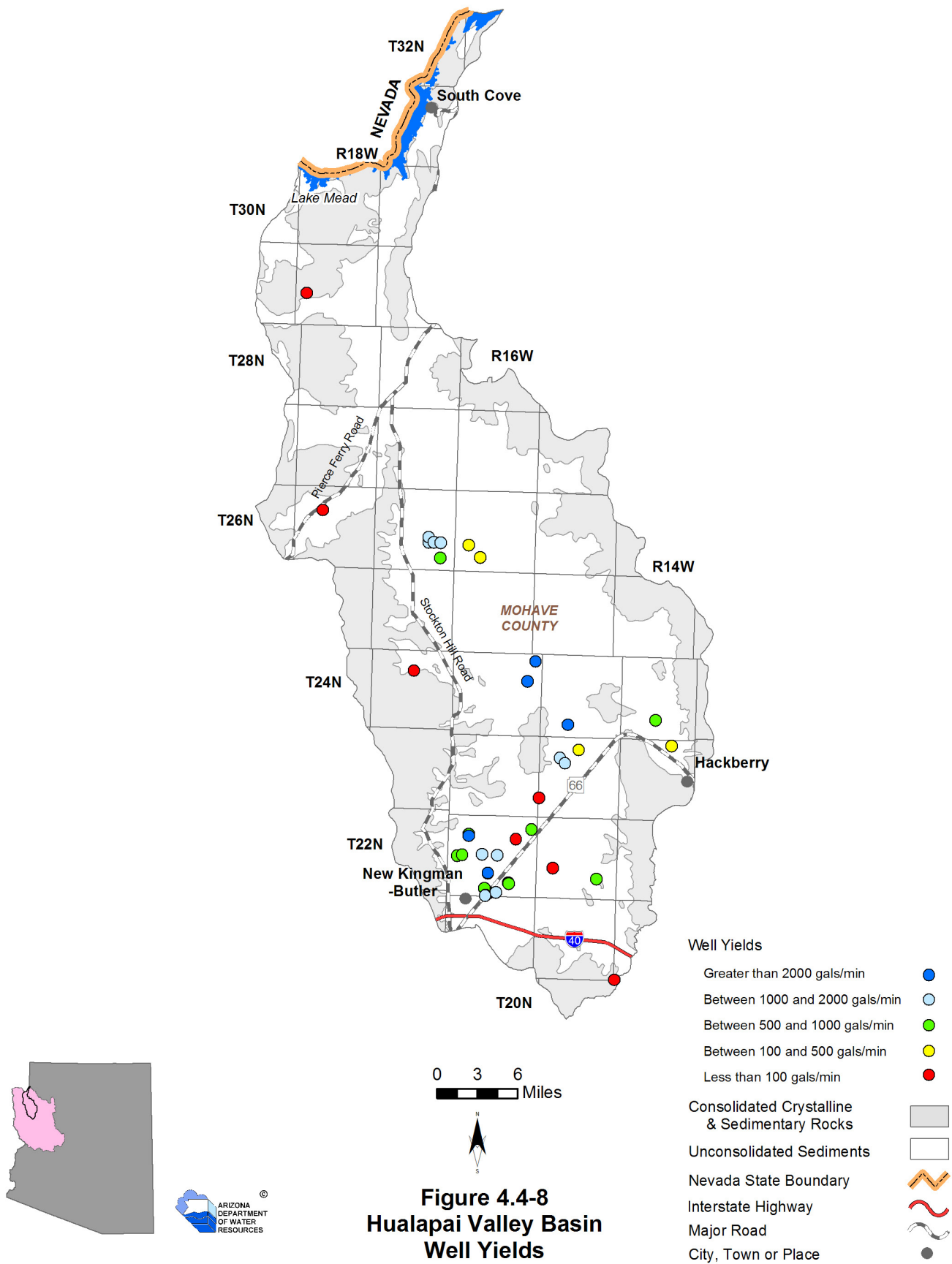


Figure 4.4-7 (Con't)
Hualapai Valley Basin
Hydrographs Showing Depth to Water in Selected Wells





4.4.7 Water Quality of the Hualapai Valley Basin

Sites with parameter concentrations that have equaled or exceeded drinking water standard(s) (DWS), including location and parameter(s) are shown in Table 4.4-5A. There are no impaired lakes or streams in this basin. Figure 4.4-9 shows the location of exceedences keyed to Table 4.4-5A. All community water systems are regulated under the Safe Drinking Water Act and treat water supplies to meet drinking water standards. Not all parameters were measured at all sites; selective sampling for particular constituents is common. A description of water quality data sources and methods is found in Volume 1, Appendix A.

Well, Mine or Spring sites that have equaled or exceeded drinking water standards (DWS)

- Refer to Table 4.4-5A.
- Thirty-one sites have parameter concentrations that have equaled or exceeded DWS.
- Frequently equaled or exceeded parameters include fluoride and radionuclides
- Other parameters commonly equaled or exceeded in the sites measured in this basin were arsenic, lead and nitrates.

Table 4.4-5 Water Quality Exceedences in the Hualapai Valley Basin¹

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded 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

Source: Compilation of databases from ADWR & others

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

Be = Beryllium

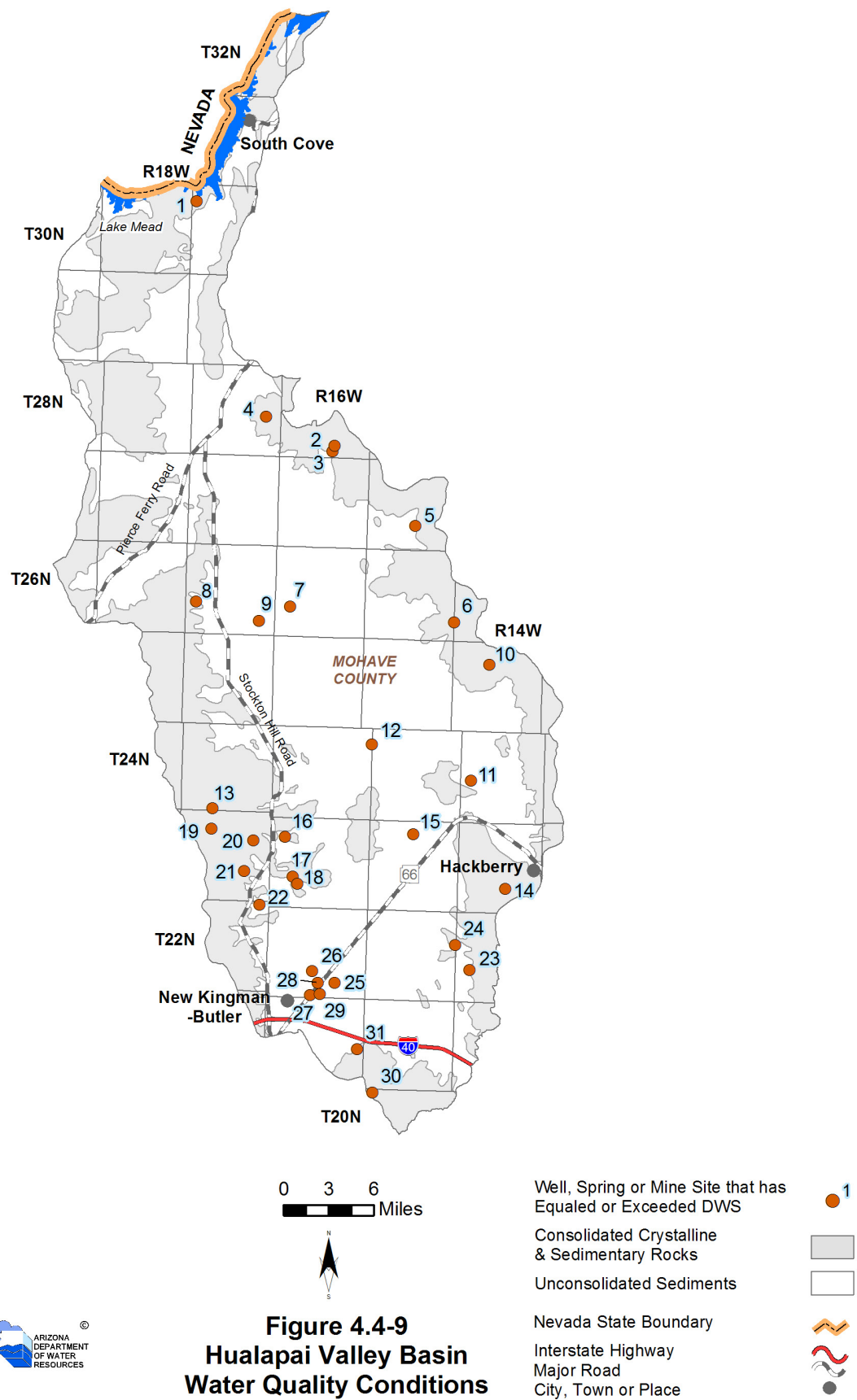
Cr = Chromium

F = Fluoride

Pb = Lead

NO3 = Nitrate

Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium



4.4.8 Cultural Water Demand 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 4.4-6. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 4.4-7. 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, Appendix A. More detailed information on cultural water demand is found in Section 4.0.7.

Cultural Water Demand

- Refer to Table 4.4-6 and Figure 4.4-10.
- Population in this basin has tripled since 1980, increasing from 11,361 in 1980 to 37,544 in 2000.
- There are no recorded surface water diversions in this basin. Groundwater use has increased in this basin since 1971, with an average of 3,850 AFA from 1971-1975 to an average of 9,050 AFA from 2001-2005. The majority of this demand, 8,900 AFA, is for municipal use. The City of Kingman, in the Sacramento Valley Basin, obtains most of its water from well fields 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.
- Industrial groundwater demand is minimal in this basin, less than 300 AFA from 1991-2005. 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 2005 there were 918 registered wells with a pumping capacity of less than or equal to 35 gpm and 91 wells with a pumping capacity of more than 35 gpm.

Effluent Generation

- Refer to Table 4.4-7.
- 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 and New Kingman-Butler.
- 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 1,800 acre-feet of effluent per year.
- The Kingman – Hilltop facility discharges to an evaporation pond and a wildlife area.

Table 4.4-6 Cultural Water Demand in the Hualapai Valley Basin¹

Year	Estimated and Projected 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 ²	Industrial	Agricultural	Municipal	Industrial	Agricultural		
1971		150 ³	45 ³	3,850			NR			ADWR (1994a)	
1972											
1973											
1974											
1975				4,850			NR				
1976											
1977											
1978											
1979		4,850			NR						
1980	11,361										
1981	12,221										
1982	13,081										
1983	13,941	53	5	4,850			NR				
1984	14,800										
1985	15,660										
1986	16,520										
1987	17,380	49	15	4,850			NR				
1988	18,240										
1989	19,100										
1990	19,960										
1991	21,718	121	6	5,500	<300	NR	NR				
1992	23,476										
1993	25,235										
1994	26,993										
1995	28,752										
1996	30,510	191	6	7,300	<300	NR	NR				
1997	32,269										
1998	34,027										
1999	35,786										
2000	37,544										
2001	38,143	354	14	8,900	<300	NR	NR				
2002	38,742										
2003	39,341										
2004	39,940										
2005	40,539										
2010	43,533										
2020	55,261										
2030	64,789										
WELL TOTALS:		918	91								

Notes:

NR = Not reported

¹ Does not include effluent or 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.

Table 4.4-7 Effluent Generation in the Hualapai Valley Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet/year)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf/Landscape	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

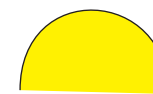
Source: Compilation of databases from ADWR & others

Notes:

Year of Record is for the volume of effluent treated/generated

NA: Data not currently available to ADWR

WWTP: Wastewater Treatment Plant



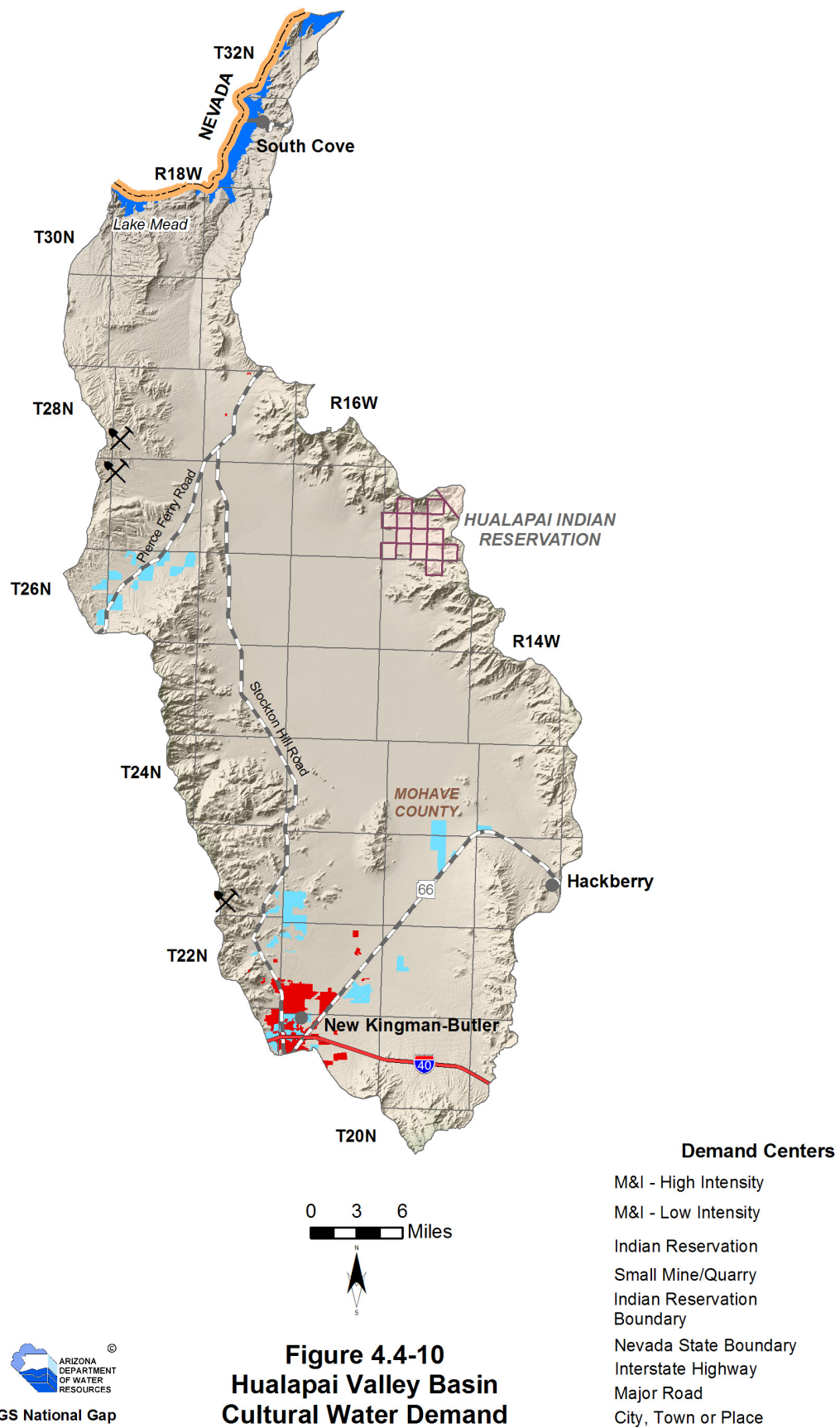


Figure 4.4-10
Hualapai Valley Basin
Cultural Water Demand

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 4.4-8A and B for water reports and analysis of adequate water supply. 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 C. Adequacy determination data sources and methods are found in Volume 1, Appendix A.

- All subdivisions receiving an adequacy determination are in Mohave County. Fifty water adequacy determinations have been made in this basin through December 2008. Of the 19,387 lots in 49 subdivisions for which lot information is available 10,969 lots, or 57%, were determined to be adequate.
- The most common reason for an inadequacy determination was because the applicant decided not to submit necessary information and/or available hydrologic data were insufficient to make a determination.
- Six analysis of Adequate Water Supply applications, for a total of 259,966 lots, have been approved for this basin.

Table 4.4-8 Adequacy Determinations in the Hualapai Valley Basin¹

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	Amatista Acres, Sunward Ho! Rn	Mohave	23 North	16 West	29	17	53-500264	Inadequate	A1	9/19/1991	Dry Lot Subdivision
2	Arizona West Tract 1112	Mohave	23 North	15 West	11	256	53-500295	Inadequate	A1	9/17/1987	Truxton Canyon Water Company
3	Cedar Ridge Estates	Mohave	22 North	17 West	11, 14	38	53-300512	Inadequate	A2	9/4/1998	Dry Lot Subdivision
4	Cerbat Ranches Unit 1	Mohave	22 North	17 West	12	125	53-500434	Adequate		11/14/1980	Cerbat Water Company, Inc.
5	Esmeralda Acres/Sunward Ho!	Mohave	23 North	16 West	31	19	53-500619	Inadequate	A1	9/19/1991	Dry Lot Subdivision
6	Fountain Hills Estates	Mohave	22 North	17 West	13	66	53-300087	Adequate		9/26/1996	Cerbat Water Company, Inc.
7	Greater Kingman Industrial Park	Mohave	22 North	15 West	5, 17	200	53-500728	Adequate		7/27/1973	Dry Lot Subdivision
8	Greater Kingman Industrial Park B	Mohave	22 North	15 West	5, 17	19	53-300156	Inadequate	A2	6/14/1996	Dry Lot Subdivision
10	Hillview Ranches	Mohave	23 North	16 West	7	9	53-400741	Inadequate	A1, A2	7/2/2002	Dry Lot Subdivision
11	Hualapai Vista Estates, Tract 3811	Mohave	22 North	16 West	12, 13	41	53-400832	Inadequate	A1, A2	10/17/2002	Dry Lot Subdivision
12	Joshua Park Unit #1	Mohave	28 North	17 West	9	48	53-300558	Inadequate	A2	10/29/1998	Dry Lot Subdivision
13	Joshua Park Unit 1	Mohave	28 North	17 West	9	141	53-402005	Inadequate	A1	1/26/2006	Dry Lot Subdivision
14	Joshua Park Unit No. 1	Mohave	28 North	17 West	9	80	53-500019	Inadequate	A1	6/11/2007	Dry Lot Subdivision
15	Lake Juniper	Mohave	22 North	17 West	11,14	16	53-400872	Inadequate	A1,A2	1/31/2003	Lake Juniper HOA & Mohave County
16	Lake Juniper Estates	Mohave	22 North	17 West	11, 14	197	53-500876	Adequate		2/22/1991	Lake Juniper Water Company
17	Lake Mead Rancheros	Mohave	25 North	15 West	3	259	53-500036	Inadequate	A1	11/30/2006	Dry Lot Subdivision
18	Lake Mead Rancheros	Mohave	25 South	15 East	21	324	53-500061	Inadequate	A1	3/12/2007	Dry Lot Subdivision
			25 North	15 West	19						
19	Lake Mead Rancheros #1-12	Mohave	25 North	15 West	27, 29, 31	1,606	53-500880	Inadequate	A1, A2	2/13/1986	Dry Lot Subdivision
20	Lake Mead Rancheros, Unit 1	Mohave	25 North	15 West	13	121	53-700390	Inadequate	A1	8/9/2007	Dry Lot Subdivision
21	Lake Mead Rancheros, Units 3, 8, 14, 16	Mohave	25 North	15 West	5, 9, 17, 27	332	53-700401	Inadequate	A1	10/3/2007	Dry Lot Subdivision
22	Lake Mead Ranchos Unit 2	Mohave	28 North	18 West	13	95	53-700458	Inadequate	A1	12/31/2007	Dry Lot Subdivision
23	Lake Mead Ranchos Unit 3	Mohave	28 North	18 West	11	592	53-300328	Inadequate	A1	7/23/1997	Dry Lot Subdivision
24	Lake Mead Ranchos Unit 4	Mohave	28 North	18 West	1	491	53-500020	Inadequate	A1	3/14/2007	Dry Lot Subdivision
25	Lake Mead Ranchos Unit 5	Mohave	29 North	18 West	25	541	53-400713	Inadequate	A1, A2	5/21/2002	Dry Lot Subdivision
26	Lake Mead Ranchos, Unit 6	Mohave	29 North	18 West	27	402	53-402006	Inadequate	A1	1/26/2006	Dry Lot Subdivision
27	Lake Mead Ranchos Unit 7	Mohave	29 North	18 West	23	567	53-400714	Inadequate	A1,A2	5/21/2002	Dry Lot Subdivision
28	Lake Mead Ranchos Unit 7	Mohave	29 North	18 West	23	569	53-402007	Inadequate	A1	1/26/2006	Dry Lot Subdivision
29	Lake Mead Rancheros Unit 10	Mohave	25 North	15 West	31	39	53-700278	Inadequate	A1	4/18/2007	Dry Lot Subdivision

Table 4.4-8 Adequacy Determinations in the Hualapai Valley Basin (Cont)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						
30	Lake Mohave Ranchos D	Mohave	26 North	18 West	1, 3, 5, 7, 9, 11, 13, 15	NA	53-500886	Inadequate	A2,A3	11/23/1977	Dry Lot Subdivision
31	Lake Mohave Ranchos, Unit 6	Mohave	26 North	19 West	25	6	53-401294	Inadequate	D	4/26/2004	NA
32	Mead-O-Rama	Mohave	29 North	18 West	35	421	53-401651	Adequate		3/4/2005	Dry Lot Subdivision
33	Mead-O-Rama #2	Mohave	29 North	19 West	27	221	53-500942	Inadequate	A2,A3	8/31/1984	Dry Lot Subdivision
34	Mead-O-Rama #3	Mohave	29 North	18 West	35	141	53-500943	Inadequate	A2,A3	8/31/1984	Dry Lot Subdivision
35	Mead-O-Rama #4	Mohave	29 North	17 West	31	441	53-500944	Inadequate	A2,A3	8/31/1984	Dry Lot Subdivision
39	Pinion Pines Estates #2	Mohave	20 North	15 West	6	21	53-501174	Inadequate	A2,A3	3/1/1977	Dry Lot Subdivision
40	Quail Valley Estates	Mohave	22 North	17 West	12	32	53-501241	Adequate		11/24/1981	Cerbat Water Company, Inc.
41	Realsite Arizona Ranchettes Units 1,3,4,6,7,8, and 9	Mohave	25 North	16 West	1, 11, 23, 25, 35	252	53-700403	Inadequate	A1	10/18/2007	Dry Lot Subdivision
			26 North	15 West	19, 31						
43	Red Wing Canyon Estates	Mohave	23 North	17 West	23	30	53-501292	Inadequate	A1	5/4/1989	Dry Lot Subdivision
44	Shadow Mountain Acres Unit Two & Three	Mohave	24 North	14 West	27, 35	93	53-400424	Inadequate	A1,A2	11/29/2000	Dry Lot Subdivision
45	Sunny Highlands Estates, Tract 1132, Phase 1-20 Lots	Mohave	23 North	14 West	3	20	53-700505	Inadequate	A1	4/14/2008	Dry Lot Subdivision
46	Sunnyvale Acres, Sunward Ho! Ranches #2	Mohave	23 North	16 West	9	22	53-300075	Inadequate	A1,A2	11/12/1995	Dry Lot Subdivision
47	Sunrise Mountain Estates	Mohave	23 North	16 West	33	35	53-501511	Inadequate	A1,A2,A3	1/14/1992	Dry Lot Subdivision
48	Sunward Ho! Ranches	Mohave	23 North	16 West	19, 30, 31, 33	430	53-300439	Inadequate	A1	4/3/1998	Dry Lot Subdivision
49	Sunward Ho! Ranches Turquesa Acres	Mohave	23 North	16 West	30	35	53-501527	Inadequate	A1	9/19/1991	Dry Lot Subdivision
51	Toro Acres, Sunward Ho! #2	Mohave	23 North	16 West	18, 19	31	53-501567	Inadequate	A1	9/19/1991	Dry Lot Subdivision
52	Valle Vista	Mohave	23 North	15 West	34	1,200	53-501596	Adequate		6/7/1973	Truxton Canyon Water Company
53	Valle Vista #1A,3A	Mohave	23 North	15 West	10, 15	8,728	53-501597	Adequate		3/19/1975	Truxton Canyon Water Company
54	Valle Vista Unit 3- Tract 1204	Mohave	24 North	16 West	34	10	53-400514	Inadequate	A1	7/10/2001	Truxton Canyon Water Company
55	Valle Vista Unit 2 Tract 1200, Lots 860, 861, 999, 1078,1709, 1631, and 1907	Mohave	23 North	15 West	3	7	53-500096	Inadequate	A1	1/24/2007	Truxton Canyon Water Company
56	Zafiro Acres-Sunward Ho Ranches	Mohave	22 North	16 West	5	7	53-400065	Inadequate	A1	5/11/1999	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				
9	Hafley Ranch	Mohave	24 North	15 West	19, 30, 31	13,993	43-402284	8/17/2007	Undetermined
36	Nugent Ranch	Mohave	24 North	16 West	3, 5, 9	19,328	43-402288	8/17/2007	Undetermined
			25 North	16 West	4				

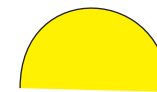


Table 4.4-8 Adequacy Determinations in the Hualapai Valley Basin (Cont)¹

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				
37	Peacock Highlands	Mohave	22 North	14 West	19, 21, 29-31	39,397	43-402287	8/17/2007	Undetermined
			22 North	15 West	1, 19, 21, 25, 27, 29, 31, 33, 35				
38	Peacock Vistas	Mohave	23 North	14 West	7	9,012	43-402286	8/18/2007	Undetermined
			23 North	15 West	1, 11, 13, 14				
42	Red Lake	Mohave	25 North	17 West	1, 3, 5, 7, 9, 15, 17, 19, 21, 28-31	155,236	43-402285	11/2/2007	Undetermined
			26 North	17 West	3, 5, 7, 9, 13-17, 19, 21, 23-27, 29, 31, 33, 35				
			26 North	18 West	13, 23, 25, 35				
			26 North	16 West	5, 7, 17-20, 28-31				
			27 North	16 West	31				
			27 North	17 West	1, 3, 13, 15, 17, 19, 21, 23, 25, 29, 31, 35				
			28 North	17 West	23, 25, 27, 35				
50	The Mardian Ranch	Mohave	27 North	18 West	1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 29, 31, 33, 35	23,000	43-402028	1/8/2007	Undetermined
			28 North	18 West	13, 23, 25, 31, 33, 35				
			28 North	17 West	7, 19, 21, 29, 31, 33				
			27 North	19 West	1, 13, 25, 35				

Source: ADWR 2008a

Notes:

¹Each 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. Between 1995-2006 all applications for adequacy were given a file number with a 22 prefix.

In 2006 a 53 prefix was assigned to all water adequacy reports and applications regardless of their issue date.

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

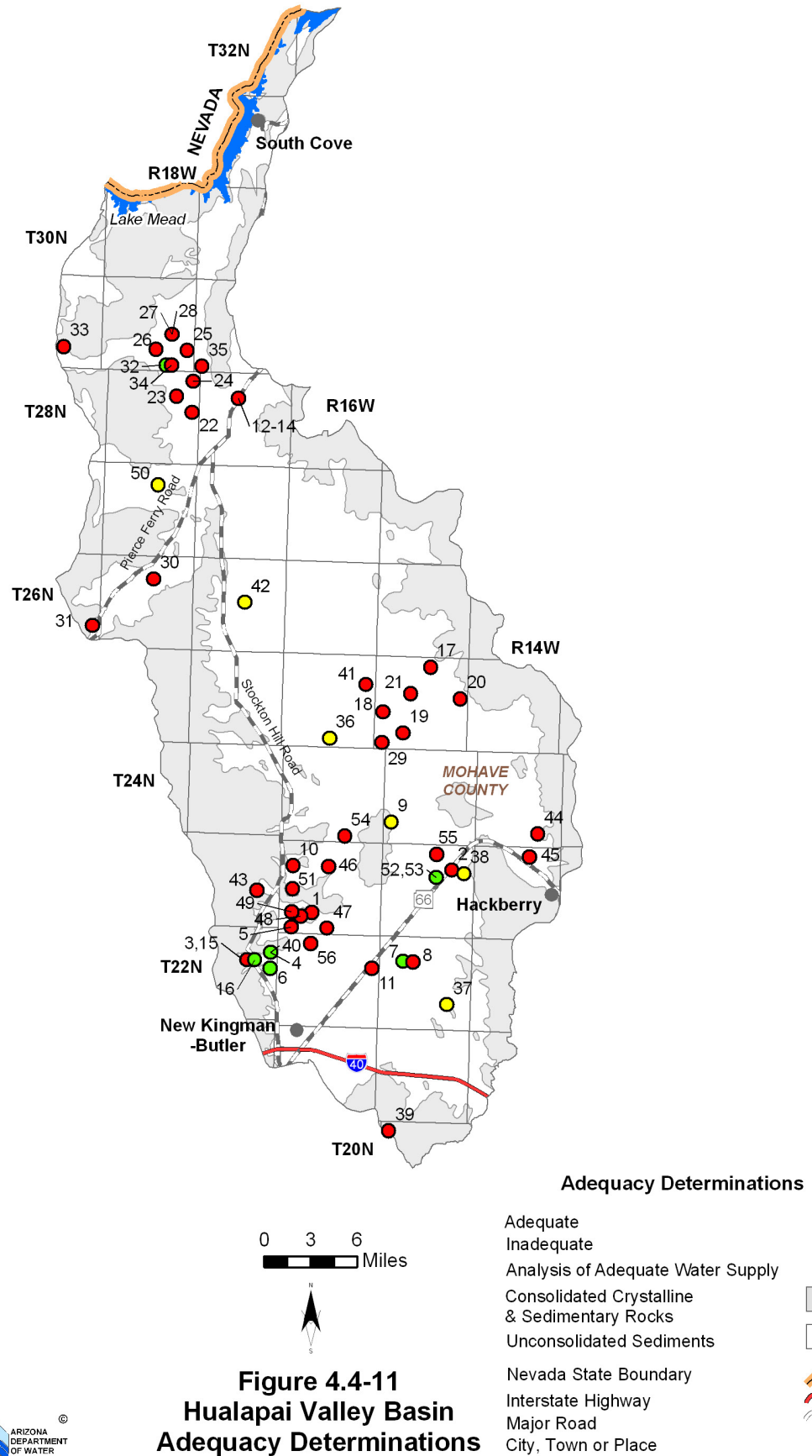


Figure 4.4-11
Hualapai Valley Basin
Adequacy Determinations

Hualapai Valley Basin

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Section 4.5

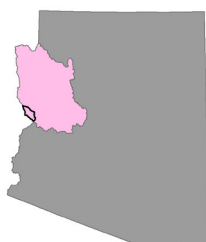
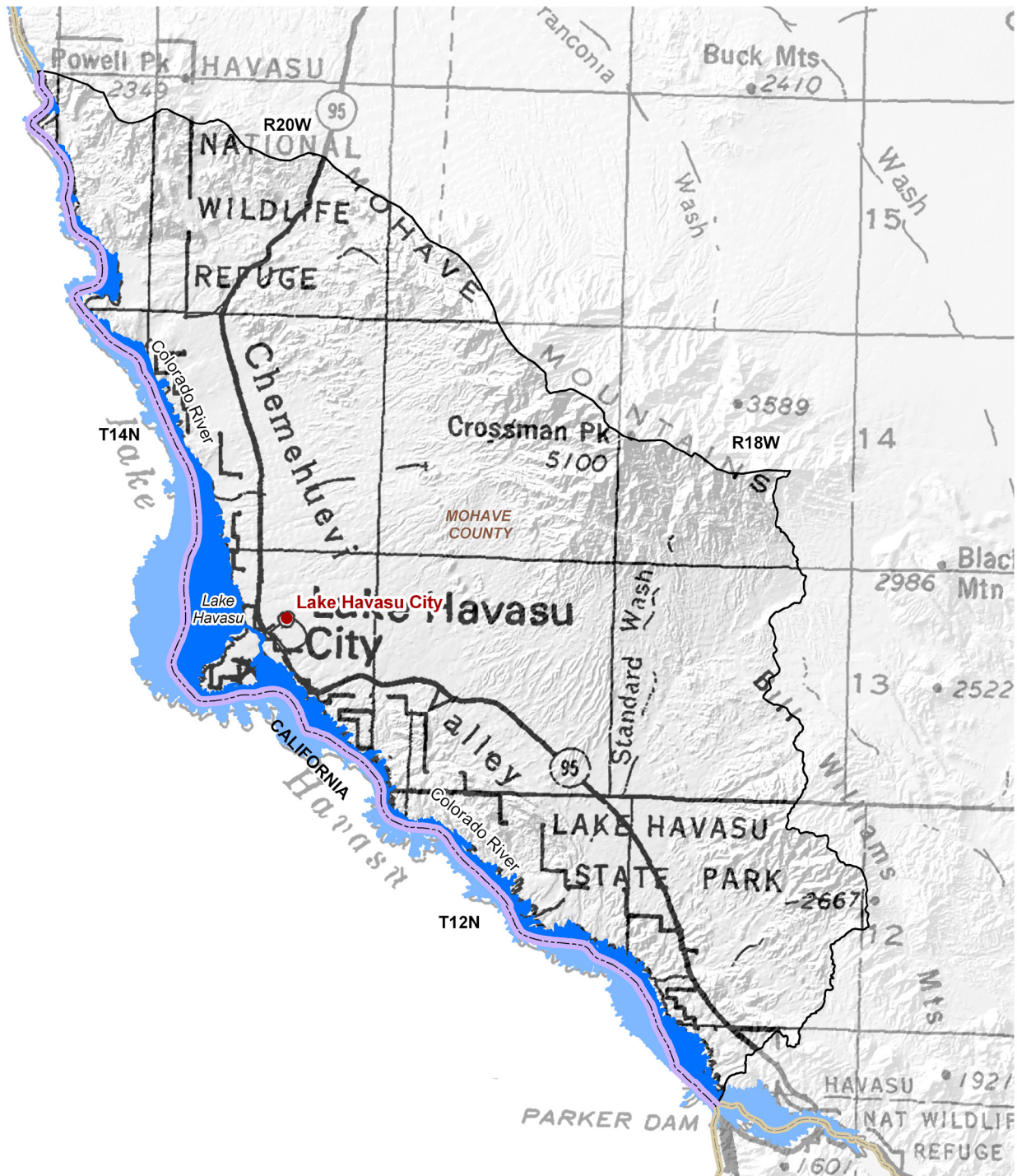
Lake Havasu Basin



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 and Arizona upland Sonoran desertscrub and Mohave desertscrub. (see Figure 4.0-9) Riparian vegetation includes tamarisk and marsh along sections of the Colorado River.

- Principal geographic features shown on Figure 4.5-1 are:
 - Chemehuevi Valley running parallel to the Colorado River and Lake Havasu
 - Standard Wash running north to south in the eastern part of the basin
 - Bill Williams Mountains on the southeastern basin boundary
 - 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 at approximately 470 feet at the Colorado River



Base Map: USGS 1:500,000, 1981

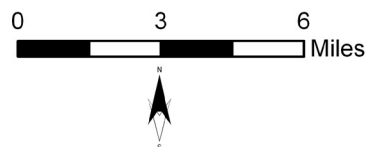


Figure 4.5-1
Lake Havasu Basin
Geographic Features

California State Boundary
City, Town or Place



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, Appendix A. More detailed information on protected areas is found in Section 4.0.4. Land ownership categories are discussed below in the order from largest to smallest percentage 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

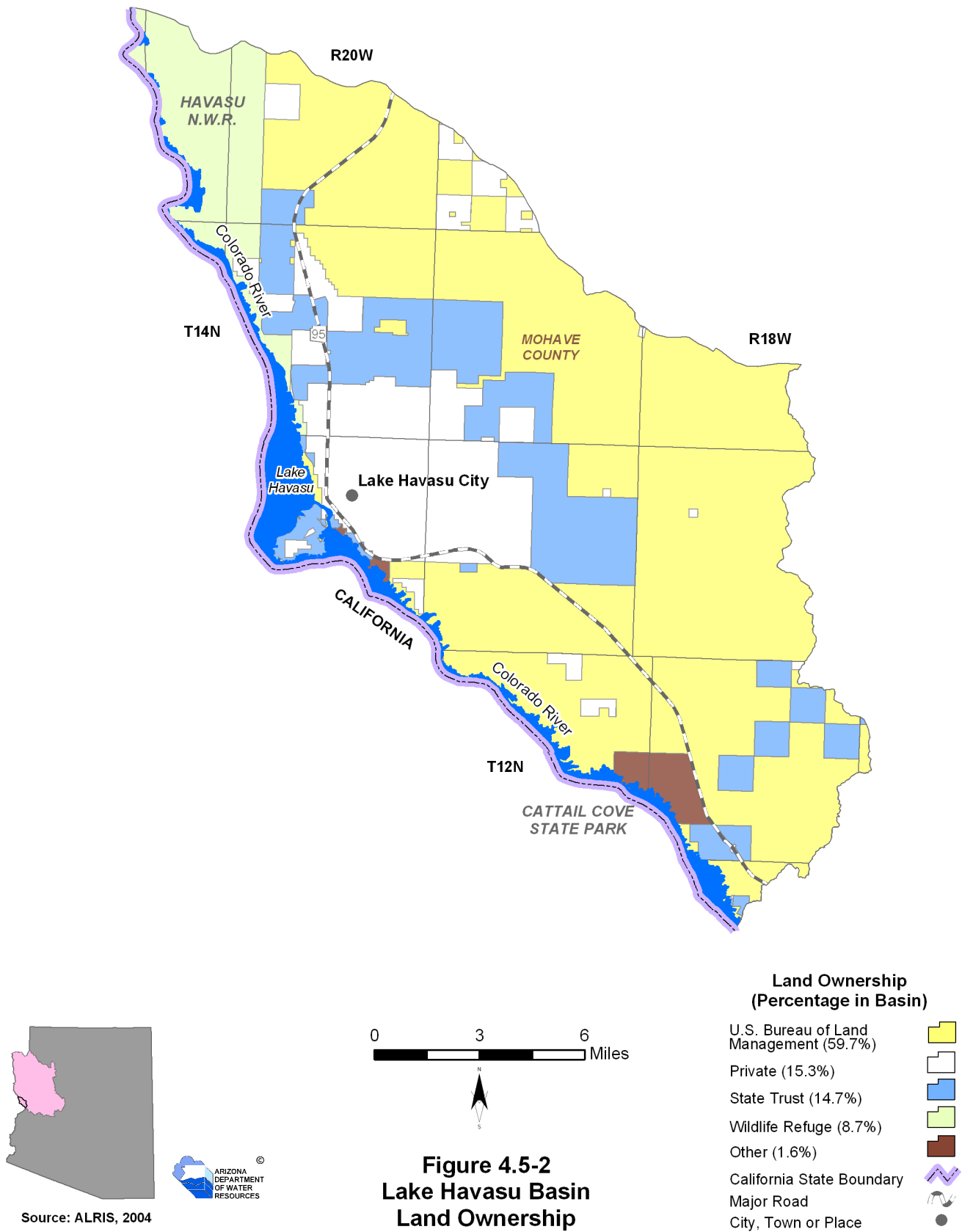
- 14.7% of the land in this basin is held in trust for the public schools and the Miner's Hospital under the State Trust Land system.
- Most state lands are surrounding Lake Havasu City. One portion of state land is located on an island created by the Bridgewater Channel in T13N, R20W.
- Primary land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



4.5.3 Climate of the Lake Havasu Basin

Climate data from NOAA/NWS Co-op Network stations are compiled 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. More detailed information on climate in the planning area is found in Section 4.0.3. A description of the climate data sources and methods is found in Volume 1, Appendix A.

NOAA/NWS Co-op Network

- Refer to Table 4.5-1A
- There are two NOAA/NWS Co-op network climate stations in the basin. The average monthly maximum temperature occurs in July and ranges between 96.6°F at Lake Havasu and 98.5°F at Lake Havasu City. The average monthly minimum temperature occurs in January or December and ranges between 52.9°F at Lake Havasu and 54.5°F at Lake Havasu City.
- Highest average seasonal rainfall occurs in the winter (January – March). For the period of record used, the highest annual rainfall is 4.82 inches at Lake Havasu and lowest is 2.90 inches at Lake Havasu City.

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.
- 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, 2005

Notes:

¹Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

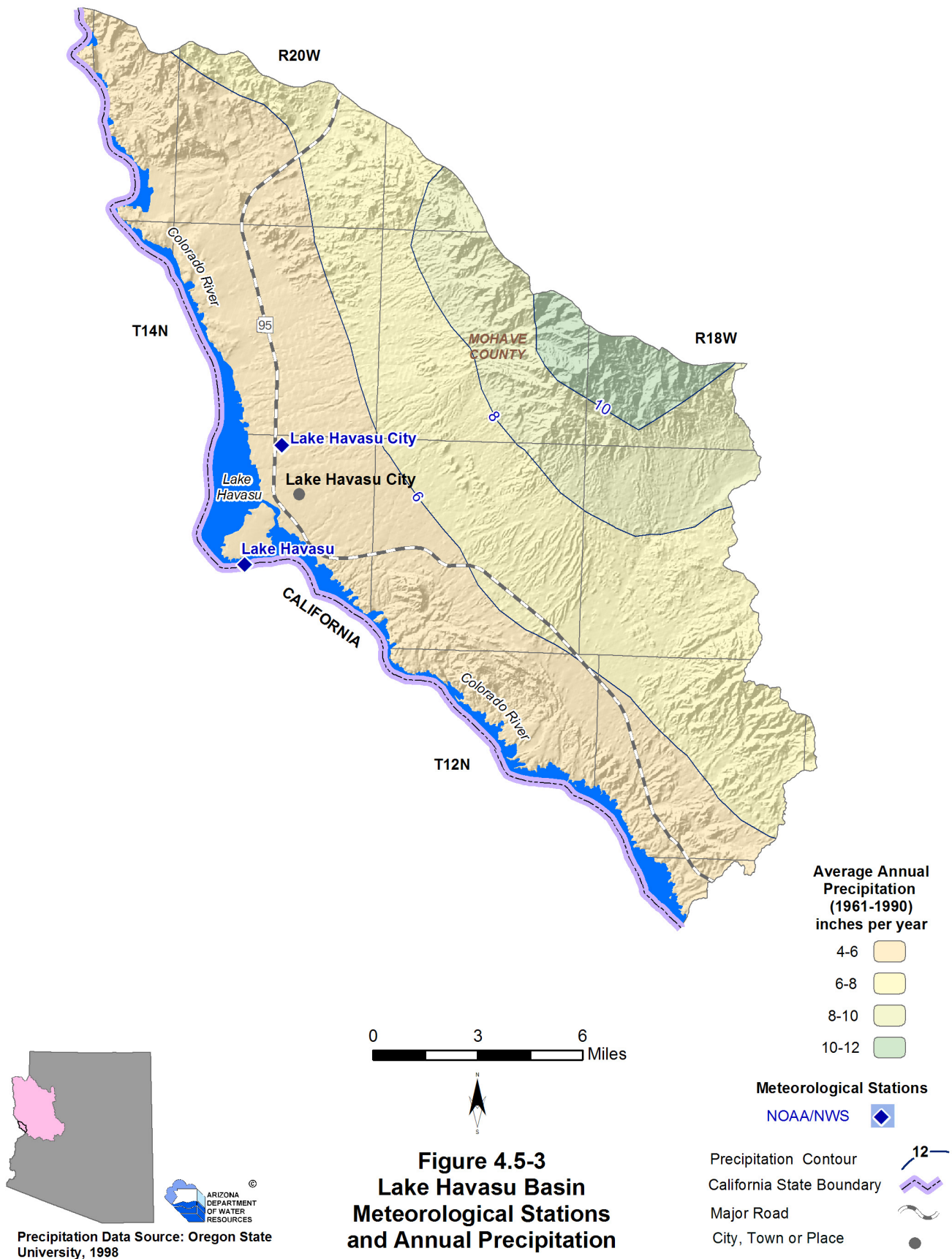
Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

C. AZMET:

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

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record	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								



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 4.5-2. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.5-3. The location of large reservoirs and flood ALERT gages are shown on Figure 4.5-4. There are no runoff data available for this basin. Descriptions of stream, reservoir and stockpond data sources and methods are found in Volume 1, Appendix A.

Flood ALERT Equipment

- Refer to Table 4.5-2.
- As of October 2005 there were four stations in the basin.

Reservoirs and Stockponds

- Refer to Table 4.5-3.
- The basin contains one large reservoir, Havasu, with a maximum capacity of 651,000 acre-feet. Lake Havasu, created by Parker Dam, is operated for hydroelectric power generation, irrigation and water supply.
- There are no other reservoirs or stockponds in this basin.

Table 4.5-2 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

Source: ADWR 2005b

Notes:

FCD = Flood Control District
NA = Not available

Table 4.5-3 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

Source: Compilation of databases from ADWR & others

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

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)

Total number: 0

Total surface area: 0 acres

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

Total number: 0 (from water right filings)

Notes:

¹H=hydroelectric; I=irrigation; S=water supply

²Dam is located in Parker Basin but lake storage is in the Lake Havasu, Sacramento Valley and Bill Williams Basins

³Includes 28,600 acre-feet of dead storage



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 4.5-4. There are no major or minor springs in this basin. The locations of perennial and intermittent streams are shown on Figure 4.5-5. Descriptions of data sources and methods for intermittent and perennial reaches and springs are found in Volume 1, Appendix A.

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

Table 4.5-4 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, 2005a and USGS, 2006a): 3



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 4.5-5. 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 as well as well data sources and methods, including water-level changes and well yields are found in Volume 1, Appendix A.

Major Aquifers

- Refer to Table 4.5-5 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 4.5-5 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 more than 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.

Natural Recharge

- Refer to Table 4.5-5.
- The estimate of natural recharge for this basin is 35,000 acre-feet per year (AFA).

Water in Storage

- Refer to Table 4.5-5.
- Storage estimates for this basin range from 1.0 million acre-feet (maf) to 2.0 maf to a depth of 1,200 feet.

Water Level

- Refer to Figure 4.5-6. The water level is shown for one well measured in 2003-2004 with a depth of 74 feet.
- The Department annually measures one index well in this basin. A hydrograph of this well is shown in Figure 4.5-7.

Table 4.5-5 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	Range 310-3,600 Median 1,500 (17 wells reported)	Reported on registration forms for large (>10-inch) diameter wells (Wells55)
	Range 30-500	ADWR (1990 and 1994b)
	Range 0-2,500	Anning and Duet (1994)
Estimated Natural Recharge, in acre-feet/year:	35,000	Freethy and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	2,000,000 ¹ (to 1,200 ft)	Freethy 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:

¹Predevelopment Estimate

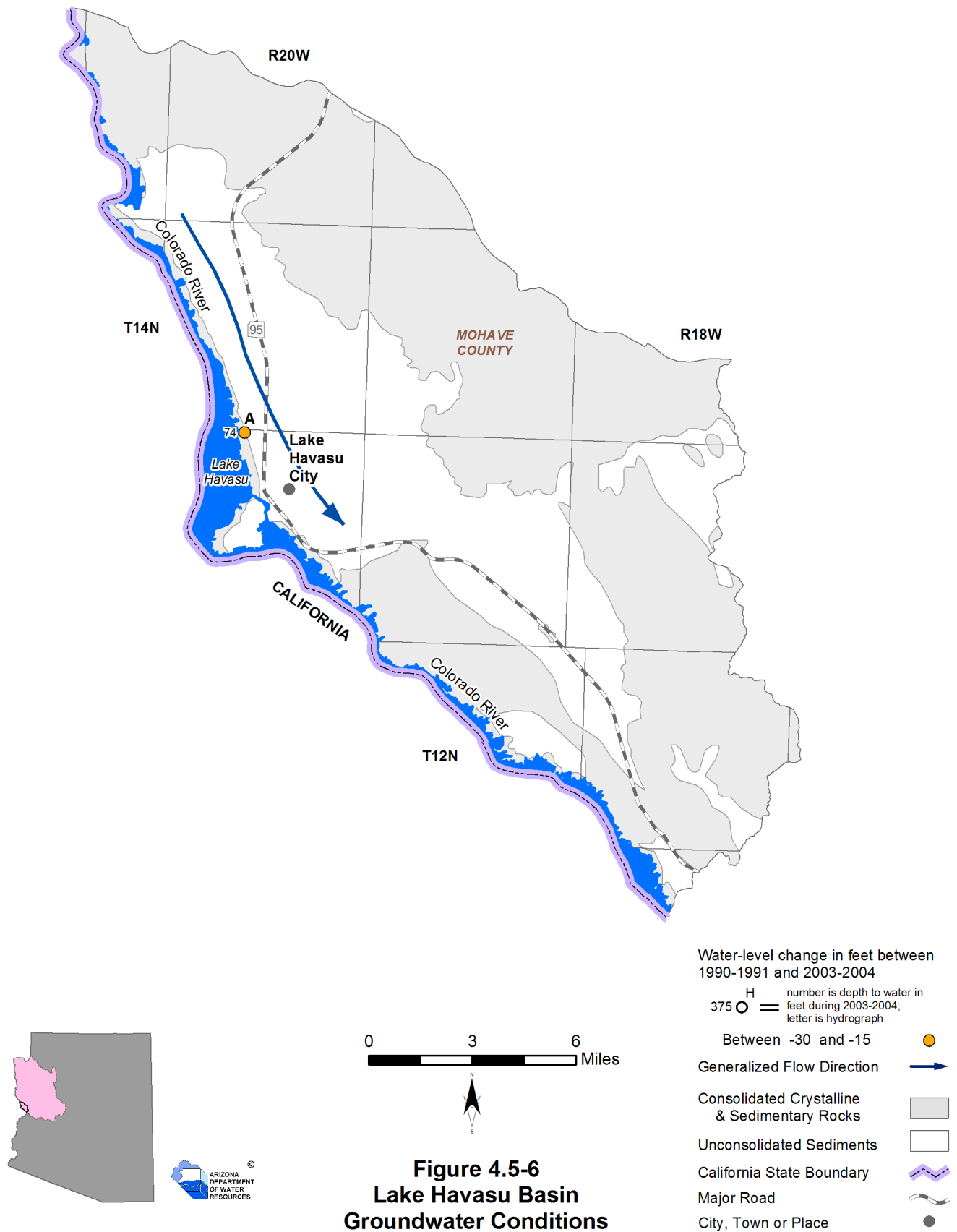
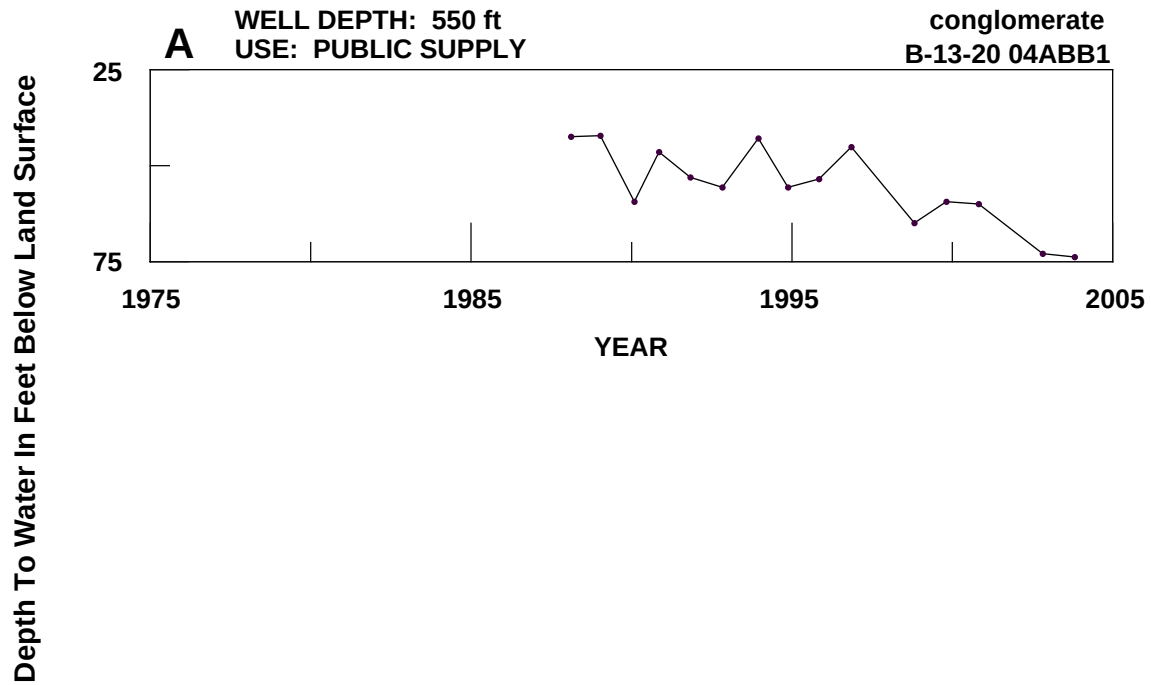
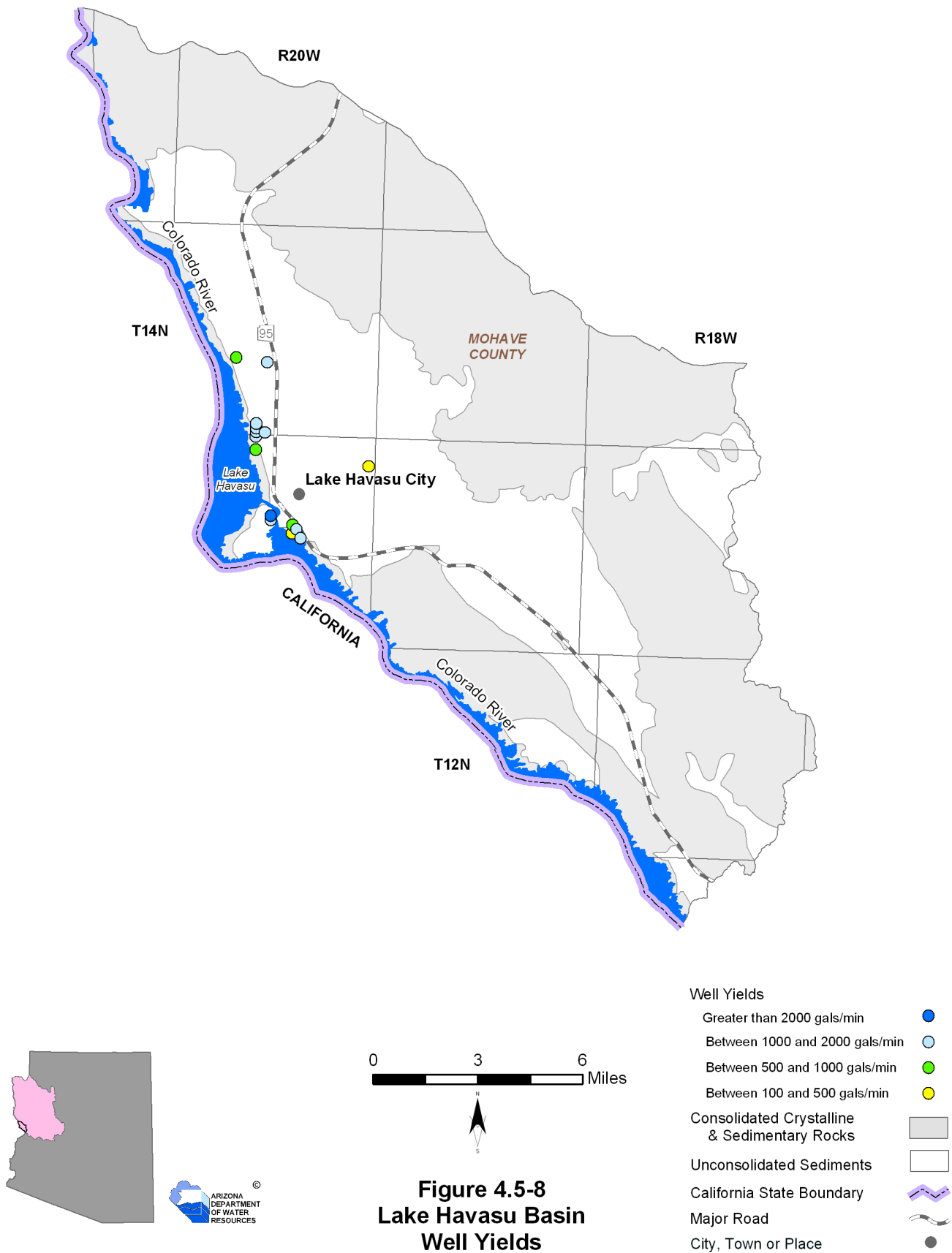


Figure 4.5-6
Lake Havasu Basin
Groundwater Conditions

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





4.5.7 Water Quality of the Lake Havasu Basin

Sites with parameter concentrations that have equaled or exceeded drinking water standard(s) (DWS), including location and parameter(s) are shown in Table 4.5-6A. There are no impaired lakes or streams in this basin. Figure 4.5-9 shows the location of exceedences keyed to Table 4.5-6A. All community water systems are regulated under the Safe Drinking Water Act and treat water supplies to meet drinking water standards. Not all parameters were measured at all sites; selective sampling for particular constituents is common. A description of water quality data sources and methods is found in Volume 1, Appendix A.

Well, Mine or Spring sites that have equaled or exceeded drinking water standards (DWS)

- Refer to Table 4.5-6A.
- Twenty sites have parameter concentrations that have equaled or exceeded DWS.
- The most frequently equaled or exceeded parameter was nitrates.
- Other parameters equaled or exceeded in the sites measured in this basin were arsenic, chromium and organics.

Table 4.5-6 Water Quality Exceedences in the Lake Havasu Basin¹

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded 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

Source: Compilation of databases from ADWR & others

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:

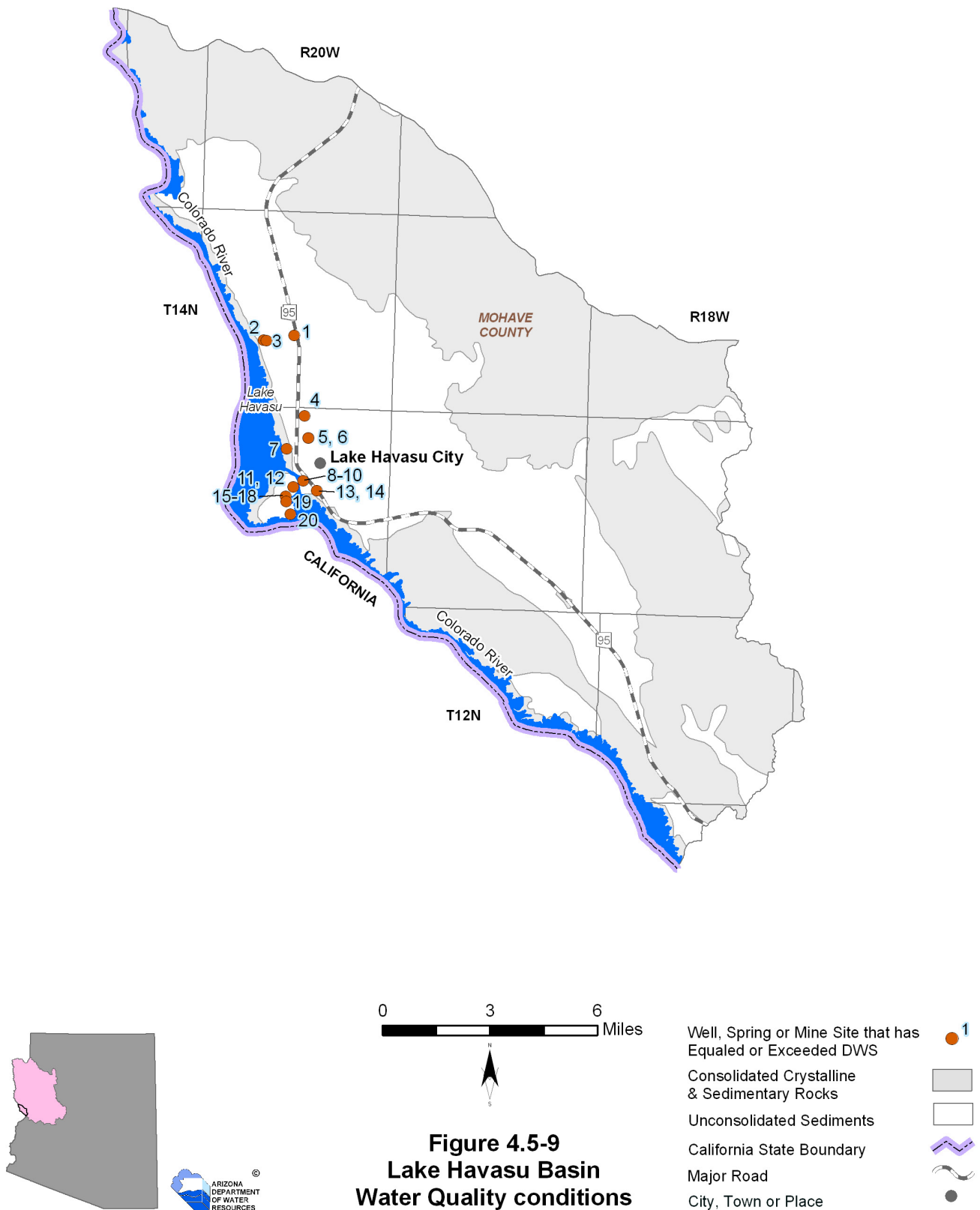
¹ Water quality samples collected between 1976 and 2000.

² As = Arsenic

Cr = Chromium

NO3 = Nitrate

Organics = One or more of several volatile and semi-volatile organic compounds and pesticides



4.5.8 Cultural Water Demand 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 4.5-7. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 4.5-8. 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, Appendix A. More detailed information on cultural water demand is found in Section 4.0.7.

Cultural Water Demand

- Refer to Table 4.5-7 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.
- Groundwater use has increased in this basin since 1971, with an average of 6,000 AFA from 1971-1975 to an average of 16,650 AFA from 2001-2005. The majority of this demand was for municipal use.
- 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.
- All surface water diversions, less than 300 AFA from 1991-2005, 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.
- Industrial groundwater demand is minimal in this basin. Less than 300 AFA were used in 2001-2005 for a small mine or quarry.
- As of 2005 there were 99 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 45 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 4.5-8.
- There are five wastewater treatment facilities in this basin.
- Over 30,000 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 3,360 acre-feet of effluent per year.

Table 4.5-7 Cultural Water Demand in the Lake Havasu Basin¹

Year	Estimated and Projected 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	Agricultural	Municipal	Industrial	Agricultural	
1971		33 ²	19 ²	6,000			NR ⁴			ADWR (1994a)
1972										
1973										
1974				14,000			NR			
1975										
1976										
1977										
1978										
1979										
1980	17,487	9	8	16,000			NR			
1981	18,376									
1982	19,265									
1983	20,154									
1984	21,043									
1985	21,932	15	3	12,000			NR			
1986	22,821									
1987	23,710									
1988	24,599									
1989	25,488									
1990	26,377									
1991	28,198	21	8	13,700	<300	NR	<300	NR	NR	USGS (2007) ADWR (2008b) ADWR (2008c)
1992	30,019									
1993	31,841									
1994	33,662									
1995	35,484									
1996	37,305	7	3	15,400	<300	NR	<300	NR	NR	
1997	39,127									
1998	40,948									
1999	42,770									
2000	44,591									
2001	46,911	14	4	16,500	<300	NR	<300	NR	NR	
2002	49,231									
2003	51,551									
2004	53,871									
2005	56,192									
2010	67,792									
2020	89,215									
2030	106,614									
WELL TOTALS:		99	45							

Notes:

NR = Not reported

¹ Does not include effluent or 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.

Table 4.5-8 Effluent Generation in the Lake Havasu Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet/year)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf/ Landscape	Wildlife Area	Discharged to Another Facility	Infiltration Basins			
Havasus Falls RV Park	Private	Lake Havasu City	NA			X						Primary/Secondary	NA	
Island Plant WWTP	Lake Havasu City	Lake Havasu City	11,000	1,120		X	Recreational fields	Havasus Island				Adv. Trt.I & Nutrient Removal	7000	2008
Mulberry WWTP	Lake Havasu City	Lake Havasu City	11,000	1,120				London Bridge				Adv. Trt.I & Nutrient Removal	7000	2008
North Regional WWTF	Lake Havasu City	Lake Havasu City	11,000	1,120				Refuge			X ¹	Secondary	7000	2008
Sun Lake Village	Private	Lake Havasu City	NA			X						Primary	NA	
Total			33,000	3,360										

Source: Compilation of databases from ADWR & others

Notes:

Year of Record is for the volume of effluent treated/generated

NA: Data not currently available to ADWR

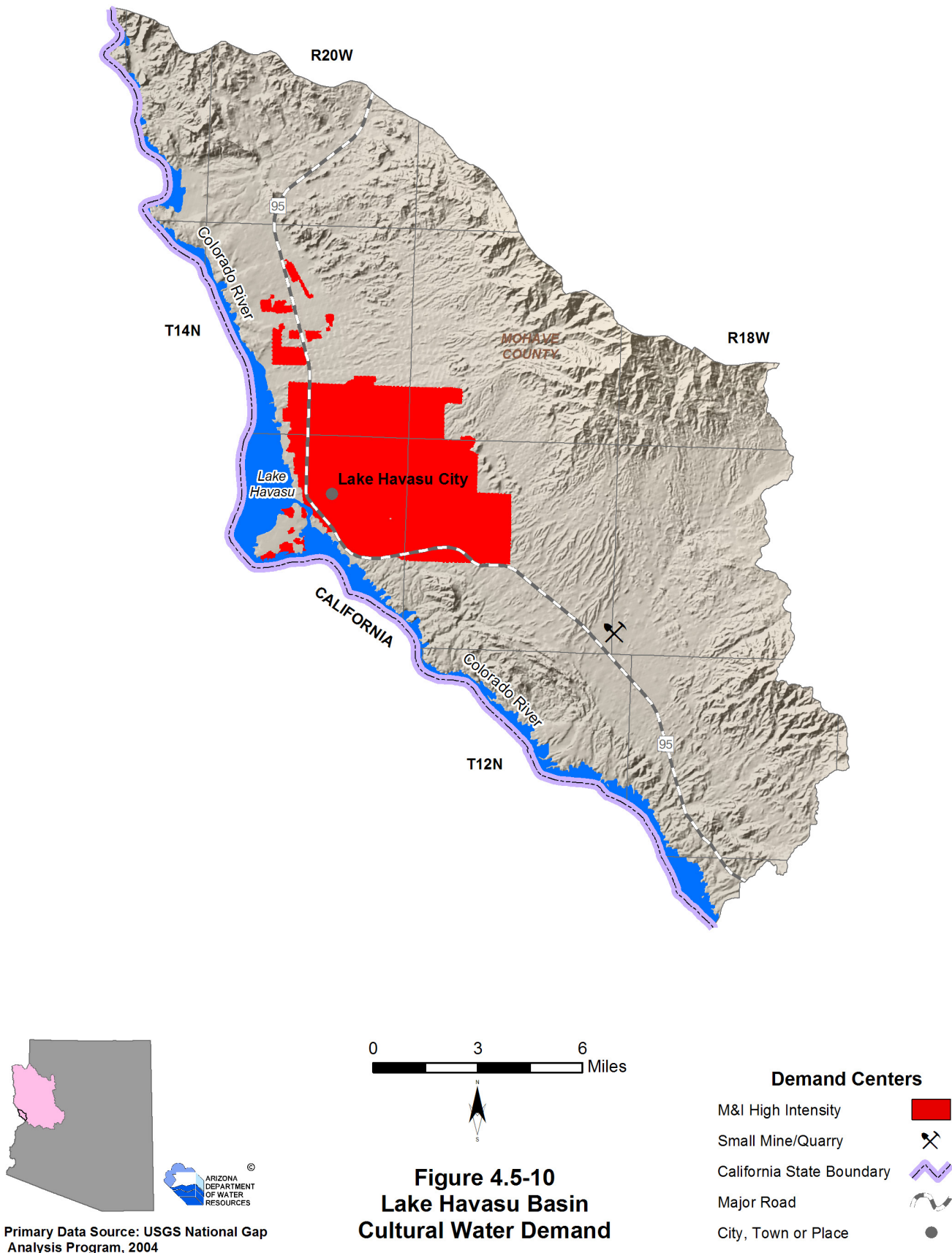
WWTP: Waste Water Treatment Plant

WWTF: Waste Water Treatment Facility

Adv. Tr 1: Advanced treatment level I

SD: Sanitation District

¹Injection Wells



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 4.5-9A. Designated water provider information is shown in Table 4.5-9B with date of application, date the designation was issued and projected or annual estimated demand. Figure 4.5-11 shows the locations of subdivisions and designated providers keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix C. Adequacy determination data sources and methods are found in Volume 1, Appendix A.

- All subdivisions receiving an adequacy determination are in Mohave County. Fourteen water adequacy determinations for more than 1,697 lots have been made in this basin through December 2008.
- One determination of inadequacy has been made north of Lake Havasu City because the applicant failed to demonstrate a legal right to use the water or failure to demonstrate their legal authority to serve the subdivision.
- There are two designated water providers, Havasu Heights Water Improvement District and Lake Havasu City. The total projected or annual estimated demand for Havasu Heights WID is 140 acre-feet. Lake Havasu City does not have a projected or annual estimated demand in their designation.

Table 4.5-9 Adequacy Determinations in the Lake Havasu Basin¹

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	Aztec Junction Tract 3019	Mohave	12 North	18 West	10	NA	53-500304	Adequate		6/13/1988	Valley Pioneer Water Co.
2	Canterbury Estates Tract 3702-A	Mohave	14 North	20 West	21	63	53-400683	Adequate		3/26/2002	Arizona-American Water Co. Havasu
3	Canterbury Estates Tract 3702B	Mohave	14 North	20 West	21	45	53-400798	Adequate		10/28/2002	Arizona-American Water Co. Havasu
4	Havasu RV Resort	Mohave	14 North	20 West	15	169	53-401108	Adequate		11/12/2003	Arizona-American Water Co. Havasu
5	Havasu RV Resort Phase II	Mohave	14 North	20 West	15	96	53-401889	Adequate		10/18/2005	Arizona-American Water Co. Havasu
6	Havasu RV Resort Phase III	Mohave	14 North	20 West	15	133	53-700449	Adequate		12/28/2007	Arizona-American Water Co. Havasu
7	Inn at Tamarisk	Mohave	14 North	21 West	21	212	53-500815	Adequate		1/5/1984	Havasu Water Company
8	North Pointe	Mohave	14 North	20 West	17	455	53-401582	Adequate		12/28/2004	Arizona-American Water Co. Havasu
9	Sunlake Village Tract 3700A	Mohave	14 North	20 West	21	35	53-300024	Adequate		8/8/1995	Arizona-American Water Co. Havasu
10	Sunlake Village Tract 3700B	Mohave	14 North	20 West	21	40	53-300407	Adequate		3/9/1998	Arizona-American Water Co. Havasu
11	Sunlake Village Tract 3700C	Mohave	14 North	20 West	21	52	53-400081	Adequate		8/24/1999	Arizona-American Water Co. Havasu
12	Sunlake Village Tract 3700D	Mohave	14 North	20 West	21	35	53-400206	Adequate		12/3/1999	Arizona-American Water Co. Havasu
13	Tamarisk Resort & Country Club	Mohave	14 North	20 West	20	NA	53-501535	Inadequate	B	1/5/1984	Havasu Water Company
14	The Refuge	Mohave	14 North	20 West	20	362	53-400660	Adequate		2/5/2002	Arizona-American Water Co. Havasu

B. Designated Adequate Water Supply

Map Key	Water Provider Name	County	Designation No.	Projected or Annual Estimated Demand (af/yr)	Date Application Received	Date Application Issued	Year of Projected or Annual Demand
a	Havasu Heights Domestic Water Improvement District	Mohave	40-700420.0001	140	6/26/2007	5/8/2008	2017
b	Lake Havasu City	Mohave	40-900008.0000	No amount designated	NA	6/18/1973	No data, hydrologic study needed

Source: ADWR 2008a

Notes:

¹Each 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. Between 1995-2006 all applications for adequacy were given a file number with a 22 prefix.

In 2006 a 53 prefix was assigned to all water adequacy reports and applications regardless of their issue date.

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= not currently available to ADWR

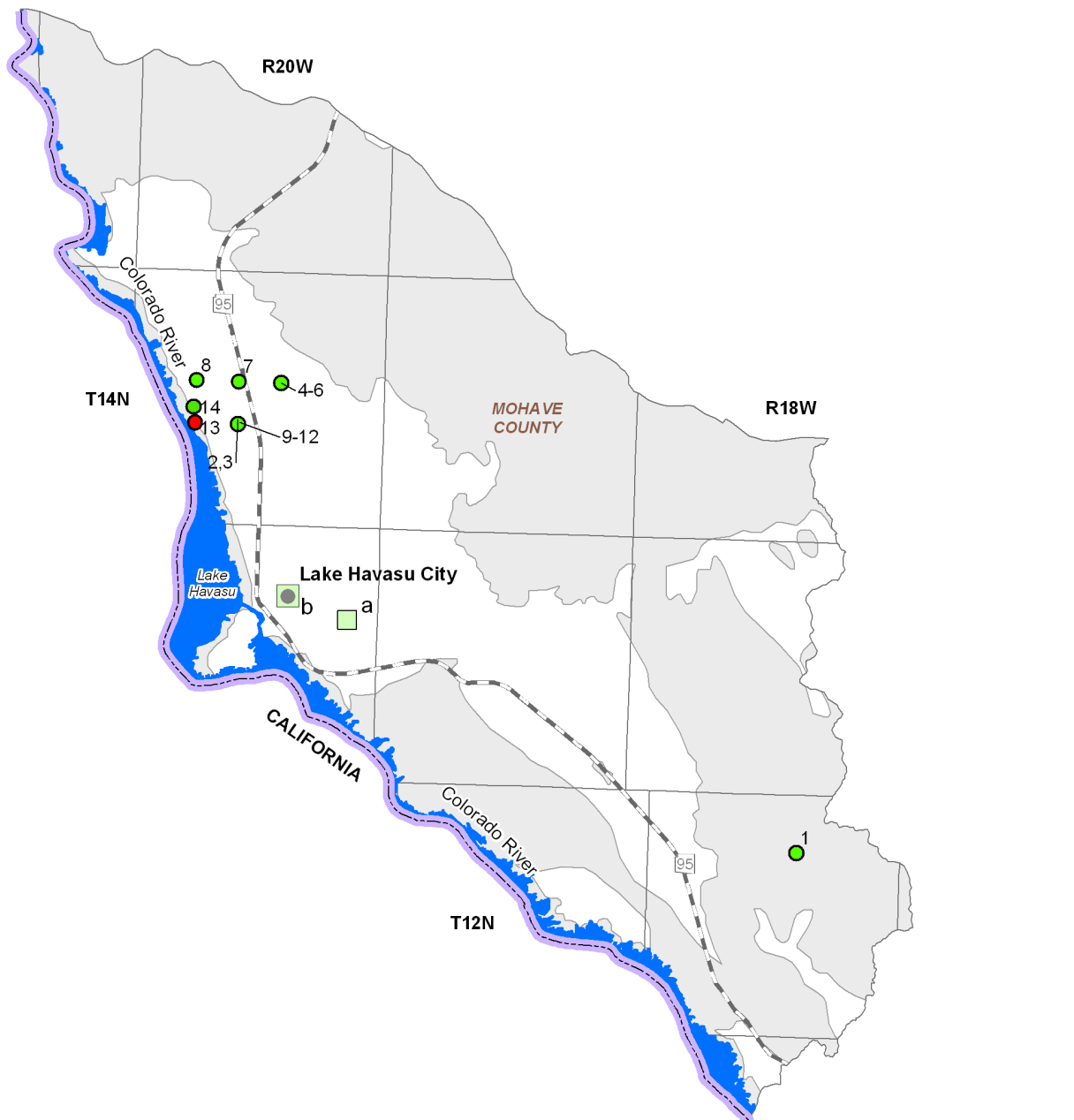


Figure 4.5-11
Lake Havasu Basin
Adequacy Determinations

Adequacy Determinations

- Adequate ●
- Inadequate ●
- Designated Water Provider
- Consolidated Crystalline & Sedimentary Rocks
- Unconsolidated Sediments
- California State Boundary ~
- Major Road —
- City, Town or Place ●

Lake Havasu Basin

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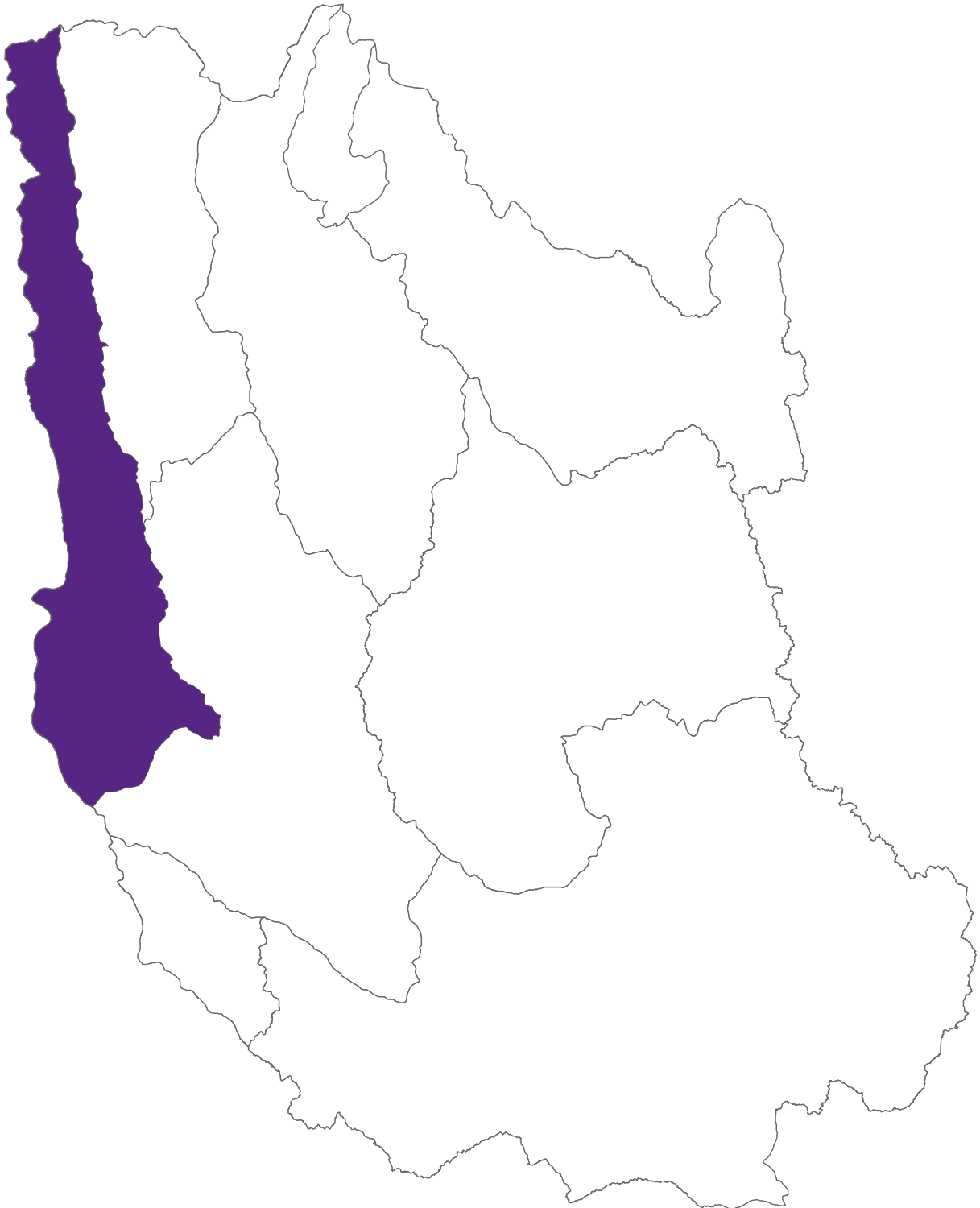
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Section 4.6

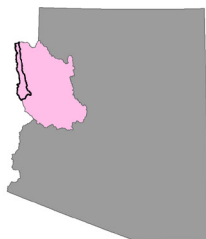
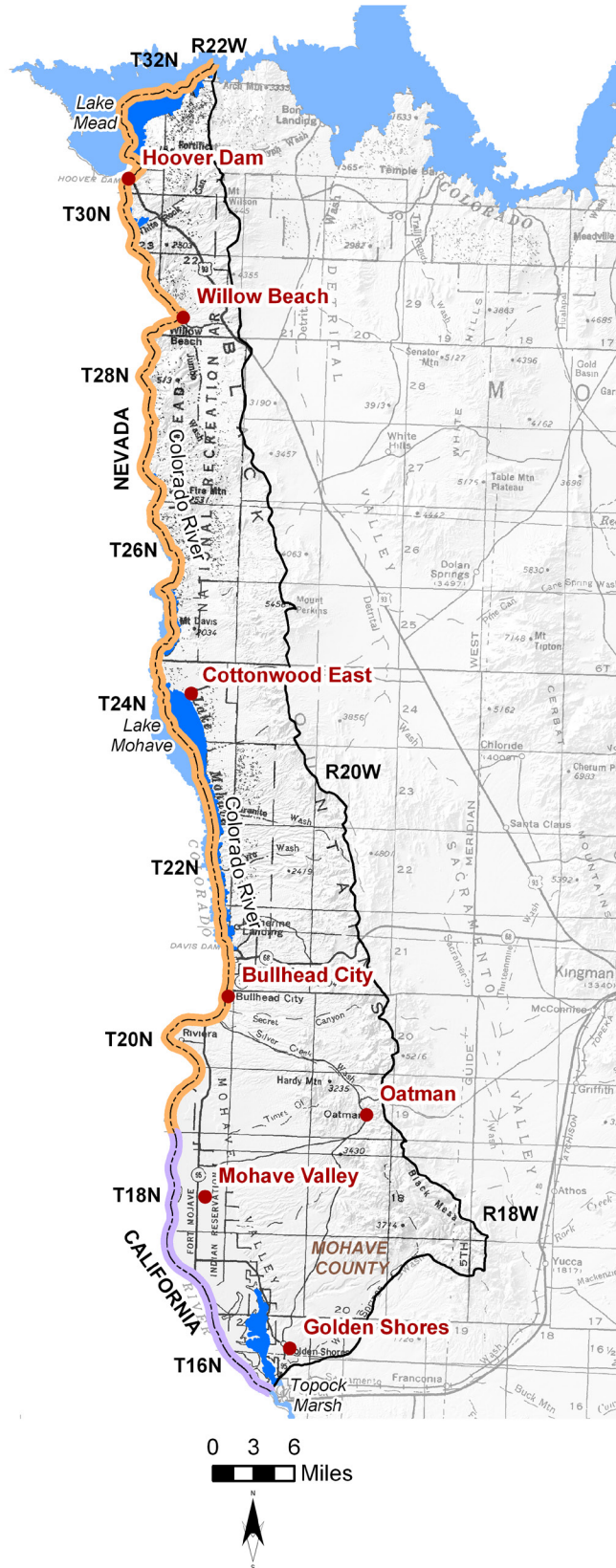
Lake Mohave Basin



4.6.1 Geography of the Lake Mohave Basin

The Lake Mohave Basin is a small and long 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 is primarily Mohave desertscrub with a small area of lower Colorado River Sonoran desertscrub (see Figure 4.0-9) and tamarisk and marsh vegetation along sections of the Colorado River.

- Principal geographic features shown on Figure 4.6-1 are:
 - 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 approximately 500 feet near Golden Shores at the Colorado River



Base Map: USGS 1:500,000, 1981

Figure 4.6-1
Lake Mohave Basin
Geographic Features

California State Boundary
Nevada State Boundary
City, Town or Place



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, Appendix A. More detailed information on protected areas is found in Section 4.0.4. Land ownership categories are discussed below in the order from largest to smallest percentage 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 and the 27,660-acre Mt. Nutt Wilderness (see Figure 4.0-12).
- Primary land uses are recreation and grazing.

National Park Service (NPS)

- 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.

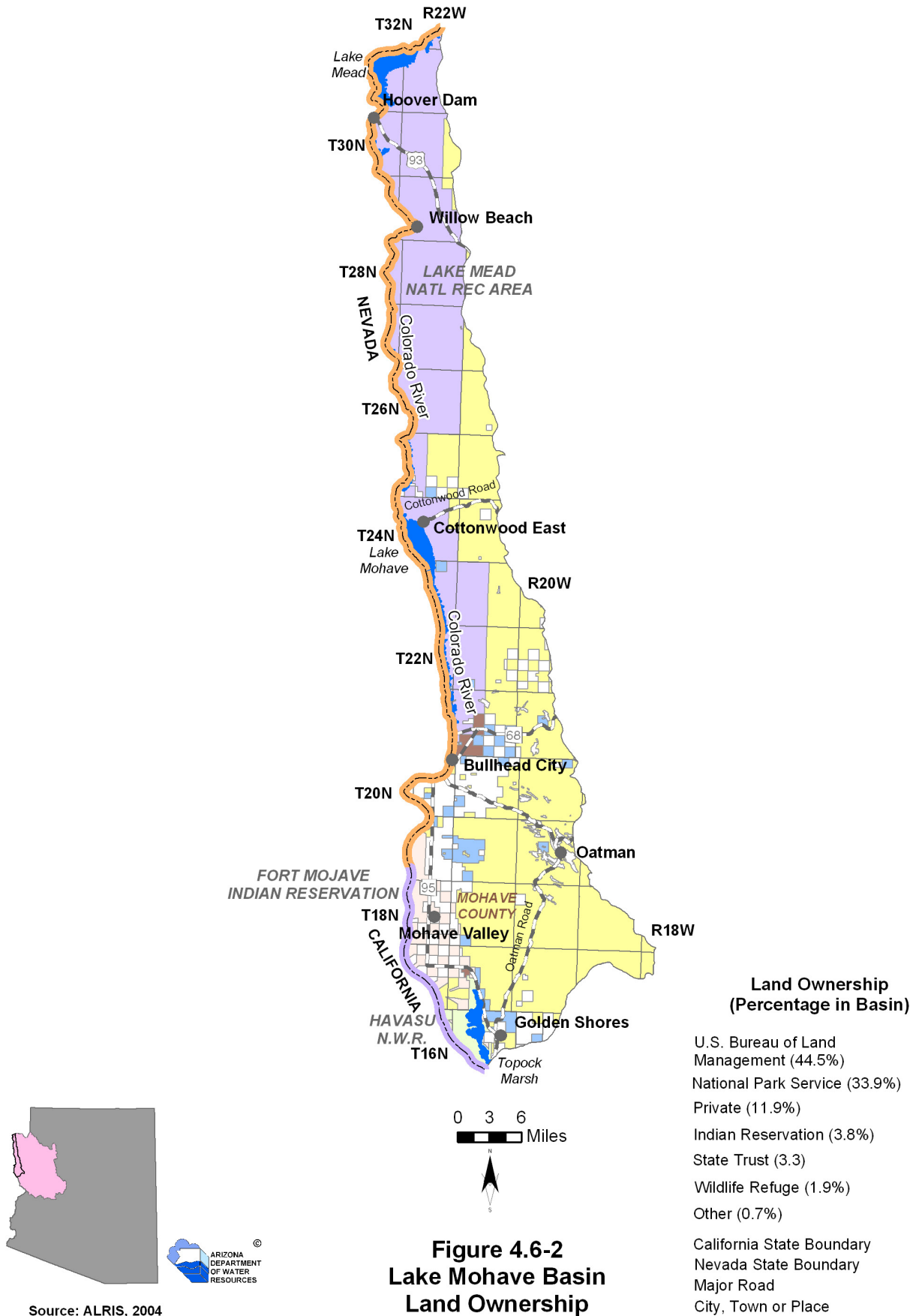
Wildlife Refuge

- 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.



4.6.3 Climate of the Lake Mohave Basin

Climate data from NOAA/NWS Co-op Network, Evaporation Pan and AZMET stations are compiled 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. More detailed information on climate in the planning area is found in Section 4.0.3. A description of the climate data sources and methods is found in Volume 1, Appendix A.

NOAA/NWS Co-op Network

- Refer to Table 4.6-1A
- There are three NOAA/NWS Co-op network climate stations in the basin. The average monthly maximum temperature occurs in July at all stations and is approximately 95°F. The average monthly minimum temperature occurs in January or December and ranges between 51.4°F at Willow Beach and 54.3°F at Bullhead City.
- Highest average seasonal rainfall occurs in the winter (January – March). For the period of record used, the highest annual rainfall is 5.84 inches at Bullhead City and the lowest is 4.63 inches at Davis Dam #2.

Evaporation Pan

- Refer to Table 4.6-1B
- There is one site at Davis Dam #2 at 660 feet with an annual 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 80.93 inches.
- Average annual evaporation at the Mohave #2 site, located at 432 feet, is 81.61 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 four inches or less in a number of areas along the boundary with Nevada. This is the lowest average annual precipitation in 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, 2005

Notes:

¹Average 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, 2005

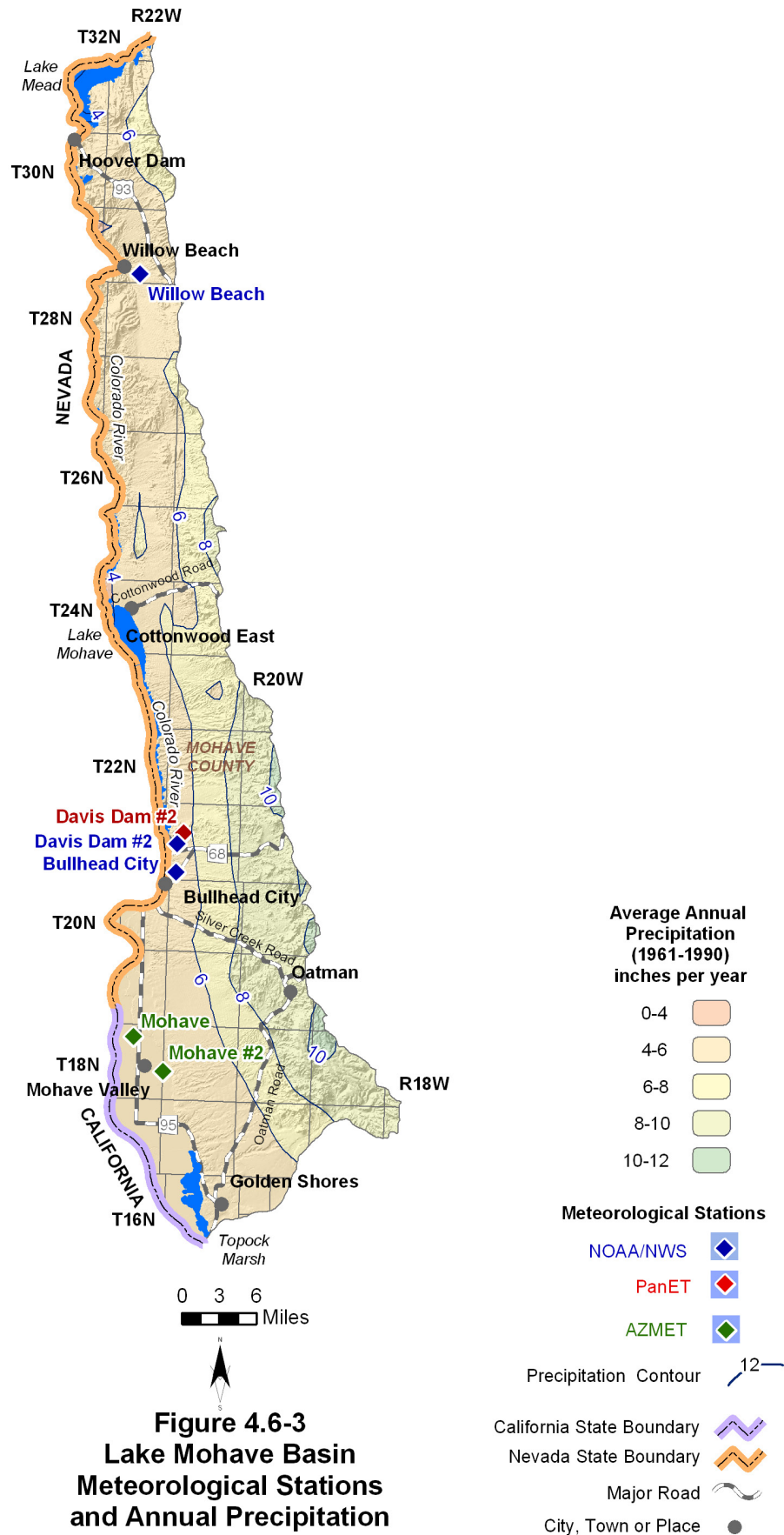
C. AZMET:

Station Name	Elevation (feet)	Period of Record	Average Annual Reference Evapotranspiration, in inches (Number of years to calculate averages)
Mohave	495	1999 - current	80.93 (9)
Mohave #2	492	2003 - current	81.61 (5)

Source: Arizona Meteorological Network, 2007

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record	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								



Precipitation Data Source: Oregon State University, 1998

ARIZONA
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RESOURCES

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 identified by USGS number, flood ALERT equipment, USGS runoff contours and large reservoirs are shown on Figure 4.6-4. Descriptions of stream, reservoir and stockpond data sources and methods are found in Volume 1, Appendix A.

Streamflow Data

- Refer to Table 4.6-2.
- Data from two real-time stations located on the Colorado River 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.
- 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 eight stations in the basin.

Reservoirs and Stockponds

- Refer to Table 4.6-4.
- The basin contains five large reservoirs. The largest is Lake Mead with a maximum capacity of 29,755,000 acre-feet.
- There are two small reservoirs in the basin.
- There are three registered stockponds in the basin.

Runoff Contours

- Refer to Figure 4.6-4
- Runoff is 0.1 inches per year, or 5.33 acre-feet per square mile, 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)	Gage Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Annual Flow Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9421500	Colorado River below Hoover Dam ¹	171,700	675	4/1934 to current (real time)	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	173,300	490	5/1905 to current (real time)	21	32	29	18	7,406,290 (1982)	8,499,496	10,102,448	21,596,249 (1984)	44

Source: USGS (NWIS) 2005 & 2008

Notes:

¹Station is located in NV

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

In Period of Record, current equals November 2008

Seasonal and annual flow data used for the statistics was retrieved in 2005

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

Source: ADWR 2005b

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,R	Federal
2	Mohave (Davis Dam)	Bureau of Reclamation	1,818,300 ⁴	H,S,R	Federal

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

Source: Compilation of databases from ADWR & others

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)⁵

Total number: 2

Total surface area: 30 acres

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

Total number: 3 (from water right filings)

Notes:

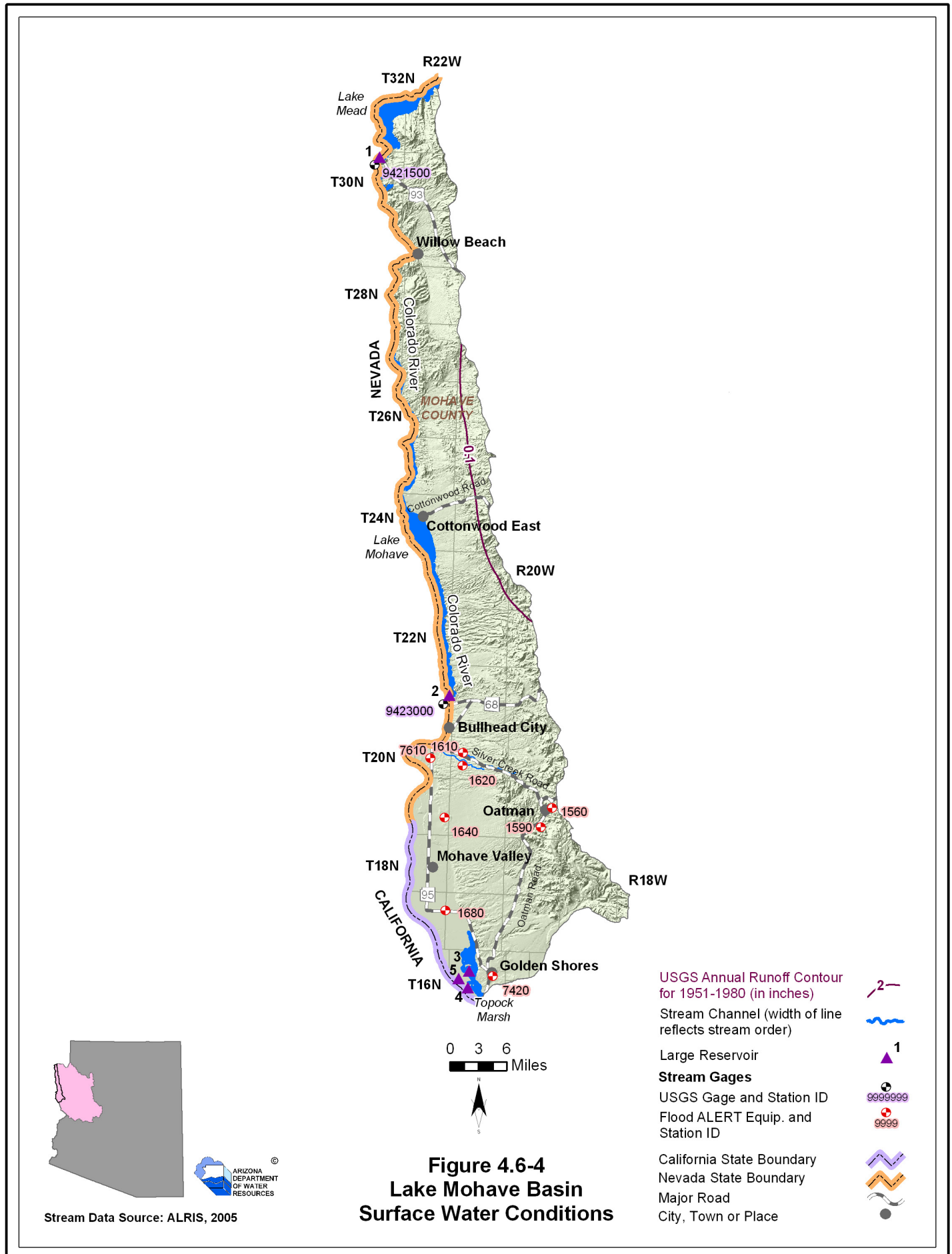
¹C=flood control; F=fish & wildlife pond; H=hydroelectric; I=irrigation; R=recreation; RR=river regulation; S=water supply

²Dam is located in Lake Mohave Basin and lake storage is located in Lake Mohave, Detrital Valley, Hualapai Valley and Meadview Basins.

³Includes 2,378,000 acre-feet of dead storage.

⁴Includes 8,530 acre-feet of dead storage.

⁵Capacity data not available to ADWR



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. Descriptions of data sources and methods for intermittent and perennial reaches and springs are found in Volume 1, Appendix A.

- There is one perennial stream, the Colorado River, located along the western basin boundary.
- There are ten major springs with a measured discharge of 10 gallons per minute (gpm) or greater at any time. The largest discharge rate is 400 gpm at Arizona Hot Springs.
- 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.
- Listed discharge rates may not be indicative of current conditions. All of the measurements, except for Arizona Hot Springs, were made during or prior to 1983.
- 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	Arizona Hot Springs	355738	1144332	400	11/1/2004
2	Unnamed	360008	1144420	100	During or prior to 1971
3	Unnamed	355956	1144410	100	During or prior to 1971
4	Hot - Ringbolt Rapids	355739	1144326	48	During or prior to 1983
5	Palm Tree- Cold ²	355942	1144415	40	During or prior to 1983
6	Arizona Seep	355542	1144220	32	During or prior to 1983
7	Arizona Hot Spot ²	360022	1144431	32	During or prior to 1983
8	Palm Tree Hot ²	355942	1144420	32	During or prior to 1983
9	Unnamed	360015	1144420	30	During or prior to 1971
10	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

Source: Compilation of databases from ADWR & others

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

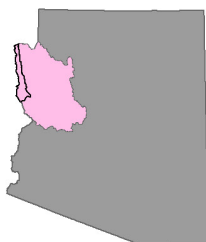
Notes:

¹Most recent measurement identified by ADWR

²Spring is not displayed on current USGS topo maps

³Location approximated by ADWR

NA=Not available



Stream Data Source: AGFD, 1993 & 1997

0 3 6
Miles



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

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



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 as well as well data sources and methods, including water-level changes and well yields are found in Volume 1, Appendix A.

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.

Natural Recharge

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

Water in Storage

- Refer to Table 4.6-6.
- Storage estimates for this basin range from 1.2 maf to 8.0 maf 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. Hydrographs for two of these wells are shown in Figure 4.6-7.
- Of the three water depths shown, the deepest is 427 feet south of Bullhead City and the shallowest is 337 feet north of Mohave Valley.

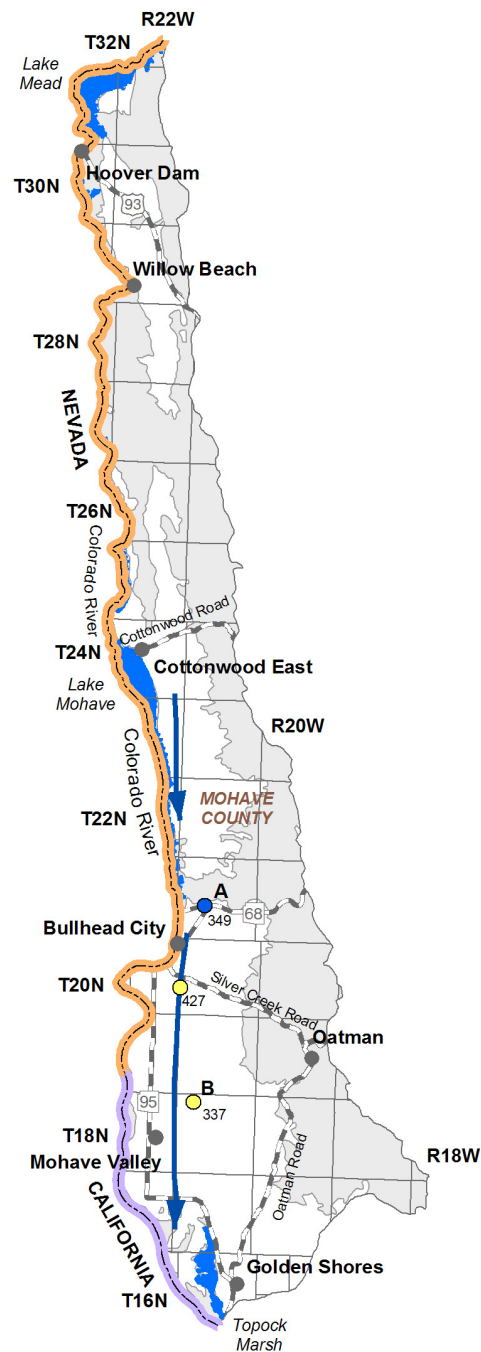
Table 4.6-6 Groundwater Data for the Lake Mohave Basin

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 (GWSI) and/or USGS
	Range 15-5,000 Median 1,000 (96 wells reported)	Reported on registration forms for large (>10-inch) diameter wells (Wells55)
	Range 30-1,000	ADWR (1990 and 1994b)
	Range 0-2,500	Anning and Duet (1994)
Estimated Natural Recharge, in acre-feet/year:	183,000	Freethy and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	1,200,000 (to 1,200 ft)	ADWR (1994b)
	8,000,000 ¹ (to 1,200 ft)	Freethy 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

¹Predevelopment Estimate



Water-level change in feet between
1990-1991 and 2003-2004

375 H = number is depth to water in
feet during 2003-2004;
letter is hydrograph

Between -15 and -1

Between +15 and +30

Generalized Flow Direction

Consolidated Crystalline
& Sedimentary Rocks

Unconsolidated Sediments

California State Boundary

Nevada State Boundary

Major Road

City, Town or Place

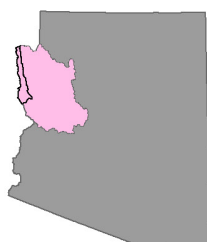
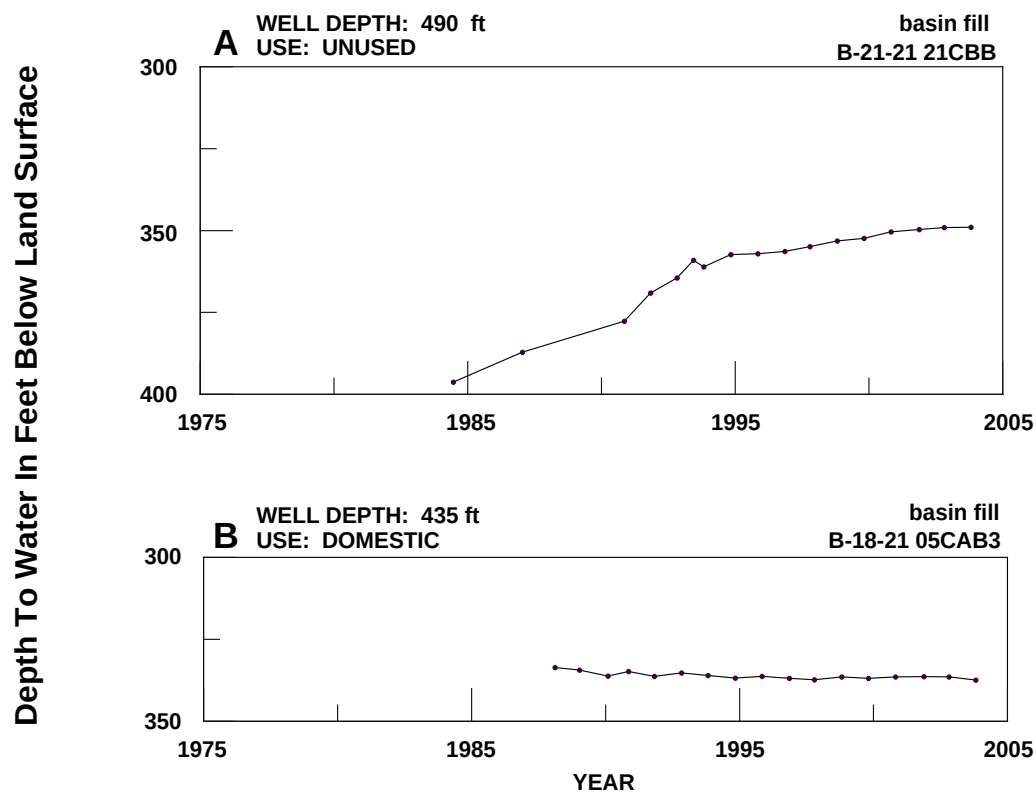
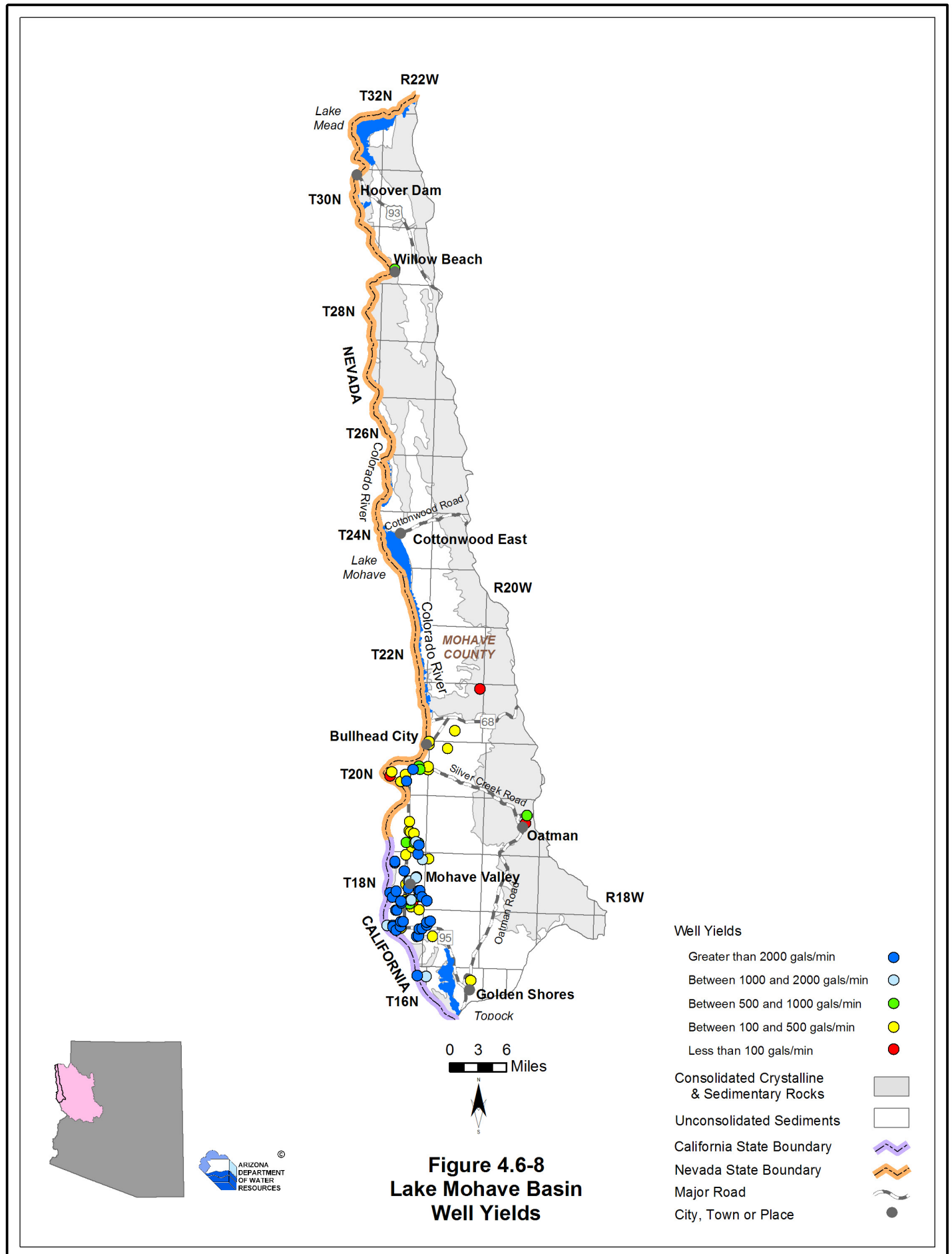


Figure 4.6-6
Lake Mohave Basin
Groundwater Conditions

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





4.6.7 Water Quality of the Lake Mohave Basin

Sites with parameter concentrations that have equaled or exceeded drinking water standard(s) (DWS), including location and parameter(s) 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. All community water systems are regulated under the Safe Drinking Water Act and treat water supplies to meet drinking water standards. Not all parameters were measured at all sites; selective sampling for particular constituents is common. A description of water quality data sources and methods is found in Volume 1, Appendix A.

Well, Mine or Spring sites that have equaled or exceeded drinking water standards (DWS)

- Refer to Table 4.6-7A.
- Sixty-five measured sites have parameter concentrations that have equaled or exceeded drinking water standards.
- The parameter most frequently equaled or exceeded in the sites measured was arsenic. Other parameters equaled or exceeded included cadmium, fluoride, lead, nitrate, mercury and total dissolved solids.

Lakes and Streams with impaired waters

- Refer to Table 4.2-7B.
- Water quality standards for selenium were equaled or exceeded in one 40-mile reach of the Colorado River between Hoover Dam and Lake Mohave.
- 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 Basin¹

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded 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)¹

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded 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

Source: Compilation of databases from ADWR & others

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

Source: ADEQ 2005d

Notes:

NA = Not applicable

¹ Water quality samples collected between 1970 and 2004.

² As = Arsenic

Cd = Cadmium

F = Fluoride

Pb = Lead

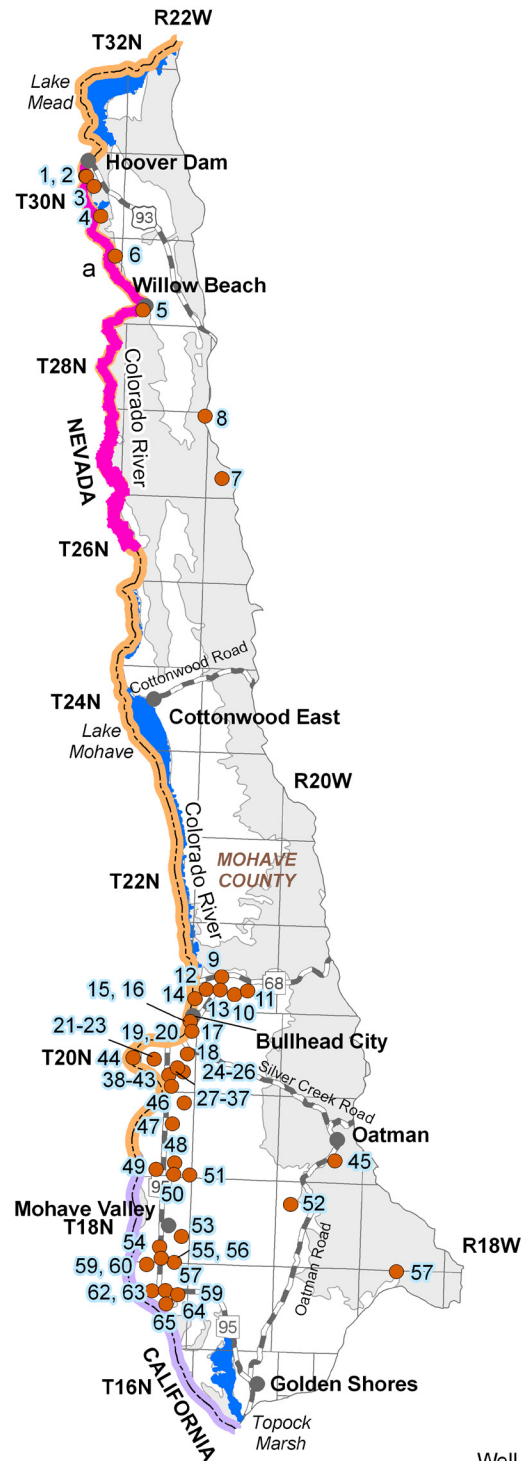
NO3 = Nitrate

Hg = Mercury

TDS = Total Dissolved Solids

Se = Selenium

³ A&W = Aquatic and Wildlife

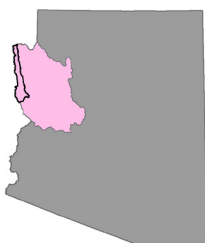
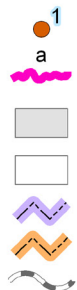


0 3 6
Miles



Figure 4.6-9
Lake Mohave Basin
Water Quality Conditions

- Well, Spring or Mine Site that has
Equalled or Exceeded DWS
- Impaired Stream or Lake
- Consolidated Crystalline
& Sedimentary Rocks
- Unconsolidated Sediments
- California State Boundary
- Nevada State Boundary
- Major Road
- City, Town or Place



4.6.8 Cultural Water Demand 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, Appendix A. More detailed information on cultural water demand is found in Section 4.0.7.

Cultural Water Demand

- 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.
- Groundwater use has increased in this basin since 1971, with an average of 17,500 AFA from 1971-1975 and an average of 54,000 AFA from 2001-2005.
- 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 1980-1985. Current surface water diversions are 69,000 AFA on average during 2001-2005.
- The majority of surface water use from 1990-2005 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 12,700 AFA in 1991 to 18,800 AFA in 2001-2005.
- Industrial groundwater demand is minimal in this basin, at an average of 600 AFA during 2001-2005. Industrial groundwater demand is for three small mines or quarries and two golf courses in the vicinity of Bullhead City. One golf course, El Rio Country Club, opened in 2005 therefore only one year of water use for is included in the average.
- In 2001-2005 an average of 3,700 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.
- As of 2005 there were 1,887 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 353 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 15,800 people and generate over 3,100 acre-feet of effluent per year.

Table 4.6-8 Cultural Water Demand in the Lake Mohave Basin¹

Year	Estimated and Projected 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	Agricultural	Municipal	Industrial	Agricultural		
1971		725 ³	201 ³	17,500			2,600			ADWR (2007)	
1972											
1973											
1974											
1975				22,000			14,400				
1976											
1977											
1978											
1979											
1980	13,653	331	34	27,300			46,600				
1981	15,353										
1982	17,053										
1983	18,752										
1984	20,452										
1985	22,152	281	37	29,500			53,600				
1986	23,852										
1987	25,551										
1988	27,251										
1989	28,951										
1990	30,651										
1991	32,740	187	31	12,700	500	36,700	500	NR	56,600	USGS (2007) BIA (1998) ADWR (2008b) ADWR (2008c)	
1992	34,830										
1993	36,920										
1994	39,010										
1995	41,100										
1996	43,190	159	32	16,000	500	35,600	700	NR	68,100		
1997	45,280										
1998	47,369										
1999	49,459										
2000	51,549										
2001	52,920	203	18	18,800	600	30,400	400	3,700	64,900		
2002	54,291										
2003	55,662										
2004	57,033										
2005	58,404										
2010	65,259										
2020	79,878										
2030	91,747										
WELL TOTALS:		1,887	353								

Notes:

NR = Not reported.

¹ Does not include effluent or evaporation losses from stockponds and reservoirs.

² Includes pumpage and diversion of Colorado River Contract Water.

³ Includes all wells through 1980.

Table 4.6-9 Effluent Generation in the Lake Mohave Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet/year)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record	
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf/ Landscape	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	NA			X						NA			
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				NA		2004	
Sun Ridge	NA	Bullhead City	500	78	X							Adv. Tr. 1	NA	2000	
Sunrise Vista Utilities	Private	Bullhead City	665	92							X	Secondary	NA	2007	
Tierra Grande ¹	NA	Bullhead City	280	37		X						Adv. Tr. 1	3,720	2000	
Wishing Well WWTP	AZ American Water	Ft. Mohave	NA	220				Desert Lakes				Secondary	NA	2007	
Total			15,845	3,126											

Source: Compilation of databases from ADWR & others

Notes:

Year of record is for the volume of effluent treated/generated

NA: Data not currently available to ADWR

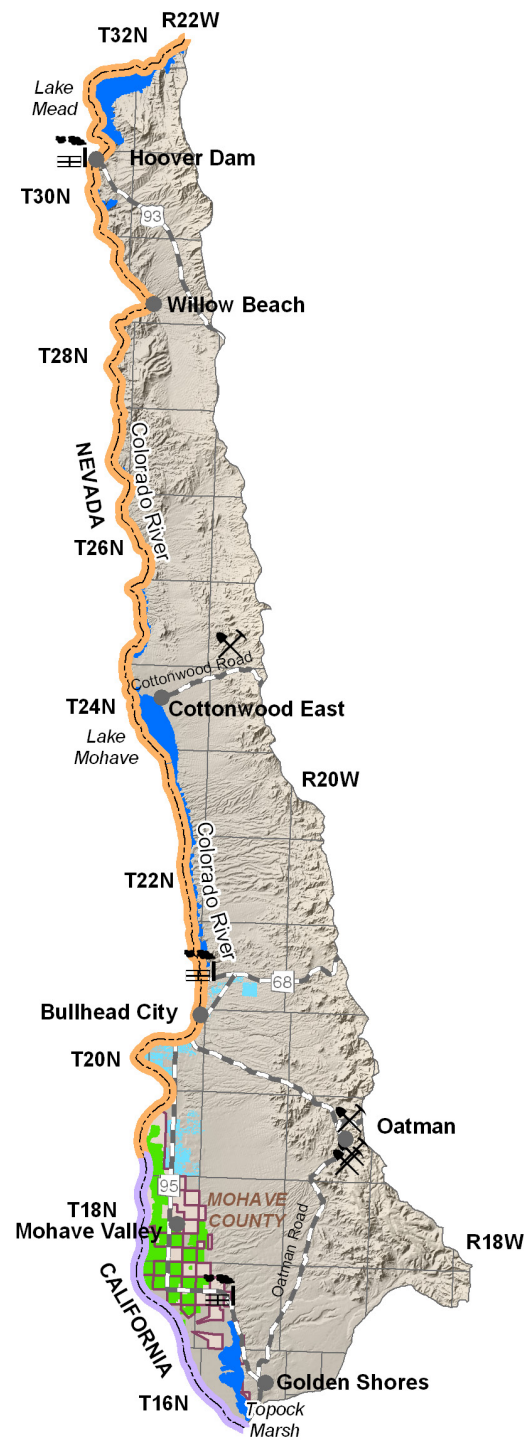
WWTF: Waste Water Treatment Facility

WWTP: Waste Water Treatment Plant

Ad. Tr. 1: Advanced treatment level 1

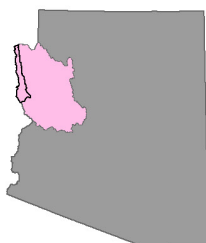
Adv. Tr. II: Advanced Treatment level II

¹Scheduled to close in May 2005



Demand Centers

- Agriculture
- M&I - Low Intensity
- Indian Reservation
- Indian Reservation Boundary
- Small Mine/Quarry
- Power Plant
- California State Boundary
- Nevada State Boundary
- Major Road
- City, Town or Place



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

Figure 4.6-10
Lake Mohave Basin
Cultural Water Demand

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 4.6-10A and B for water reports and analysis of adequate water supply. Designated water provider information is shown in Table 4.6-10C with date of application, date the designation was issued and projected or annual estimated demand. Figure 4.6-11 shows the locations of subdivisions and designated providers keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix C. Adequacy determination data sources and methods are found in Volume 1, Appendix A.

- All subdivisions receiving an adequacy determination are in Mohave County. Two hundred and sixty-five water adequacy determinations have been made in this basin through December 2008. Of the 32,802 lots in 262 subdivisions for which lot information is available, 32,530 lots or 99% were determined to be adequate.
- The three 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.
- Five Analyses of Adequate Water Supply applications have been approved for this basin, for a total of 663 lots.
- There is one designated water provider, Bullhead City, with a projected or annual estimated demand of 23,691 acre-feet.

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin¹

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	53-500254	Adequate		2/28/1994	Fort Mohave Tribal Utilities
2	American Business Park	Mohave	19 North	22 West	35	NA	53-500265	Adequate		10/19/1988	Bermuda Water Company, Inc.
3	American Business Park Tct 4075	Mohave	19 North	22 West	35	NA	53-500266	Adequate		10/19/1992	Bermuda Water Company, Inc.
4	Arroyo Park at Desert Foothills	Mohave	20 North	21 West	5	63	53-300215	Adequate		11/18/1996	Citizens Utilities Company-Mohave
5	Arroyo Vista Estates	Mohave	19 North	22 West	12	NA	53-500301	Adequate		1/6/1988	Bermuda Water Company, Inc.
6	Arroyo Vista Estates 4077-E Uni	Mohave	19 North	22 West	12	36	53-400526	Adequate		6/29/2001	Bermuda Water Company, Inc.
7	Aztec Village Tract 4144A	Mohave	19 North	22 West	23	7	53-500305	Adequate		4/20/1993	Bermuda Water Company, Inc.
8	Bermuda Dunes Tract 4039A	Mohave	17 North	22 West	15	NA	53-500319	Adequate		12/11/1984	Bermuda Water Company, Inc.
9	Bermuda Dunes Tract 4039C	Mohave	17 North	22 West	15	NA	53-500320	Adequate		1/7/1988	Bermuda Water Company, Inc.
10	Bermuda Dunes Tract 4039D	Mohave	17 North	22 West	15	NA	53-500321	Adequate		11/15/1988	Bermuda Water Company, Inc.
11	Bermuda Dunes Tract 4059B	Mohave	17 North	22 West	15	NA	53-500322	Adequate		11/21/1985	Bermuda Water Company, Inc.
14	Bermuda Meadows (A)	Mohave	17 North	22 West	15	4	53-500325	Adequate		3/4/1992	Fort Mohave Tribal Utilities
15	Bermuda Meadows (B)	Mohave	17 North	22 West	15	8	53-500326	Adequate		2/27/1992	Fort Mohave Tribal Utilities
16	Beverly Hills Estates Tract 402	Mohave	19 North	22 West	25	NA	53-500329	Adequate		5/2/1983	Dry Lot Subdivision
17	Black Mountain Park	Mohave	20 North	22 West	23	988	53-500342	Adequate		5/1/1990	Citizens Utilities Company-Mohave
18	Bluewater Shores	Mohave	20 North	22 West	17	4	53-500346	Adequate		3/13/1990	Citizens Utilities Company-Mohave
19	Brett Canyon Estates, Tract 419	Mohave	19 North	22 West	25	55	53-401809	Adequate		8/4/2005	Bermuda Water Company, Inc.
20	Buena Vista #4	Mohave	20 North	22 West	16	NA	53-500365	Adequate		11/12/1975	Oasis Utility Company
21	Bullhead Airpark Phase 1	Mohave	21 North	21 West	31,32	7	53-300153	Adequate		7/23/1996	North Mohave Valley Corp.
22	Bullhead Plaza	Mohave	20 North	22 West	18	NA	53-500369	Adequate		5/17/1982	Oasis Utility Company
23	Camp Mohave Heights	Mohave	19 North	22 West	23	NA	53-500385	Adequate		10/23/1989	Citizens Utilities Company-Mohave
24	Casa Blanca	Mohave	20 North	23 West	13	13	53-500401	Adequate		4/9/1991	Citizens Utilities Company-Mohave
25	Casa Grande Condominiums	Mohave	21 North	21 West	21	19	53-500406	Adequate		6/26/1992	North Mohave Valley Corp.
26	Casa de Rio Villas Condos	Mohave	20 North	22 West	17	60	53-500403	Adequate		9/28/1983	Citizens Utilities Company-Mohave
27	Central Village A	Mohave	20 North	22 West	19	46	53-500432	Adequate		3/21/1978	Citizens Utilities Company-Mohave
28	Chaparral Country Club Tract 50	Mohave	20 North	22 West	29	30	53-500437	Adequate		11/22/1994	Citizens Utilities Company-Mohave
29	Chaparral Terrace	Mohave	20 North	22 West	29	319	53-500444	Adequate		10/11/1985	Citizens Utilities Company-Mohave
30	Chaparral Villas Condominiums	Mohave	20 North	22 West	29	NA	53-500446	Adequate		10/25/1988	Citizens Utilities Company-Mohave
31	Chaparral del Rio Condominiums	Mohave	20 North	22 West	29	90	53-500438	Adequate		7/28/1989	Citizens Utilities Company-Mohave
32	Clearwater Hills #1	Mohave	19 North	22 West	11	120	53-500470	Adequate		10/15/1980	Bermuda Water Company, Inc.
33	Clearwater Hills #2	Mohave	19 North	22 West	11	75	53-500471	Adequate		6/13/1985	Bermuda Water Company, Inc.

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (Cont)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						
34	Clearwater Hills #2,3	Mohave	19 North	22 West	11	81	53-500472	Adequate		4/12/1982	Bermuda Water Company, Inc.
35	Colorado River Estates	Mohave	20 North	22 West	25,26	128	53-500486	Adequate		4/2/1990	Dry Lot Subdivision
36	Colorado Riverfront Terrace	Mohave	17 North	22 West	23	61	53-500488	Adequate		6/22/1989	Bermuda Water Company, Inc.
37	Courtney Greens Tract 4054	Mohave	19 North	22 West	23	42	53-500531	Adequate		12/16/1986	Bermuda Water Company, Inc.
38	Courtney Greens #2 Tract 4054B	Mohave	19 North	22 West	23	30	53-500532	Adequate		8/20/1990	Bermuda Water Company, Inc.
39	Courtney Park East 4147A	Mohave	19 North	22 West	23	6	53-500533	Adequate		7/22/1993	Bermuda Water Company, Inc.
40	Courtney Park East Tract 4147-B	Mohave	19 North	22 West	23	64	53-500534	Adequate		6/23/1997	Bermuda Water Company, Inc.
41	Courtney Place Tract 4070	Mohave	19 North	22 West	23	5	53-500535	Adequate		10/24/1990	Bermuda Water Company, Inc.
42	Courtney Place Townhomes 4071A	Mohave	19 North	22 West	23	18	53-500536	Adequate		9/24/1992	Bermuda Water Company, Inc.
43	Covina Gardens Condominiums	Mohave	20 North	22 West	29	12	53-500538	Adequate		12/8/1982	Citizens Utilities Company-Mohave
44	Coyote Run Tract 4176-B	Mohave	19 North	22 West	23	104	53-700238	Adequate		2/21/2007	Arizona American Water Co.
45	Coyote Run Tract, 4176-A	Mohave	19 North	22 West	23	42	53-401144	Adequate		2/18/2004	Arizona American Water Co.
46	Del Rio Estates	Mohave	20 North	22 West	32	7	53-400542	Adequate		8/6/2001	Citizens Utilities Company-Mohave
47	Delta City #5	Mohave	17 North	21 West	7	2,173	53-500548	Adequate		9/13/1973	Bermuda Water Company, Inc.
48	Desert Canyon at SunRidge	Mohave	21 North	21 West	21	141	53-401837	Adequate		2/2/2006	North Mohave Valley Corp.
49	Desert Foothills Estates #5011	Mohave	20 North	21 West	5	3,353	53-500559	Adequate		4/18/1995	Citizens Utilities Company-Mohave
50	Desert Glen	Mohave	20 North	22 West	13	103	53-500562	Adequate		5/20/1981	Citizens Utilities Company-Mohave
51	Desert Horizons, Tract 4161	Mohave	19 North	22 West	23	44	53-400113	Adequate		9/21/1999	Bermuda Water Company, Inc.
52	Desert Isle	Mohave	20 North	22 West	13	15	53-500566	Adequate		11/15/1990	Citizens Utilities Company-Mohave
53	Desert Lakes Estates Tract 4152	Mohave	19 North	22 West	36	31	53-300025	Adequate		6/5/1996	Bermuda Water Company, Inc.
54	Desert Lakes Estates Tract 4152	Mohave	19 North	22 West	36	40	53-400220	Adequate		1/5/2000	Bermuda Water Company, Inc.
55	Desert Lakes Estates Tract 4152	Mohave	19 North	22 West	36	42	53-400987	Adequate		10/22/2003	Bermuda Water Company, Inc.
56	Desert Lakes Estates Tract 4159	Mohave	19 North	22 West	35	6	53-400475	Adequate		4/27/2001	Bermuda Water Company, Inc.
57	Desert Lakes Estates, Tract 415	Mohave	19 North	22 West	36	159	53-401687	Adequate		9/27/2005	Bermuda Water Company, Inc.
58	Desert Lakes Golf Course & Estates	Mohave	19 North	22 West	36	233	53-500569	Adequate		5/14/1990	Bermuda Water Company, Inc.
59	Desert Lakes Golf Course & Estates #F	Mohave	19 North	22 West	35	38	53-300326	Adequate		10/29/1997	Bermuda Water Company, Inc.
60	Desert Lakes Golf Course & Estates Tract 4163	Mohave	19 North	22 West	35	32	53-400697	Adequate		5/7/2002	Bermuda Water Company, Inc.
61	Desert Ridge Tract 4032A	Mohave	19 North	22 West	11	83	53-500575	Adequate		2/23/1984	Bermuda Water Company, Inc.
62	Dos Vientos Tr. 4199	Mohave	19 North	22 West	23	15	53-401676	Adequate		4/11/2005	Bermuda Water Company, Inc.
63	East Shore Villas #1 Tract 5070	Mohave	20 North	22 West	9,16	51	53-400175	Adequate		11/22/1999	Arizona American Water Co.

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (Cont)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						
64	Edgewood Condominiums Tr 4021	Mohave	20 North	22 West	13	36	53-500599	Adequate		8/18/1981	Citizens Utilities Company-Mohave
65	El Camino Estates	Mohave	19 North	22 West	1	763	53-500601	Adequate		12/7/1989	Bermuda Water Company, Inc.
66	El Camino Village #1	Mohave	19 North	22 West	1	251	53-500602	Adequate		12/26/1991	Bermuda Water Company, Inc.
67	El Rio Country Club, Tract 417	Mohave	18 North	22 West	11	143	53-401778	Adequate		9/1/2005	Bermuda Water Company, Inc.
68	El Rio Country Club, Tract 4177	Mohave	18 North	22 West	11	161	53-401466	Adequate		5/4/2005	Bermuda Water Company, Inc.
69	Emerald River Estates T4093	Mohave	19 North	22 West	25	45	53-500612	Adequate		8/21/1990	Bermuda Water Company, Inc.
70	Emerald River Estates Tract 409	Mohave	19 North	22 West	25	62	53-400002	Adequate		8/24/1999	Bermuda Water Company, Inc.
71	Everglades Estates Tract 4214A	Mohave	19 North	22 West	36	65	53-700575	Adequate		10/23/2008	Bermuda Water Company, Inc.
72	Evergreen Addition	Mohave	18 North	22 West	27	38	53-500623	Adequate		7/3/1979	Willow Valley Water Co.
73	Evergreen Addition #3	Mohave	18 North	22 West	27	77	53-500625	Adequate		10/19/1987	Willow Valley Water Co.
74	Fairway Estates #1-4148A	Mohave	19 North	22 West	35	49	53-500630	Adequate		10/22/1992	Bermuda Water Company, Inc.
75	Fairway Estates #2	Mohave	19 North	22 West	35	28	53-500631	Adequate		4/26/1993	Bermuda Water Company, Inc.
76	Fairway Estates Tract 4097A	Mohave	19 North	22 West	35	100	53-500632	Adequate		5/8/1991	Bermuda Water Company, Inc.
77	Fairway Estates Tract 4097B	Mohave	19 North	22 West	35	28	53-500633	Adequate		7/12/1991	Bermuda Water Company, Inc.
78	Fairway Estates Tract 4097C	Mohave	19 North	22 West	35	47	53-401366	Adequate		9/9/2004	Bermuda Water Company, Inc.
79	Fairway Estates Tract 4097D	Mohave	19 North	22 West	35	48	53-401201	Adequate		2/13/2004	Bermuda Water Company, Inc.
80	Fairway Estates Tract 4097 E	Mohave	19 North	22 West	35	41	53-400538	Adequate		3/4/2002	Bermuda Water Company, Inc.
81	Fox Creek Estates	Mohave	20 North	21 West	31	1,750	NA	Adequate		11/2/1988	Citizens Utilities Company-Mohave
82	Fort Mojave Business Park, Trac	Mohave	19 North	22 West	25	28	53-700474	Adequate		1/25/2008	Bermuda Water Company, Inc.
83	Golden Shores Tract 4051	Mohave	16 North	21 West	11	32	53-500720	Adequate		5/19/1989	Golden Shores Water Co.
84	Granmar Estates, Tract 4181	Mohave	18 North	22 West	3	49	43-401259	Adequate		5/11/2004	Bermuda Water Company, Inc.
85	Highlands at Desert Foothills	Mohave	20 North	21 West	5	211	53-500792	Adequate		4/18/1995	Citizens Utilities Company-Mohave
86	Holiday Hills	Mohave	20 North	21 West	29	658	53-500796	Adequate		11/14/1986	Citizens Utilities Company-Mohave
87	Holiday Shores	Mohave	20 North	22 West	18	458	53-500797	Adequate		6/11/1973	Oasis Utility Company
88	Holiday Shores #4	Mohave	20 North	22 West	18	458	53-500798	Adequate		11/23/1973	Oasis Utility Company
89	Holiday Shores #5	Mohave	20 North	22 West	18	120	53-500799	Adequate		9/2/1975	Oasis Utility Company
90	Holiday Shores #6	Mohave	20 North	22 West	18	405	53-500800	Adequate		11/13/1975	Oasis Utility Company
91	Joy Lane Plaza	Mohave	19 North	22 West	26	13	53-500829	Adequate		3/27/1991	Bermuda Water Company, Inc.
92	La Mesa Acres Tract 4038	Mohave	19 North	22 West	13	51	53-500857	Adequate		4/29/1983	Bermuda Water Company, Inc.
93	La Paloma Condominiums	Mohave	21 North	21 West	21	194	53-500858	Adequate		12/8/1992	North Mohave Valley Corp.
94	Lagoon Estates #6	Mohave	17 North	22 West	1	160	53-500869	Adequate		7/20/1976	Lagoon Estates Water Co.
95	Lagoon, The	Mohave	20 North	22 West	9	72	53-500870	Adequate		2/16/1982	Citizens Utilities Company-Mohave

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (Cont)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						
97	Lake Cimarron Estates, Unit II,	Mohave	18 North	22 West	23	35	53-401661	Adequate		3/11/2005	Willow Valley Water Co.
98	Lake Mohave Highlands	Mohave	21 North	21 West	29	93	53-500881	Adequate		8/15/1973	Lake Mohave Highlands Water Company
99	Lake Mohave Highlands #2	Mohave	21 North	21 West	29	10	53-500882	Adequate		12/4/1974	Lake Mohave Highlands Water Company
100	Lake Mohave Highlands #3	Mohave	21 North	21 West	29	124	NA	Adequate		2/28/1975	Lake Mohave Highlands Water Company
101	Lake Mohave Highlands #4	Mohave	21 North	21 West	29	7	53-500883	Adequate		3/1/1976	Lake Mohave Highlands Water Company
102	Lakeside Estates	Mohave	20 North	22 West	18	44	53-500890	Adequate		5/5/1981	Oasis Utility Company
103	Lakeview Village Tract 4097	Mohave	19 North	22 West	35	279	53-500892	Adequate		5/2/1990	Bermuda Water Company, Inc.
104	Las Estancias Tract 1199	Mohave	19 North	22 West	26	151	53-500894	Adequate		8/28/1973	Bermuda Water Company, Inc.
105	Las Palmas, Tract 4222 (fkaTrac	Mohave	19 North	22 West	23	14	53-401739	Adequate		12/3/2007	Arizona American Water Co.
106	Linda Vista	Mohave	19 North	22 West	23	42	53-400839	Adequate		11/19/2002	Arizona American Water Co.
107	Linda Vista Tract 4178	Mohave	19 North	22 West	23	42	53-400899	Adequate		2/19/2003	Arizona American Water Co.
108	Lone Star Commercial Park	Mohave	19 North	22 West	23	9	53-500914	Adequate		8/20/1990	Bermuda Water Company, Inc.
109	Los Altos, Tract 4184	Mohave	19 North	22 West	25	21	53-401370	Adequate		8/22/2005	Arizona American Water Co.
110	Los Lagos	Mohave	18 North	22 West	1	457	53-500919	Adequate		10/16/1990	Bermuda Water Company, Inc.
111	Los Pueblos @Desert FoothillsTr	Mohave	20 North	21 West	5	71	53-400235	Adequate		1/31/2000	Arizona American Water Co.
112	Mesa Vista, Tract 4169	Mohave	19 North	22 West	24	131	53-400618	Adequate		3/4/2002	Bermuda Water Company, Inc.
113	Miracle View Condominiums	Mohave	20 North	22 West	26	32	53-500986	Adequate		8/28/1985	Citizens Utilities Company-Mohave
114	Mohave Landing Tract 4213 A, Ph	Mohave	18 North	22 West	23	46	53-700571	Adequate		12/10/2008	Citizens Utilities Company-Mohave
115	Mohave Mesa Estates Tract 4013	Mohave	19 North	22 West	27	14	53-500999	Adequate		4/27/1982	Dry Lot Subdivision
116	Mohave Sun Valley Airport	Mohave	18 North	22 West	25	170	53-501000	Adequate		2/12/1985	Bermuda Water Company, Inc.
117	Mohave Sunrise Tract 1084B	Mohave	19 North	22 West	11	99	53-501001	Adequate		5/18/1989	Bermuda Water Company, Inc.
118	Mohave Sunrise Tract 4085	Mohave	19 North	22 West	11	NA	53-501002	Adequate		6/22/1989	Bermuda Water Company, Inc.
119	Mohave Valley Business Park	Mohave	19 North	22 West	23	31	53-501004	Adequate		5/2/1986	Bermuda Water Company, Inc.
120	Monte Vista Estates	Mohave	18 North	22 West	23	22	53-501007	Adequate		12/2/1981	Dry Lot Subdivision
121	Moon Ridge	Mohave	19 North	22 West	25	99	53-501011	Adequate		7/25/1991	Bermuda Water Company, Inc.
122	Moon River Resort, Inc.	Mohave	18 North	22 West	3	89	53-400579	Adequate		12/10/2001	Bermuda Water Company, Inc.
123	Moon Valley Tract 4120	Mohave	19 North	22 West	25	16	53-501012	Adequate		9/5/1991	Bermuda Water Company, Inc.
124	Mountain View Ranches	Mohave	18 North	21 West	5	34	53-501032	Inadequate	A1	4/15/1981	Dry Lot Subdivision
126	Mountainside Village Ranch	Mohave	18 North	21 West	6	315	53-402049	Adequate		4/8/2008	Bermuda Water Company, Inc.
127	Mystic Canyon, Tract 4197	Mohave	18 North	21 West	7	266	53-401832	Adequate		8/15/2005	Bermuda Water Company, Inc.
128	Mystic Canyon, Tract 4197 A	Mohave	18 North	21 West	7	119	53-500021	Adequate		10/20/2006	Bermuda Water Company, Inc.

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (Cont)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						
129	Palm Estates #2 Tract 4104	Mohave	19 North	22 West	14	56	53-501093	Adequate		8/2/1990	Bermuda Water Company, Inc.
130	Palm Estates #2, Tract 4104B	Mohave	19 North	22 West	14	25	53-400003	Adequate		8/24/1999	Bermuda Water Company, Inc.
131	Palm Villa Ranchos Tract 1226	Mohave	19 North	22 West	11	50	53-501094	Adequate		12/8/1982	Bermuda Water Company, Inc.
132	Palma Quartz	Mohave	20 North	22 West	17	33	53-501095	Adequate		6/19/1991	Citizens Utilities Company-Mohave
133	Palo Verde Place Tract 4006	Mohave	20 North	22 West	32	420	53-501096	Adequate		5/27/1980	Rio Utility Co.
134	Palo Verde Place Tract 4006-E	Mohave	20 North	22 West	32	68	53-501097	Adequate		7/2/1992	Rio Utility Co.
135	Palo Verde Plaza, Tract 5025	Mohave	20 North	22 West	35	15	53-300097	Adequate		3/20/1996	Arizona American
136	Palo Verde Shores	Mohave	20 North	22 West	29	28	53-400330	Adequate		7/18/2000	Citizens Utilities Company-Mohave
137	Park at Mesquite Creek, The	Mohave	18 North	22 West	12	226	53-501107	Inadequate	B	1/16/1992	Fort Mohave Triba
139	Patriot Estates Subdivision	Mohave	19 North	22 West	36	119	53-500031	Adequate		11/30/2006	Bermuda Water Company, Inc.
140	Pebble Lake #2	Mohave	19 North	22 West	34	30	53-501131	Adequate		8/25/1978	Pebble Lake Water Co.
141	Pebble Lake #3	Mohave	19 North	21 West	34	143	53-501132	Adequate		5/8/1980	Pebble Lake Water Co.
142	Pegasus Ranch	Mohave	21 North	21 West	29	100	53-501139	Adequate		10/22/1992	Citizens Utilities Company-Mohave
143	Pegasus Ranch Tract 4019-A	Mohave	21 North	21 West	29	26	53-501140	Adequate		8/22/1983	Citizens Utilities Company-Mohave
144	Pegasus Ranch Estates Tract 508	Mohave	21 North	21 West	29	20	53-400638	Adequate		1/15/2002	Citizens Utilities Company-Mohave
145	Pegasus Ranch Tract 5030	Mohave	21 North	21 West	29	14	53-300355	Adequate		10/29/1997	Arizona American Water Co.
146	Perry Acres #2 Tract 4026	Mohave	18 North	22 West	13	157	53-501142	Adequate		5/21/1982	Mohave Valley Water Co
147	Perry Acres Tract 4007	Mohave	18 North	22 West	13	96	53-501143	Adequate		10/7/1980	Mohave Valley Water Co
148	Pine River Estates Tract 4128	Mohave	19 North	22 West	25	17	53-501155	Adequate		9/5/1991	Bermuda Water Company, Inc.
149	Pueblo Grove	Mohave	18 North	22 West	35	14	53-501227	Adequate		9/18/1981	Dry Lot Subdivision
150	Punto de Vista #5	Mohave	21 North	21 West	27	233	53-501229	Adequate		6/25/1980	Thumb Butte Water Co.
151	Rancho Colorado	Mohave	20 North	21 West	13	1,886	53-501253	Adequate		7/28/1988	Citizens Utilities Company-Mohave
152	Rancho Colorado B	Mohave	20 North	22 West	13	15	53-501254	Adequate		7/28/1988	Citizens Utilities Company-Mohave
153	Rancho Grande Tract 4083	Mohave	19 North	22 West	14	NA	53-501259	Adequate		1/5/1990	Bermuda Water Company, Inc.
154	Rio Camino Tract 4123	Mohave	19 North	22 West	23	34	53-501300	Adequate		2/14/1991	Bermuda Water Company, Inc.
155	Rio Hacienda	Mohave	19 North	22 West	14	102	53-501301	Adequate		8/1/1975	Bermuda Water Company, Inc.
156	Rio Lado Villas Condominiums	Mohave	20 North	23 West	13	25	53-501302	Adequate		7/3/1986	Citizens Utilities Company-Mohave
157	Rio Las Palmas	Mohave	20 North	22 West	1	48	53-501303	Adequate		2/10/1982	Citizens Utilities Company-Mohave
158	Rio Lindo Condominiums	Mohave	20 North	23 West	13	32	53-501304	Adequate		4/25/1984	Citizens Utilities Company-Mohave
159	Rio Lomas #4	Mohave	19 North	22 West	11	104	53-501306	Adequate		1/28/1974	Bermuda Water Company, Inc.
160	Rio Vista Condominiums	Mohave	20 North	22 West	9	22	53-501322	Adequate		5/5/1981	Citizens Utilities Company-Mohave

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (Cont)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						
161	Rio Vista Estates	Mohave	18 North	22 West	27	36	53-501324	Adequate		4/12/1988	Willow Valley Water Co.
162	River Retreat	Mohave	20 North	23 West	13	127	53-501325	Adequate		12/11/1974	Fort Mohave Tribal Utilities
163	River Road City Tract 1022	Mohave	17 North	22 West	11	141	53-501326	Adequate		2/1/1991	Fort Mohave Tribal Utilities
164	River View Mall	Mohave	20 North	22 West	23	8	53-501327	Adequate		11/17/1988	Citizens Utilities Company-Mohave
165	River View Ranches	Mohave	19 North	22 West	13	197	53-501328	Adequate		1/23/1980	Dry Lot Subdivision
166	Rivershore Villas Condominiums	Mohave	20 North	22 West	9	165	53-501329	Adequate		3/26/1981	Citizens Utilities Company-Mohave
167	Riverview Bluffs #2A	Mohave	20 North	22 West	13	54	53-501331	Adequate		8/28/1989	Citizens Utilities Company-Mohave
168	Riverview Bluffs Condominiums	Mohave	20 North	22 West	13	63	53-501332	Adequate		2/6/1985	Citizens Utilities Company-Mohave
169	Riviera Commercial Park	Mohave	20 North	22 West	19	12	53-501333	Inadequate	C	2/28/1984	Citizens Utilities Company-Mohave
170	Riviere D' Azur Villas	Mohave	20 North	22 West	16	243	53-501334	Adequate		5/1/1990	Citizens Utilities Company-Mohave
171	Roadhaven Marina Condominiums	Mohave	20 North	22 West	16	58	53-501335	Adequate		10/19/1983	Oasis Utility Company
172	Roadhaven Marina Condos #2	Mohave	20 North	22 West	16	51	53-501336	Adequate		2/3/1984	Oasis Utility Company
173	Roadhaven Marina Condos #3	Mohave	20 North	22 West	16	60	53-501337	Adequate		8/21/1984	Citizens Utilities Company-Mohave
174	Roadhaven Resort of Bullhead Ct	Mohave	20 North	22 West	24	697	53-501338	Adequate		2/3/1984	Citizens Utilities Company-Mohave
175	Rodeo Park Tract 4145-A	Mohave	19 North	22 West	23	24	53-400296	Adequate		3/14/2001	Bermuda Water Company, Inc.
176	Rodeo Park Tract 4145-B	Mohave	19 North	22 West	23	31	53-400755	Adequate		7/30/2002	Bermuda Water Company, Inc.
177	Rodeo Park Tract 4145-C	Mohave	19 North	22 West	23	60	53-401117	Adequate		11/3/2003	Bermuda Water Company, Inc.
178	Sage Hill, Tract 4179-A	Mohave	19 North	22 West	25	46	53-401219	Adequate		2/23/2004	Bermuda Water Company, Inc.
179	Sage Hill, Tract 4179-B, Phase	Mohave	19 North	22 West	25	53	53-401506	Adequate		11/24/2004	Bermuda Water Company, Inc.
180	Santa Evinita, Tract 4167-A	Mohave	19 North	22 West	23	34	53-400515	Adequate		7/17/2001	Bermuda Water Company, Inc.
181	Santa Evinita, Tract 4167-B	Mohave	19 North	22 West	23	40	53-400860	Adequate		3/17/2003	Bermuda Water Company, Inc.
182	Sellan Estates, Tract 5024	Mohave	21 North	21 West	30	6	53-300051	Adequate		10/10/1995	North Mohave Valley Corp.
183	Shores, The	Mohave	20 North	23 West	13	17	53-501390	Adequate		6/28/1977	Citizens Utilities Company-Mohave
184	Silver Ridge Townhouse Condos	Mohave	20 North	21 West	19	210	53-501410	Adequate		3/6/1991	Citizens Utilities Company-Mohave
185	Silver Sands Estates	Mohave	19 North	22 West	26	159	53-501411	Adequate		6/19/1990	Bermuda Water Company, Inc.
186	South Valley Park Tract 4068	Mohave	17 North	22 West	15	30	53-501442	Adequate		1/7/1988	Bermuda Water Company, Inc.
188	Stoneridge	Mohave	19 North	22 West	11	14	53-501459	Adequate		9/18/1990	Bermuda Water Company, Inc.
189	Sun Desert Estates	Mohave	19 North	22 West	25	49	53-501479	Adequate		9/5/1991	Bermuda Water Company, Inc.
190	Sun Ridge Tract 4042F	Mohave	21 North	21 West	30	59	53-501481	Adequate		2/8/1990	North Mohave Valley Corp.
191	Sun Ridge 4042-J	Mohave	21 North	21 West	21	36	53-400633	Adequate		1/18/2002	North Mohave Valley Corp.

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (Cont)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						
192	Sun Ridge Estates Tract 4024A	Mohave	21 North	21 West	21	223	53-501482	Adequate		11/16/1983	North Mohave Valley Corp.
193	Sun Ridge Estates Tract 4024B	Mohave	21 North	21 West	29	NA	53-501483	Adequate		8/1/1984	North Mohave Valley Corp.
194	Sun Ridge Estates Tract 4024C	Mohave	21 North	21 West	21	376	53-501484	Adequate		10/25/1985	North Mohave Valley Corp.
195	Sun Ridge Estates Tract 4042D	Mohave	21 North	21 West	30	175	53-501485	Adequate		4/11/1988	North Mohave Valley Corp.
196	Sun Ridge Estates Tract 4042E	Mohave	21 North	21 West	29	215	53-501486	Adequate		1/19/1989	North Mohave Valley Corp.
197	Sun Ridge Estates Tract 4042F	Mohave	21 North	21 West	29	59	53-501487	Adequate		8/2/1989	North Mohave Valley Corp.
198	Sun Valley	Mohave	19 North	22 West	29	302	53-501488	Adequate		7/18/1983	Bermuda Water Company, Inc.
199	Sun Valley Tract 4063B	Mohave	19 North	22 West	36	98	53-501490	Adequate		10/30/1997	Bermuda Water Company, Inc.
200	Sun Valley Tract 4017	Mohave	19 North	22 West	36	211	53-501491	Adequate		1/8/1982	Bermuda Water Company, Inc.
201	Sun Valley Tract 4018A,B	Mohave	19 North	22 West	36	302	53-501492	Adequate		7/14/1983	Bermuda Water Company, Inc.
202	Sun Valley Tract 4064A	Mohave	18 North	22 West	1	210	53-501493	Adequate		12/11/1991	Bermuda Water Company, Inc.
203	Sun Valley Unit II, Tract 4185	Mohave	18 North	22 West	1	53	53-401785	Adequate		7/18/2005	Bermuda Water Company, Inc.
204	Sun Valley Unit II, Tract 4185	Mohave	18 North	22 West	1	18	53-401784	Adequate		10/6/2005	Bermuda Water Company, Inc.
205	Sun Valley Unit II, Tract 4185	Mohave	18 North	22 West	1	50	53-401954	Adequate		1/3/2006	Bermuda Water Company, Inc.
206	Sunrise Estates	Mohave	19 North	22 West	35	52	53-501507	Adequate		8/19/1986	Bermuda Water Company, Inc.
207	Sunrise Estates #2	Mohave	19 North	22 West	35	49	53-501508	Adequate		11/14/1988	Bermuda Water Company, Inc.
208	Sunrise Vistas Tract 4108-A	Mohave	19 North	21 West	18	146	53-501515	Adequate		9/16/1993	Sunrise Vistas Utilities Company
209	Sunrise Vistas Tract 4108-B	Mohave	19 North	21 West	18	86	NA	Adequate		8/23/1994	Sunrise Vistas Utilities Company
210	Sunrise Vistas Tract 4108-C	Mohave	19 North	21 West	18	92	NA	Adequate		11/8/1995	Sunrise Vistas Utilities Company
211	Sunrise Vistas Tract 4108-D	Mohave	19 North	21 West	18	40	53-300296	Adequate		6/3/1997	Sunrise Vistas Utilities Company
212	Sunrise Vistas Tract 4108-E	Cochise	19 North	21 West	18	57	53-400170	Adequate		11/22/1999	Sunrise Vistas Utilities Company
213	Sunrise Vistas Tract 4108-F	Cochise	19 North	21 West	18	28	53-400071	Adequate		5/21/1999	Sunrise Vistas Utilities Company
214	Sunrise Vistas Tract 4108-G	Cochise	19 North	21 West	18	27	53-400082	Adequate		8/30/1999	Sunrise Vistas Utilities Company
215	Sunrise Vistas Tract 4108-H	Mohave	19 North	21 West	18	6	53-400553	Adequate		10/10/2001	Sunrise Vistas Utilities Company
216	Sunrise Vistas Tract 4108-I	Mohave	19 North	21 West	18	31	53-400554	Adequate		10/10/2001	Sunrise Vistas Utilities Company
217	Sunrise Vistas Tract 4108-J	Mohave	19 North	21 West	18	22	53-400612	Adequate		11/26/2001	Sunrise Vistas Utilities Company

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (Cont)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						
218	Sunrise Vistas - Tract 4108-K	Mohave	19 North	21 West	18	22	53-400801	Adequate		12/3/2002	Sunrise Vistas Utilities Company
219	Sunrise Vistas, Tract 4108-L	Mohave	19 North	21 West	18	23	53-400877	Adequate		5/12/2003	Sunrise Vistas Utilities Company
220	Sunrise Vistas, Tract 4108-M	Mohave	19 North	21 West	18	30	53-400999	Adequate		9/25/2003	Sunrise Vistas Utilities Company
221	Sunrise Vistas, Tract 4108-N	Mohave	19 North	21 West	18	30	53-400998	Adequate		9/25/2003	Sunrise Vistas Utilities Company
222	Sunrise Vista, Tract 4108-O	Mohave	19 North	21 West	18	50	53-401347	Adequate		12/15/2004	Sunrise Vistas Utilities Company
223	Sunrise Vistas, Unit II Tract 4	Mohave	19 North	21 West	17	10	53-500046	Adequate		4/24/2007	Sunrise Vistas Utilities Company
224	Sunset Palms, Tr. 4183-A	Mohave	19 North	22 West	26	33	53-401760	Adequate		6/6/2005	Bermuda Water Company, Inc.
225	Sunset Ranchos II, Tract 4156	Mohave	19 North	22 West	13	22	53-300221	Adequate		10/23/1996	Bermuda Water Company, Inc.
226	Sunset Ranchos Unit 2	Mohave	19 North	22 West	13	18	53-400445	Adequate		1/30/2001	Dry Lot Subdivision
227	Sunset Ranchos, Tract 4046-B	Mohave	19 North	22 West	13	NA	53-501520	Adequate		7/28/1987	Dry Lot Subdivision
228	Sunset Ranchos, Tract 4046-C	Mohave	19 North	22 West	13	284	53-501521	Adequate		7/7/1992	Bermuda Water Company, Inc.
229	Sunset Ranchos, Tract 4046-A	Mohave	19 North	22 West	13	NA	53-501522	Adequate		2/20/1986	Dry Lot Subdivision
230	Tangerine Terrace Tract 4142	Mohave	17 North	22 West	23	22	53-501537	Adequate		7/13/1992	Fort Mohave Tribal Utilities
231	Terraces at Desert Foothills Es	Mohave	20 North	21 West	5	123	53-300214	Adequate		11/18/1996	Citizens Utilities Company-Mohave
232	The Borgata on Mountain View, T	Mohave	19 North	22 West	14	107	53-402045	Adequate		6/22/2006	Bermuda Water Company, Inc.
233	The Coves on The Colorado River	Mohave	17 North	22 West	23	99	53-401766	Adequate		3/13/2006	Fort Mohave Tribal Utilities
234	The Estates at Cimarron Lake Tr	Mohave	18 North	22 West	23	35	53-401688	Adequate		11/3/2005	Willow Valley Water Co.
235	The Villas at Desert Horizons	Mohave	19 North	22 West	23	33	53-401084	Adequate		1/12/2004	Bermuda Water Company, Inc.
236	Tierra Grande Tract 4023 A	Mohave	20 North	21 West	19	130	53-501549	Adequate		7/18/1983	Citizens Utilities Company-Mohave
237	Tierra Grande Tract 4023B	Mohave	20 North	21 West	24	202	53-501550	Adequate		8/3/1984	Citizens Utilities Company-Mohave
238	Tierra Grande Tract 4023C	Mohave	20 North	21 West	19	78	53-501551	Adequate		11/16/1984	Citizens Utilities Company-Mohave
239	Tierra Grande Tract 4052	Mohave	20 North	21 West	19	22	53-501552	Adequate		8/28/1985	Citizens Utilities Company-Mohave
240	Tierra Verde Tract 1073-B	Mohave	19 North	22 West	14	360	53-501557	Adequate		4/8/1974	Bermuda Water Company, Inc.
241	Tierra del Rio Tract 4048	Mohave	19 North	22 West	25	348	53-501547	Adequate		8/2/1984	Bermuda Water Company, Inc.
242	Tierre Plaza	Mohave	19 North	22 West	14	35	53-501559	Adequate		6/17/1986	Bermuda Water Company, Inc.
243	Tierre del Sol	Mohave	19 North	22 West	23	32	53-501558	Adequate		5/9/1983	Dry Lot Subdivision
244	Topock Village Estates, Tract 4	Mohave	16 North	21 West	23	205	53-402046	Adequate		9/28/2006	Golden Shores Wat
245	Toprock Lake Rancheros	Mohave	17 North	21 West	17	8	53-501566	Adequate		5/1/1991	Dry Lot Subdivision

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (Cont)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						
246	Twin Palms Estates, Tract 4189	Mohave	19 North	22 West	36	144	43-401423	Adequate		8/5/2005	Bermuda Water Company, Inc.
247	Twin Palms Estates, Tract 4189A	Mohave	19 North	22 West	36	97	53-402255	Adequate		8/31/2006	Bermuda Water Company, Inc.
249	Valley Springs Estates Subdivision	Mohave	19 North	22 West	36	132	53-700215	Adequate		1/31/2007	Bermuda Water Company, Inc.
250	Valley View at Sunrise Hills, T	Mohave	18 North	21 West	6	124	53-700269	Adequate		9/15/2008	Bermuda Water Company, Inc.
251	Villa del Rio Tract 4016 A&B	Mohave	20 North	22 West	29	13	53-501623	Adequate		1/22/1983	Rio Verde Utilities
252	Villa del Sol Condominiums	Mohave	20 North	23 West	24	24	53-501624	Adequate		2/18/1982	Citizens Utilities Company-Mohave
253	Village Estates Tr. 4198	Mohave	18 North	22 West	3	347	53-700260	Adequate		3/6/2007	Bermuda Water Company, Inc.
254	Villas At Desert Horizons, Trac	Mohave	19 North	22 West	23	48	53-400496	Adequate		7/17/2001	Bermuda Water Company, Inc.
255	Villas at Desert Horizons	Mohave	19 North	22 West	23	51	53-400180	Adequate		11/5/1999	Bermuda Water Company, Inc.
256	Vineyard at Sun Ridge, Tract 50	Mohave	21 North	21 West	30	67	53-300213	Adequate		12/18/1996	North Mohave Valley Corp.
257	Vineyard at Sun Ridge Unit 3	Mohave	21 North	21 West	30	8	53-401351	Adequate		12/20/2004	North Mohave Valley Corp.
258	Vista Grande Condominiums	Mohave	21 North	21 West	21	32	53-501647	Adequate		2/27/1990	North Mohave Valley Corp.
259	Vista del Rio # 3, Tract 5066	Mohave	19 North	22 West	11	12	53-400052	Adequate		5/24/1999	Bermuda Water Company, Inc.
260	Vista del Rio # 4, Tract 5067	Mohave	19 North	22 West	11	21	53-400053	Adequate		5/21/1999	Bermuda Water Company, Inc.
261	Vista del Rio #2, Tract 5061	Mohave	19 North	22 West	11	18	53-300411	Adequate		6/19/1998	Bermuda Water Company, Inc.
262	Vista del Rio Tract 5043	Mohave	19 North	22 West	11	35	53-300139	Adequate		7/12/1996	Bermuda Water Company, Inc.
263	Vista del Rio Condominiums	Mohave	20 North	22 West	17	18	53-501644	Adequate		9/8/1981	Oasis Utility Company
264	Willow Valley Estates	Mohave	18 North	22 West	21	48	NA	Adequate		9/18/1994	Willow Valley Water Co.
265	Willow Valley Estates 20, Tract	Mohave	18 North	22 West	21	27	53-300085	Adequate		12/13/1996	Willow Valley Water Co.
266	Willow Valley Estates Tract 413	Mohave	18 North	22 West	21	29	53-400791	Adequate		9/25/2003	Willow Valley Water Co.
267	Willow Valley Mobile Homes Est	Mohave	18 North	22 West	27	277	53-501689	Adequate		12/2/1981	Willow Valley Water Co.
268	Willows at Cimarron Lake #2 Tra	Mohave	18 North	22 West	23	79	53-400142	Adequate		8/30/1999	Willow Valley Water Co.
269	Willows at Cimarron Lake, The	Mohave	18 North	22 West	23	94	53-501690	Adequate		12/7/1990	Willow Valley Water Co.
270	Winterhaven Estates	Mohave	20 North	22 West	18	148	53-501699	Adequate		2/23/1988	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				
96	Lake Cimarron Estates Unit II,	Mohave	18 North	22 West	23	35	43-401439	3/22/2005	Willow Valley Water Company
125	Mountainside Village Ranch	Mohave	18 North	21 West	6	320	43-401581	12/22/2004	Bermuda Water Company, Inc.

Table 4.6-10 Adequacy Determinations in the Lake Mohave Basin (Cont)¹

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				
138	Patriot Estates Subdivision	Mohave	19 North	22 West	36	119	43-401619	2/4/2005	Bermuda Water Company, Inc.
187	Stetson Ranch	Mohave	19 North	22 West	25	57	43-401875	5/1/2006	Bermuda Water Company, Inc.
248	Valley Springs Estates Subdivision	Mohave	19 North	22 West	36	132	43-401861	2/1/2006	Bermuda Water Company, Inc.

C. Designated Adequate Water Supply

Map Key	Water Provider Name	County	Designation No.	Projected or Annual Estimated Demand (af/yr)	Date Application Received	Date Application Issued	Year of Projected or Annual Demand
a	City of Bullhead City	Mohave	41-400649	23,691	2/25/2005	2/11/2008	2018

Source: ADWR 2008a

Notes:

¹Each 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. Between 1995-2006 all applications for adequacy were given a file number with a 22 prefix. In 2006 a 53 prefix was assigned to all water adequacy reports and applications regardless of their issue date.

³ A. Physical/Continuous

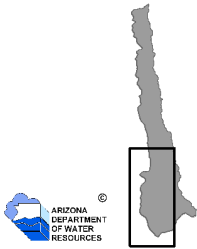
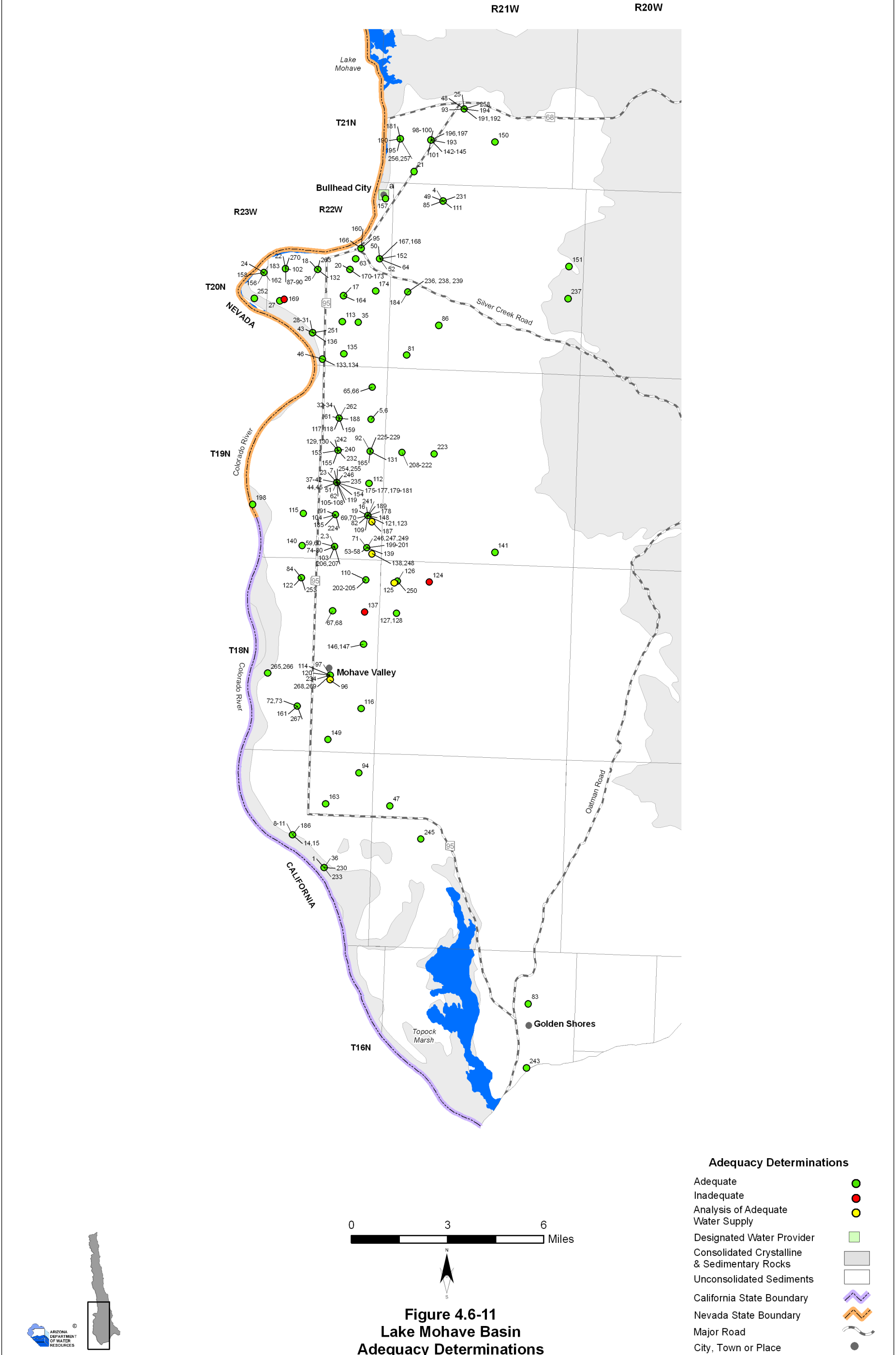
- 1) Insufficient Data (applicant chose not to submit necessary information, and/or available hydrologic data insufficient to make determination)
- 2) Insufficient Supply (existing water supply unreliable or physically unavailable; for groundwater, depth-to-water exceeds criteria)
- 3) Insufficient Infrastructure (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= not currently available to ADWR



Lake Mohave Basin

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Section 4.7

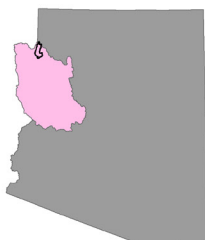
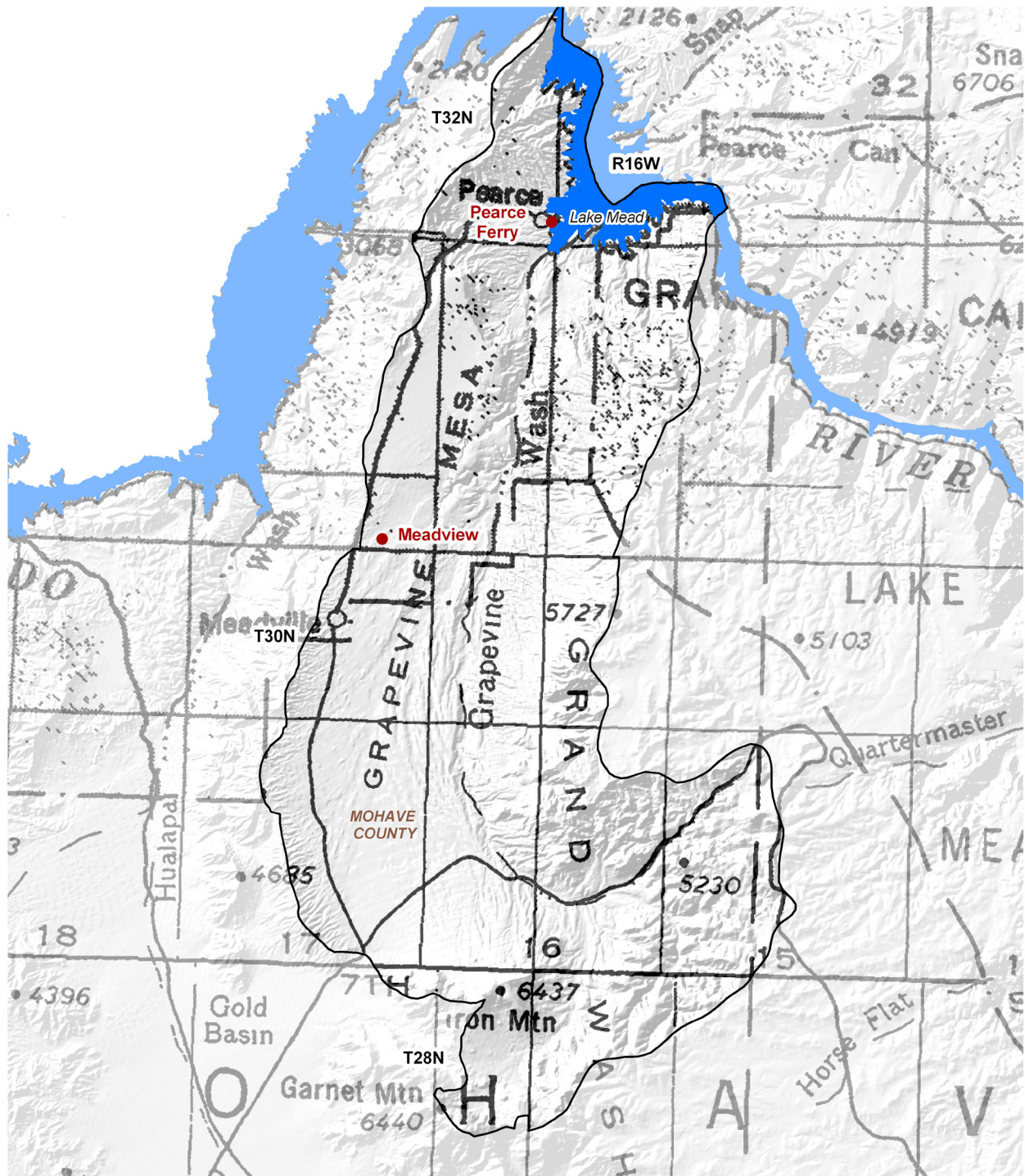
Meadview Basin



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 includes Mohave desertscrub and Great Basin conifer woodland. (see Figure 4.0-9)

- Principal geographic features shown on Figure 4.7-1 are:
 - Grapevine Wash running south to north in the center of the basin
 - 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

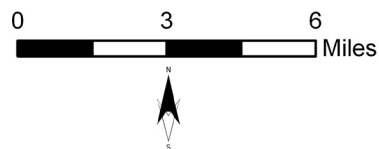


Figure 4.7-1
Meadview Basin
Geographic Features

City, Town or Place ●

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, Appendix A. More detailed information on protected areas is found in Section 4.0.4. Land ownership categories are discussed below in the order from largest to smallest percentage 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 BLM.
- All BLM lands are in the southern half of the basin.
- Primary land use is grazing.

National Park Service (NPS)

- 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.
- Private land in the southern portion of the basin 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, in T29N, R15W.
- 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.
- Primary land use is grazing.

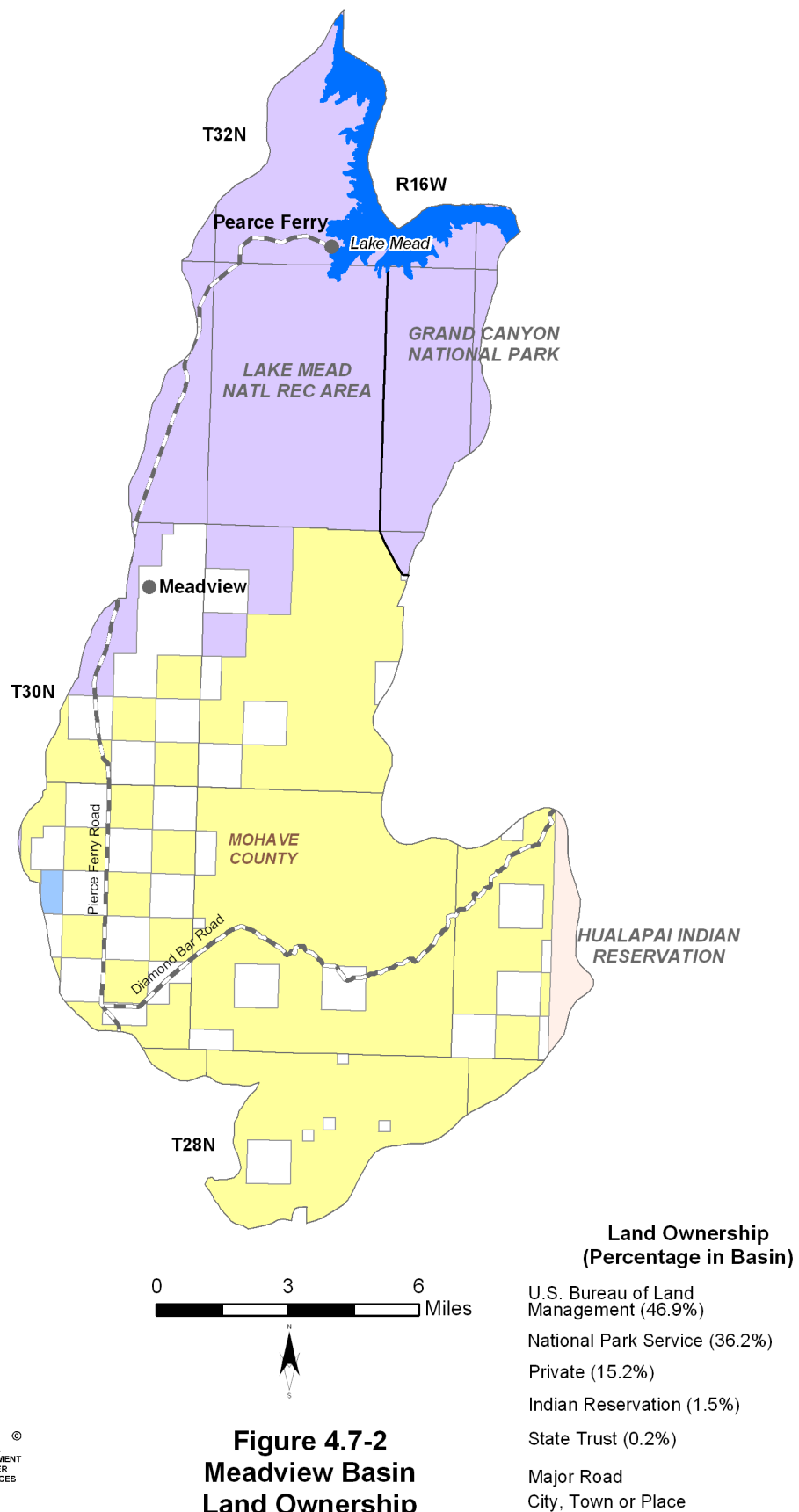


Figure 4.7-2
Meadview Basin
Land Ownership

Source: ALRIS, 2004



4.7.3 Climate of the Meadview Basin

Climate data from a NOAA/NWS Co-op Network station are compiled 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. More detailed information on climate in the planning area is found in Section 4.0.3. A description of the climate data sources and methods is found in Volume 1, Appendix A.

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 17 SSW. The average monthly maximum temperature occurs in July and is 83.1°F and average minimum temperature occurs in January and is 40.0°F.
- Highest average seasonal rainfall occurs in the winter (January - March). For the period of record used, the highest annual rainfall is 10.87 inches.

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.
- 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, 2005

Notes:

¹Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

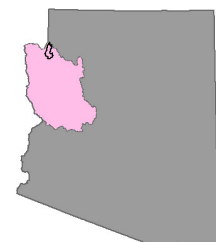
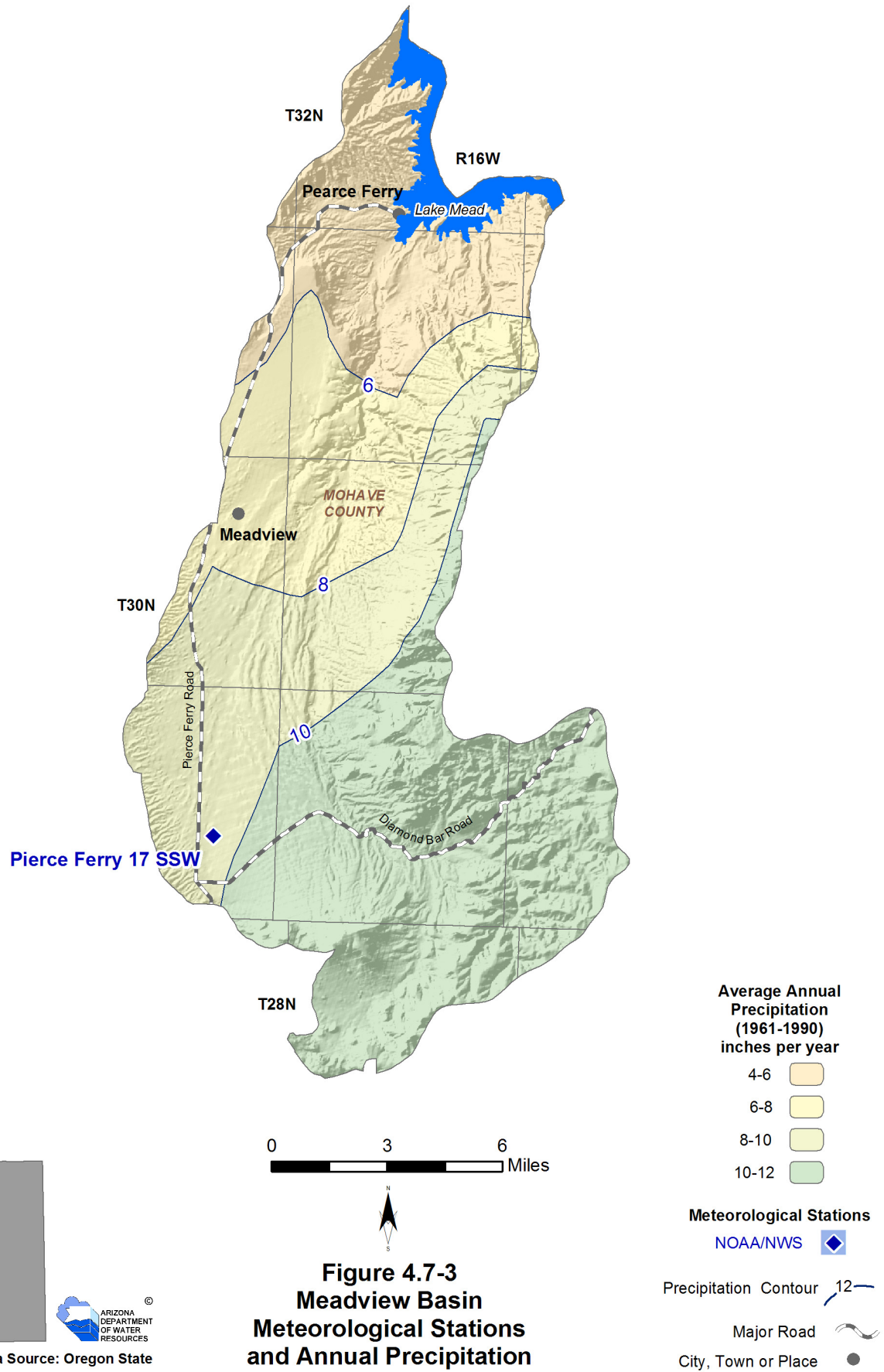
Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

C. AZMET:

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

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record	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								



Precipitation Data Source: Oregon State University, 1998



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 4.7-2. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.7-3. The location of flood ALERT gages is shown on Figure 4.7-4. There are no runoff data available for this basin. Descriptions of stream, reservoir and stockpond data sources and methods are found in Volume 1, Appendix A.

Flood ALERT Equipment

- Refer to Table 4.7-2.
- As of October 2005 there were two stations in the basin.

Reservoirs and Stockponds

- Refer to Table 4.7-3.
- 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.
- There are no small reservoirs in the basin.
- There are 14 registered stockponds in the basin.

Table 4.7-2 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

Source: ADWR 2005b

Notes:

FCD = Flood Control District
NA = Not available

Table 4.7-3 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,R	Federal

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

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					

Source: Compilation of databases from ADWR & others

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)

Total number: 0

Total surface area: 0 acres

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

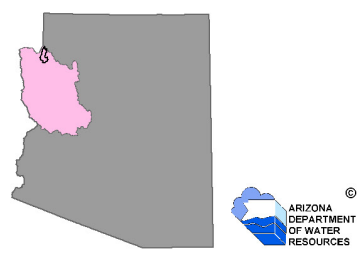
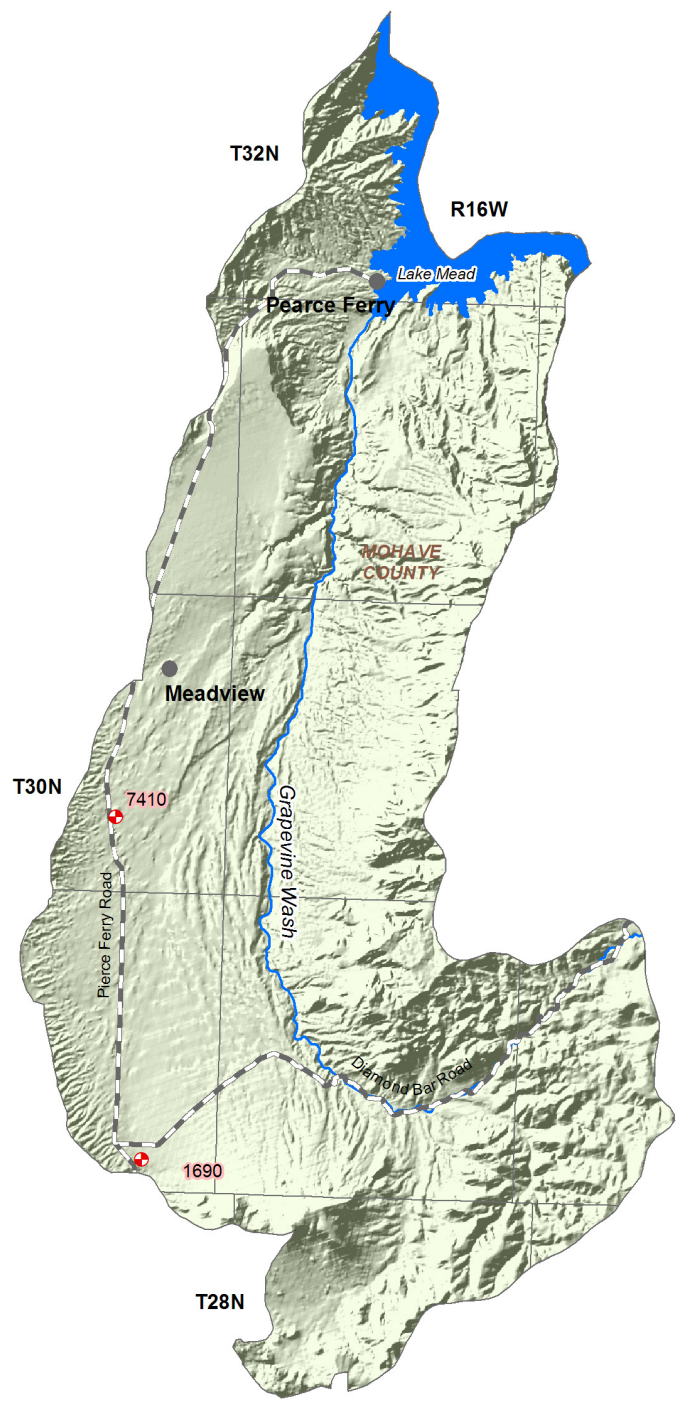
Total number: 14 (from water right filings)

Notes:

¹C=flood control; H=hydroelectric; I=irrigation; RR=river regulation; S=water supply

²Dam is located in Lake Mohave Basin and lake storage is located in Lake Mohave, Detrital Valley, Hualapai Valley and Meadview Basins.

³Includes 2,378,000 acre-feet of dead storage.



Stream Data Source: ALRIS, 2005b

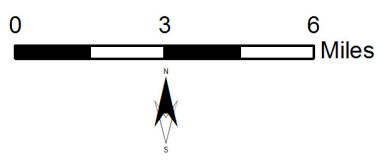


Figure 4.7-4
Meadview Basin
Surface Water Conditions

- Stream Channel (width of line reflects stream order) 
- Stream Gages**
Flood ALERT Equip. and Station ID 
- Major Road 
- City, Town or Place 

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 4.7-4. The locations of major springs as well as perennial and intermittent streams are shown on Figure 4.7-5. Descriptions of data sources and methods for intermittent and perennial reaches and springs are found in Volume 1, Appendix A.

- 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. The largest discharge rate is 108 gpm at Iron spring.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 4.7-4B. There are two minor springs identified in this basin.
- Listed discharge rates may not be indicative of current conditions. All of the measurements were taken prior to 1995.
- The total number of springs identified by the USGS varies from 8 to 10, depending on the database reference.

Table 4.7-4 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

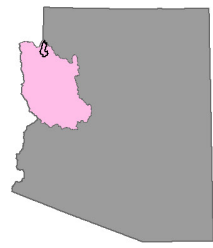
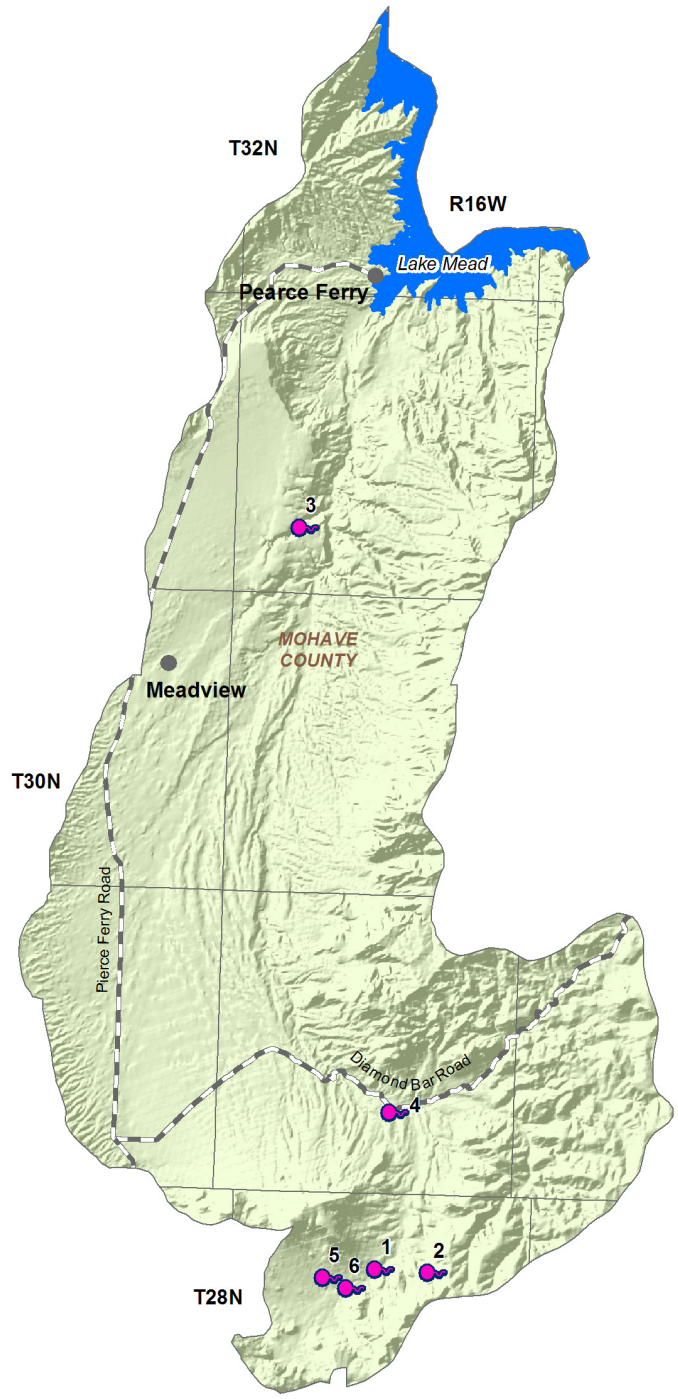
Source: Compilation of databases from ADWR & others

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

Notes:

¹Most recent measurement identified by ADWR

²Spring is not displayed on current USGS topo maps



Stream Data Source: AGFD, 1993 & 1997

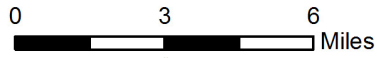


Figure 4.7-5
Meadview Basin
Perennial/Intermittent Streams
and Major (>10 gpm Springs)

- Springs 
- Perennial Streams 
- Major Road 
- City, Town or Place 

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 4.7-5. 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 as well as well data sources and methods, including water-level changes and well yields are found in Volume 1, Appendix A.

Major Aquifers

- Refer to Table 4.7-5 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 4.7-5 and Figure 4.7-8.
- As shown on Figure 4.7-8 well yields in this basin are less than 100 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 4.7-5.
- The estimate of natural recharge for this basin is 4,000 acre-feet per year (AFA).
- 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 4.7-5.
- Storage estimates for this basin range from 62,440 acre-feet to a depth of 700 feet to 1.0 million acre-feet to a depth of 1,200 feet.

Water Level

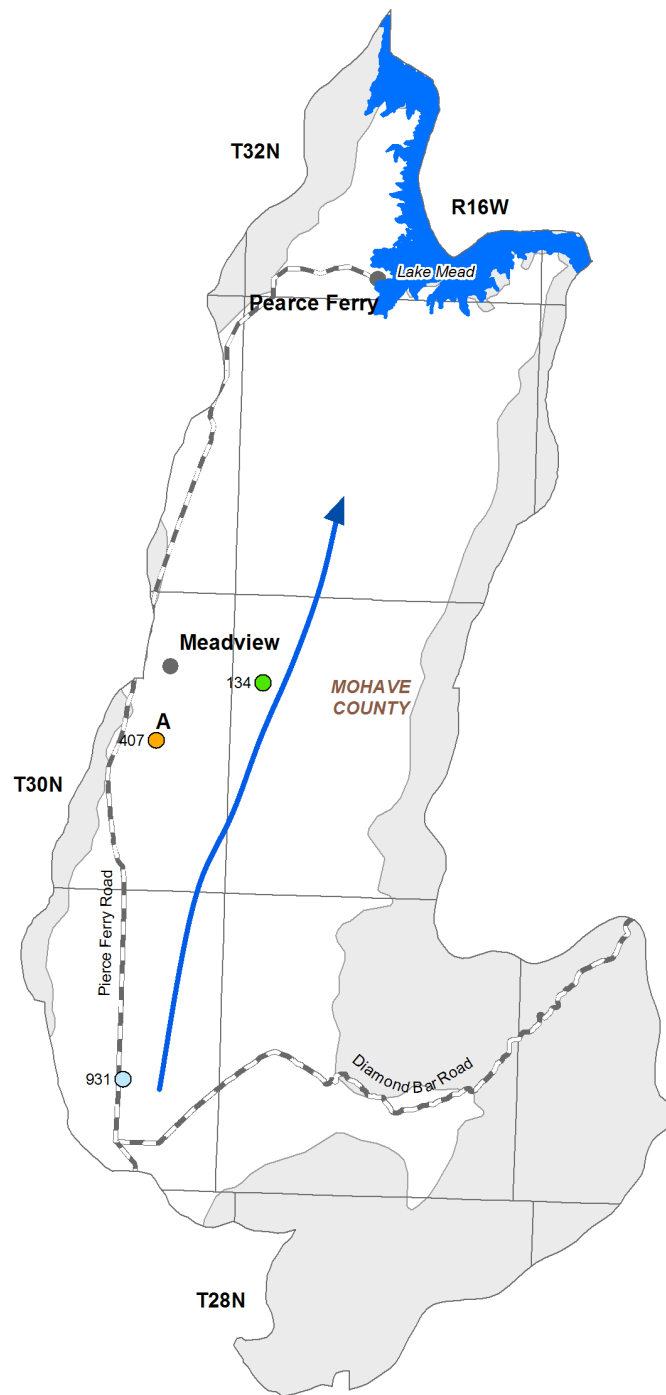
- Refer to Figure 4.7-6. Water level is shown for wells measured in 2003-2004.
- The Department annually measures one index well in this basin. A hydrograph for this well is shown in Figure 4.7-7.
- The Department measures water levels four times daily at one automated ground water monitoring site in the west-central portion of the basin.
- There are only three water depths recorded in this basin in 2003-2004. In these wells, the deepest is 931 feet in the southern portion of the basin along Pierce Ferry Road and the shallowest is 134 northeast of Meadview.

Table 4.7-5 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 (GWSI) and/or USGS
	35 (1 well reported)	Reported on registration forms for large (>10-inch) diameter wells (Wells55)
	Range 30-100	ADWR (1990)
	Range 0-500	Anning and Duet (1994)
Estimated Natural Recharge, in acre-feet/year:	4,000	Freethy and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	62,440 (to 700 ft)	ADWR (1994b)
	1,000,000 ¹ (to 1,200 ft)	Freethy 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:	2006 (16 wells measured)	

Notes:

¹ Predevelopment Estimate



Water-level change in feet between 1990-1991 and 2003-2004

H = number is depth to water in feet during 2003-2004; letter is hydrograph

Between -30 and -15

Between -1 and +1

Between +1 and +15

Generalized Flow Direction

Consolidated Crystalline & Sedimentary Rocks

Unconsolidated Sediments

Major Road

City, Town or Place

0 3 6 Miles



Figure 4.7-6
Meadview Basin
Groundwater Conditions

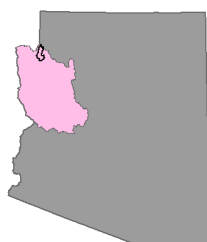
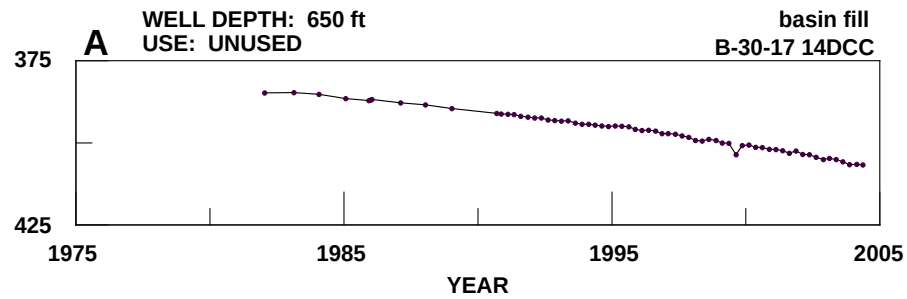
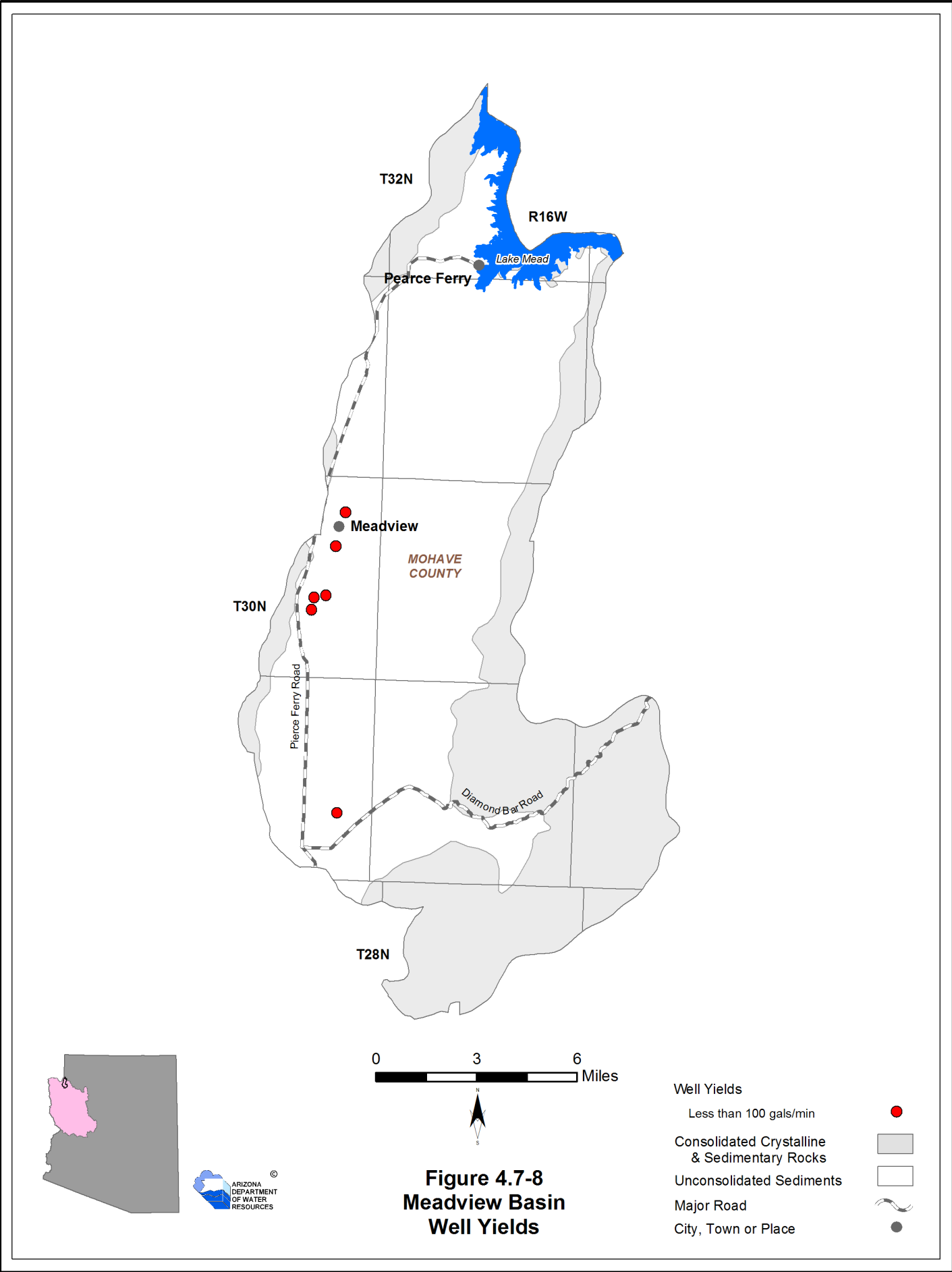


Figure 4.7-7
Meadview Basin
Hydrographs Showing Depth to Water in Selected Wells

Depth To Water In Feet Below Land Surface





4.7.7 Water Quality of the Meadview Basin

Sites with parameter concentrations that have equaled or exceeded drinking water standard(s) (DWS), including location and parameter(s) are shown in Table 4.7-6A. There are no impaired lakes or streams in this basin. Figure 4.7-9 shows the location of exceedences keyed to Table 4.7-6A. Not all parameters were measured at all sites; selective sampling for particular constituents is common. A description of water quality data sources and methods is found in Volume 1, Appendix A.

Well, Mine or Spring sites that have equaled or exceeded drinking water standards (DWS)

- Refer to Table 4.7-6A.
- Eight measured springs have parameter concentrations that have equaled or exceeded drinking water standards.
- The parameter most frequently equaled or exceeded in the sites measured was radionuclides. Other parameters equaled or exceeded included arsenic, nitrates and fluoride.

Table 4.7-6 Water Quality Exceedences in the Meadview Basin¹

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded 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

Source: Compilation of databases from ADWR & others

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

Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium

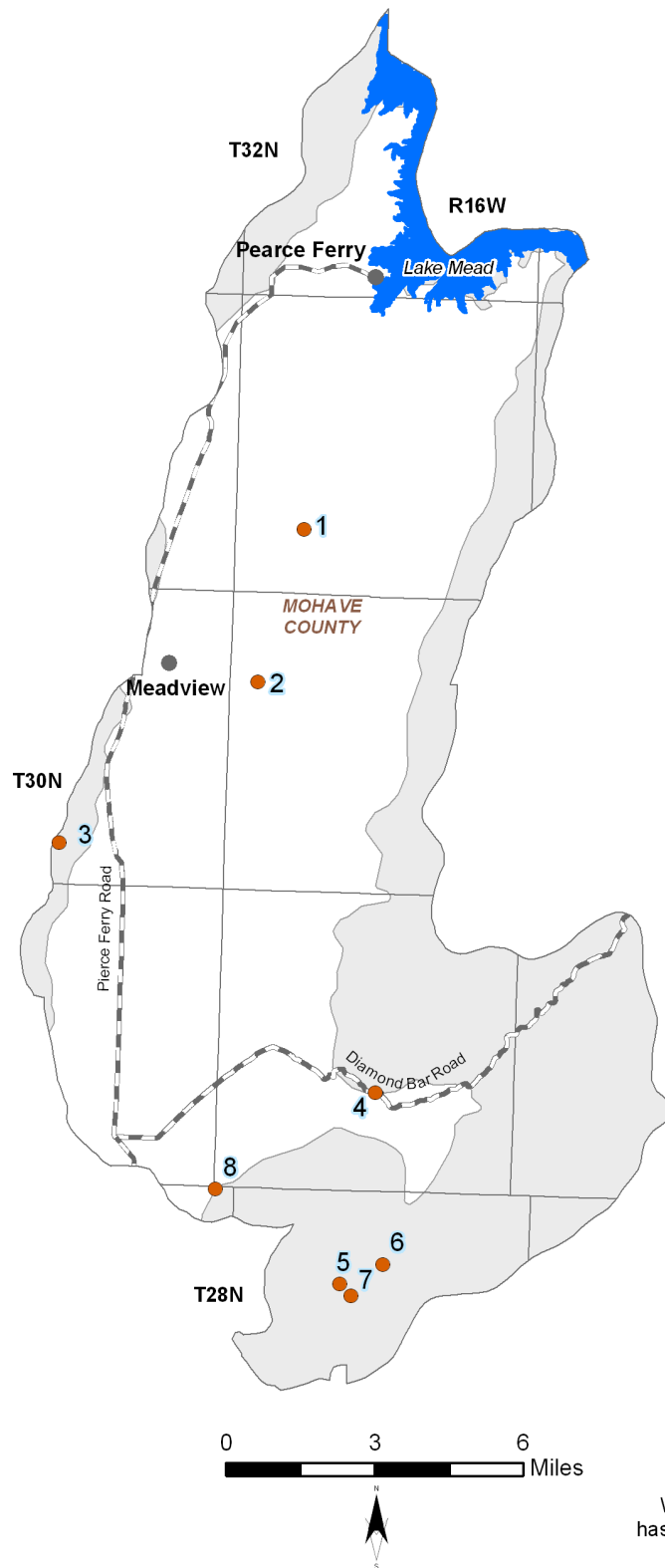


Figure 4.7-9
Meadview Basin
Water Quality Conditions

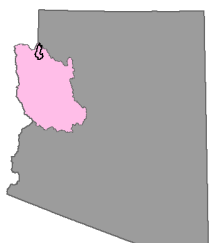
Well, Spring or Mine Site that
has Equaled or Exceeded DWS

Consolidated Crystalline
& Sedimentary Rocks

Unconsolidated Sediments

Major Road

City, Town or Place



4.7.8 Cultural Water Demand 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 4.7-7. 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, Appendix A. More detailed information on cultural water demand is found in Section 4.0.7.

Cultural Water Demand

- Refer to Table 4.7-7 and Figure 4.7-10.
- Population in this basin is minimal but has increased since 1980, from 104 in 1980 to 823 in 2000.
- There are no reported surface water diversions in this basin. Groundwater use in this basin is minimal, with current use similar to historical use. An average of less than 300 AFA during 2001-2005.
- The only demand center identified by USGS Gap in the basin is low intensity municipal and industrial located east of Pierce Ferry Road, however low intensity M&I is also found north of this center along Pierce Ferry Road, including at Meadview, to the Lake Mead NRA boundary.
- As of 2005 there were 21 registered wells with a pumping capacity of less than or equal to 35 gpm and 15 wells with a pumping capacity of more than 35 gpm.

Table 4.7-7 Cultural Water Demand in the Meadview Basin¹

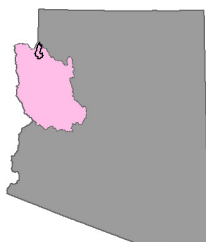
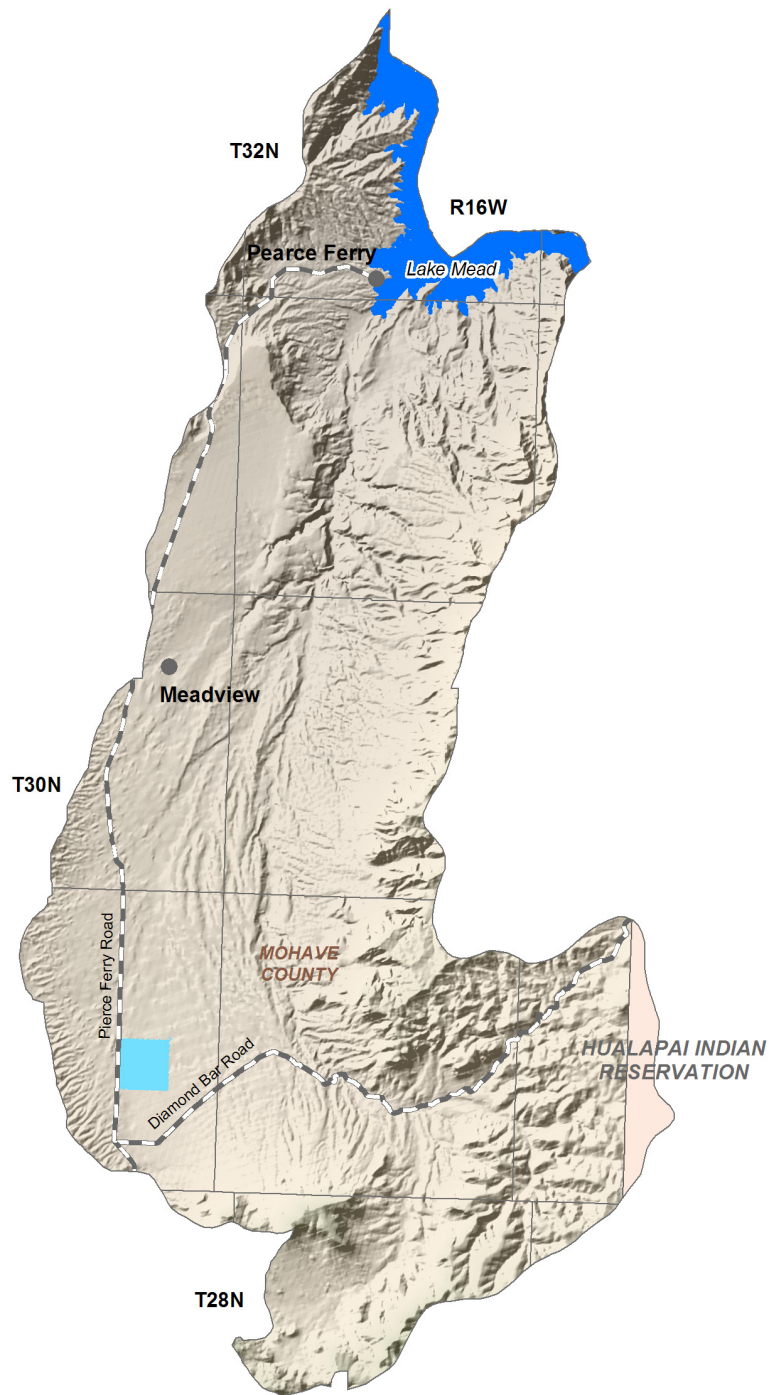
Year	Estimated and Projected Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet)							Data Source
				Well Pumpage			Surface-Water Diversions				
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial	Agricultural	Municipal	Industrial	Agricultural		
1971		4 ²	13 ²	<300			NR			ADWR (1994a)	
1972											
1973											
1974				<300			NR				
1975											
1976											
1977											
1978											
1979											
1980	104	0	1	<300			NR				
1981	139										
1982	174										
1983	209										
1984	243										
1985	278										
1986	313	2	1	<300			NR				
1987	348										
1988	383										
1989	418										
1990	453										
1991	490										
1992	527	1	0	<300	NR	NR	NR			USGS (2007)	
1993	563										
1994	600										
1995	637										
1996	674										
1997	711										
1998	748	1	0	<300	NR	NR	NR				
1999	785										
2000	823										
2001	858										
2002	894										
2003	929										
2004	964	13	0	<300	NR	NR	NR				
2005	1,000										
2010	1,176										
2020	1,495										
2030	1,755										
WELL TOTALS:										21	15

Notes:

NR = Not reported

¹ Does not include effluent or evaporation losses from stockponds and reservoirs.

² Includes all wells through 1980.



Primary Data Source: USGS National Gap Analysis Program, 2004

0 3 6 Miles



Figure 4.7-10
Meadview Basin
Cultural Water Demand

Demand Centers

M&I - Low Intensity



Indian Reservation



Major Road



City, Town or Place



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 4.7-8. 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 C. Adequacy determination data sources and methods are found in Volume 1, Appendix A.

- All subdivisions receiving an adequacy determination are in Mohave County. Six water adequacy determinations for 4,793 lots have been made in this basin through December 2008.
- No lots were determined to be adequate. The most common reason for a determination of inadequacy was because the applicant chose not to submit the necessary information and/or available hydrologic data were insufficient to make a determination.
- There is one designated water provider, Joshua Valley Utility Company. The projected or annual estimated demand has not been designated.

Table 4.7-8 Adequacy Determinations in the Meadview Basin¹

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. 15-29-17	Mohave	29 North	17 West	15	25	53-402136	Inadequate	A1	5/8/2006	NA
2	Lake Mead City Unit No. 23-29-17	Mohave	29 North	17 West	23	41	53-500018	Inadequate	A1	3/23/2007	Dry Lot Subdivision
3	Meadview B	Mohave	30 North	17 West	35	336	53-500948	Inadequate	A1, A2, A3	2/17/1984	Dry Lot Subdivision
4	Meadview	Mohave	30 North	17 West	1, 12	3,999	53-500947	Inadequate	A1	8/27/1973	Joshua Valley Utility Company
5	Meadview Highlands	Mohave	30 North	17 West	1	135	53-500949	Inadequate	A2, A3	6/30/1993	Joshua Valley Utility Company
6	Meadview Unit #5	Mohave	29 North	17 West	15	257	53-500950	Inadequate	A2, A3	10/22/1985	Dry Lot Subdivision

B. Designated Adequate Water Supply

Map Key	Water Provider Name	County	Designation No.	Projected or Annual Estimated Demand (af/yr)	Date Application Received	Date Application Issued	Year of Projected or Annual Demand
a	Joshua Valley Utility Company	Mohave	40-900006	No amount designated	NA	6/26/1985	No data, hydrologic study needed

Source: ADWR 2008a

Notes:

¹Each 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. Between 1995-2006 all applications for adequacy were given a file number with a 22 prefix.

In 2006 a 53 prefix was assigned to all water adequacy reports and applications regardless of their issue date.

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

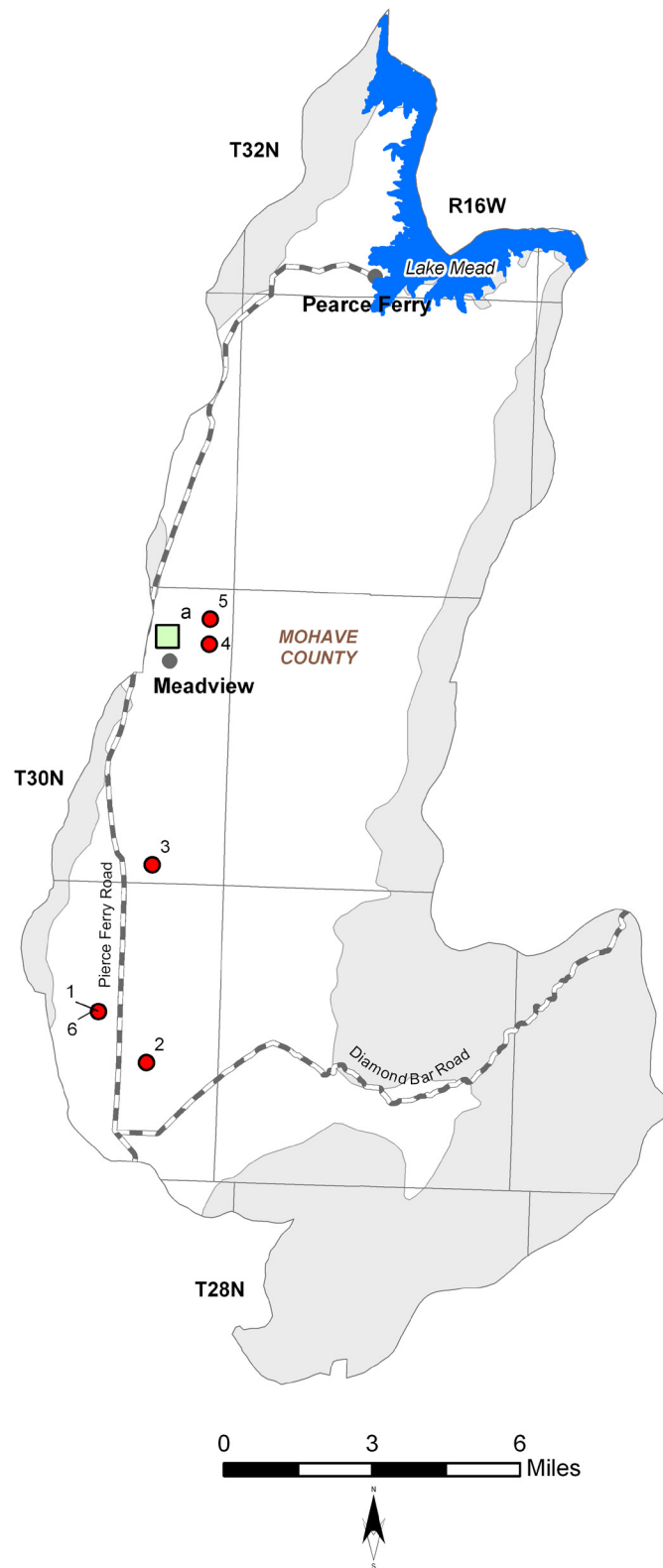


Figure 4.7-11
Meadview Basin
Adequacy Determinations

- Adequacy Determinations**
- Inadequate ●
 - Designated Water Provider ■
 - Consolidated Crystalline & Sedimentary Rocks
 - Unconsolidated Sediments
 - Major Road
 - City, Town or Place

Meadview Basin

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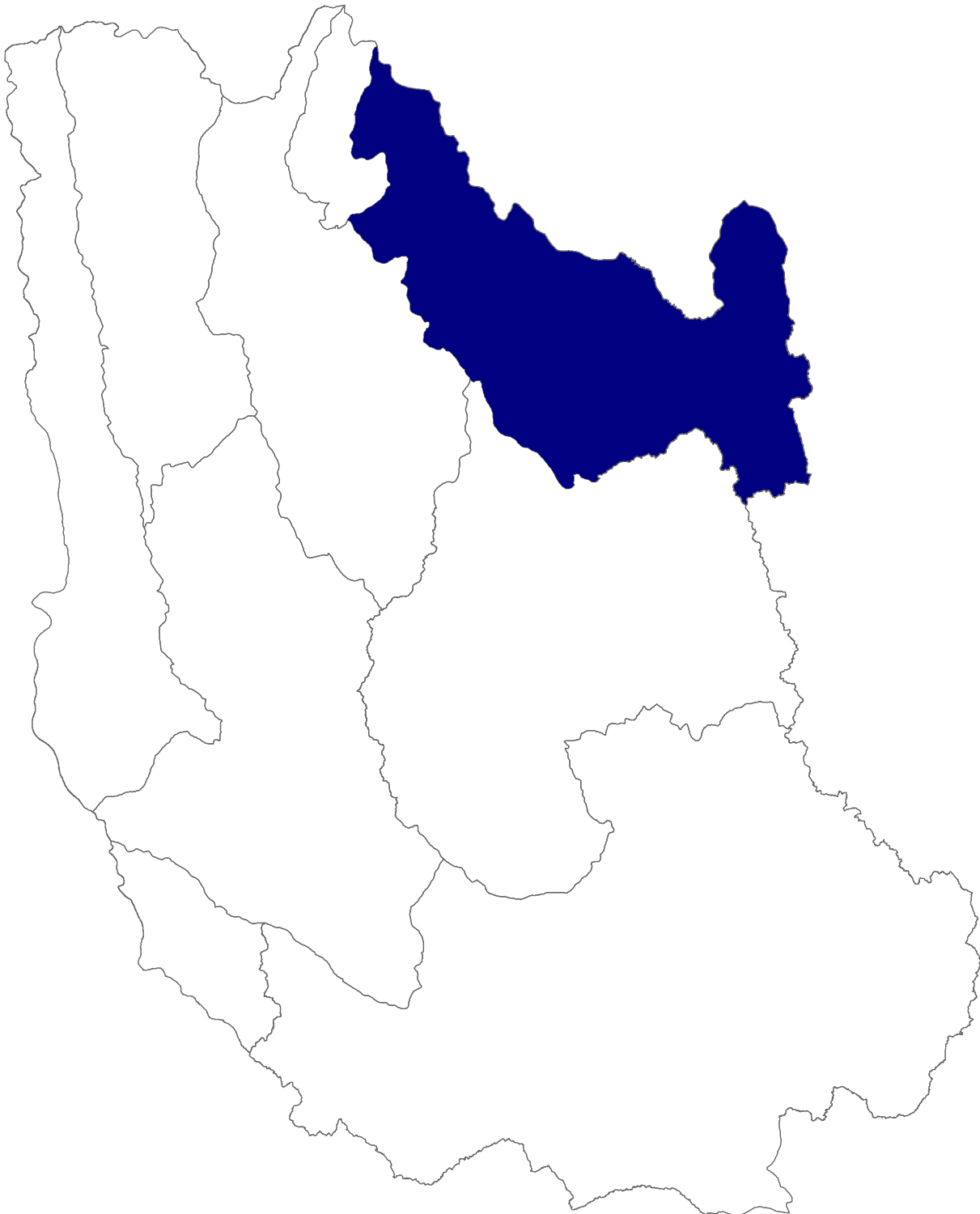
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Section 4.8

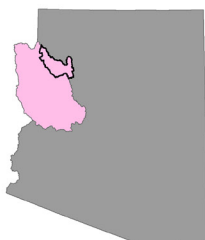
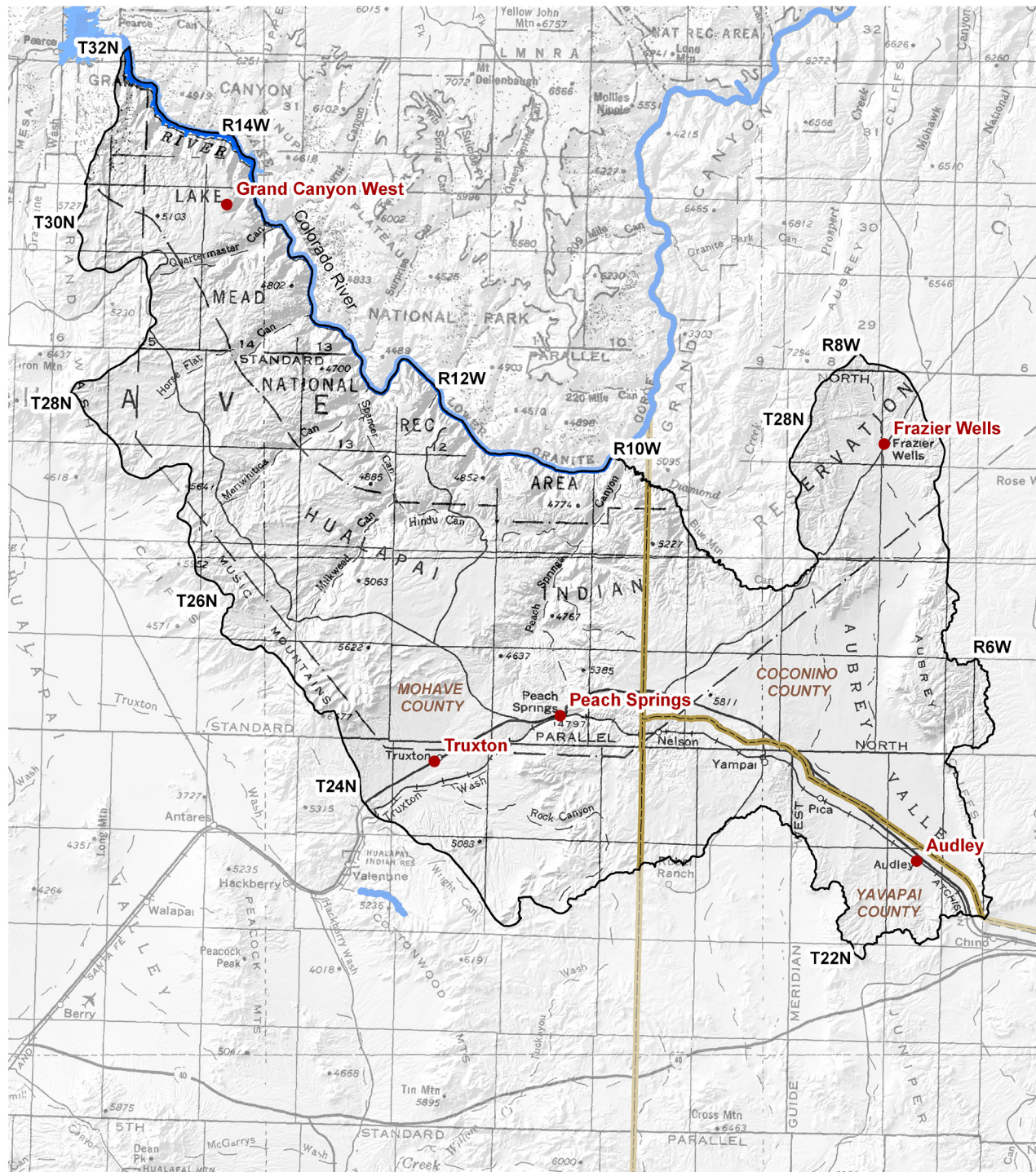
Peach Springs Basin



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 relatively small valleys. The Colorado River defines the northwestern basin boundary. Vegetation types include Great Basin conifer woodland, plains and Great Basin grassland, Great Basin and Mohave desertscrub and a small area of montane conifer forest. (see Figure 4.0-9)

- Principal geographic features shown on Figure 4.8-1 are:
 - The Grand Wash Cliffs on the northwest basin boundary
 - Aubrey Valley north of Audley
 - Aubrey Cliffs on the eastern basin boundary
 - Peach Springs Canyon, with access to the Colorado River
 - 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 on the Colorado River at the northwest point of the basin
 - Not well indicated is the Hualapai Plateau comprising most of the basin north of Peach Springs



Base Map: USGS 1:500,000, 1981

0 3 6
Miles



Figure 4.8-1
Peach Springs Basin
Geographic Features

COUNTY
City, Town or Place



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, Appendix A. More detailed information on protected areas is found in Section 4.0.4. Land ownership categories are discussed below in the order from largest to smallest percentage 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)

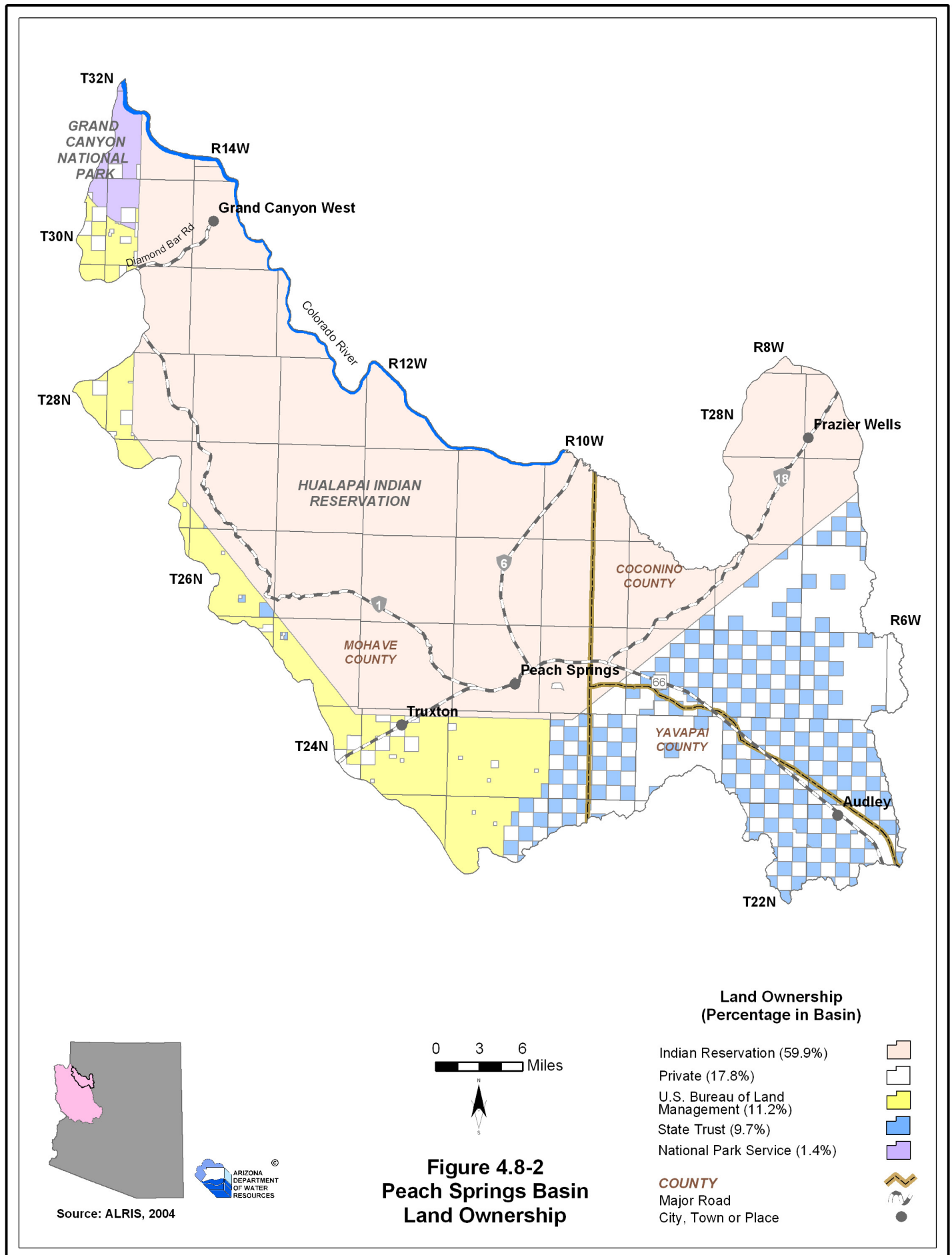
- 11.2% of the land is federally owned and managed by the Kingman Field Office of the BLM.
- All BLM lands are located along the western basin boundary.
- This basin contains the smallest percentage off BLM lands in the planning area.
- Primary land use is grazing.

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 Park Service

- 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.

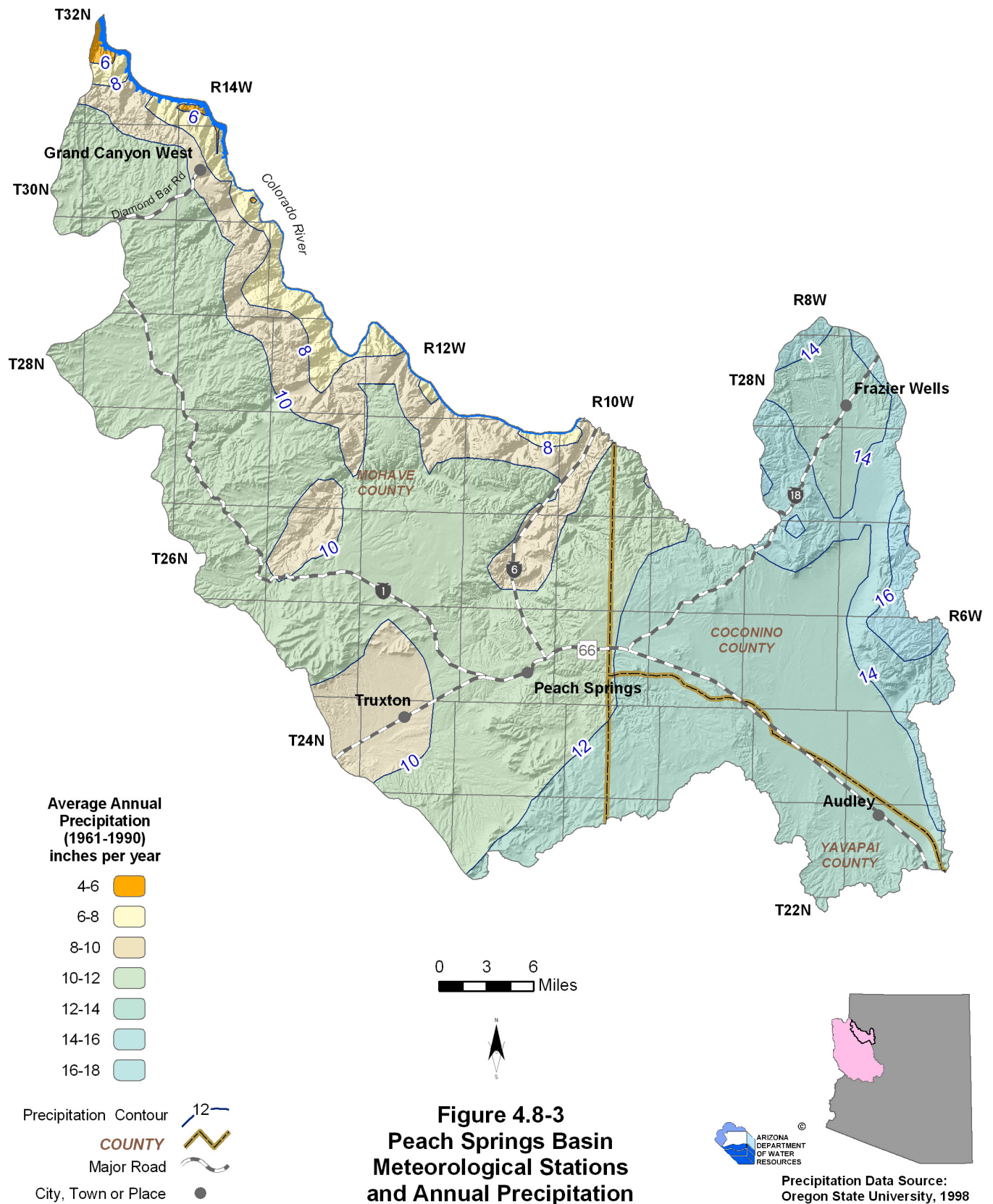


4.8.3 Climate of the Peach Springs Basin

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. More detailed information on climate in the planning area is found in Section 4.0.3. A description of this and other climate data sources and methods is found in Volume 1, Appendix A.

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 and as low as four inches in the northernmost tip of the basin.



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 4.8-1. Flood ALERT equipment in the basin is shown in Table 4.8-2. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.8-3. The location of streamflow gages identified by USGS number, flood ALERT equipment and USGS runoff contours are shown on Figure 4.8-4. Descriptions of stream, reservoir and stockpond data sources and methods are found in Volume 1, Appendix A.

Streamflow Data

- Refer to Table 4.8-1.
- Data from one real-time 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) and lowest in the winter (January-March).
- 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 4.8-2.
- As of October 2005 there were three stations in the basin.

Reservoirs and Stockponds

- Refer to Table 4.8-3.
- There are no large lakes or reservoirs in the basin. Surface water is stored or could be stored in 10 small reservoirs in the basin.
- There are 135 registered stockponds in this basin.

Runoff Contour

- Refer to Figure 4.8-4.
- Average annual runoff is 0.1 inch per year in the eastern portion of the basin.

Table 4.8-1 Streamflow Data for the Peach Springs Basin

Station Number	USGS Station Name	Drainage Area (in mi ²)	Gage Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Annual Flow Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9404222	Spencer Creek near Peach Springs	NA	1,620	3/1998-current (real time)	19	27	32	21	760 (2002)	1,456	1,485	2,267 (1993)	4

Source: USGS (NWIS) 2005 & 2008

Notes:

NA = not available

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

In Period of Record, current equals November 2008

Seasonal and annual flow data used for the statistics was retrieved in 2005

Table 4.8-2 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

Source: ADWR 2005b

Notes:

FCD = Flood Control District

NA = Not available

Table 4.8-3 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)

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					

Source: Compilation of databases from ADWR & others

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

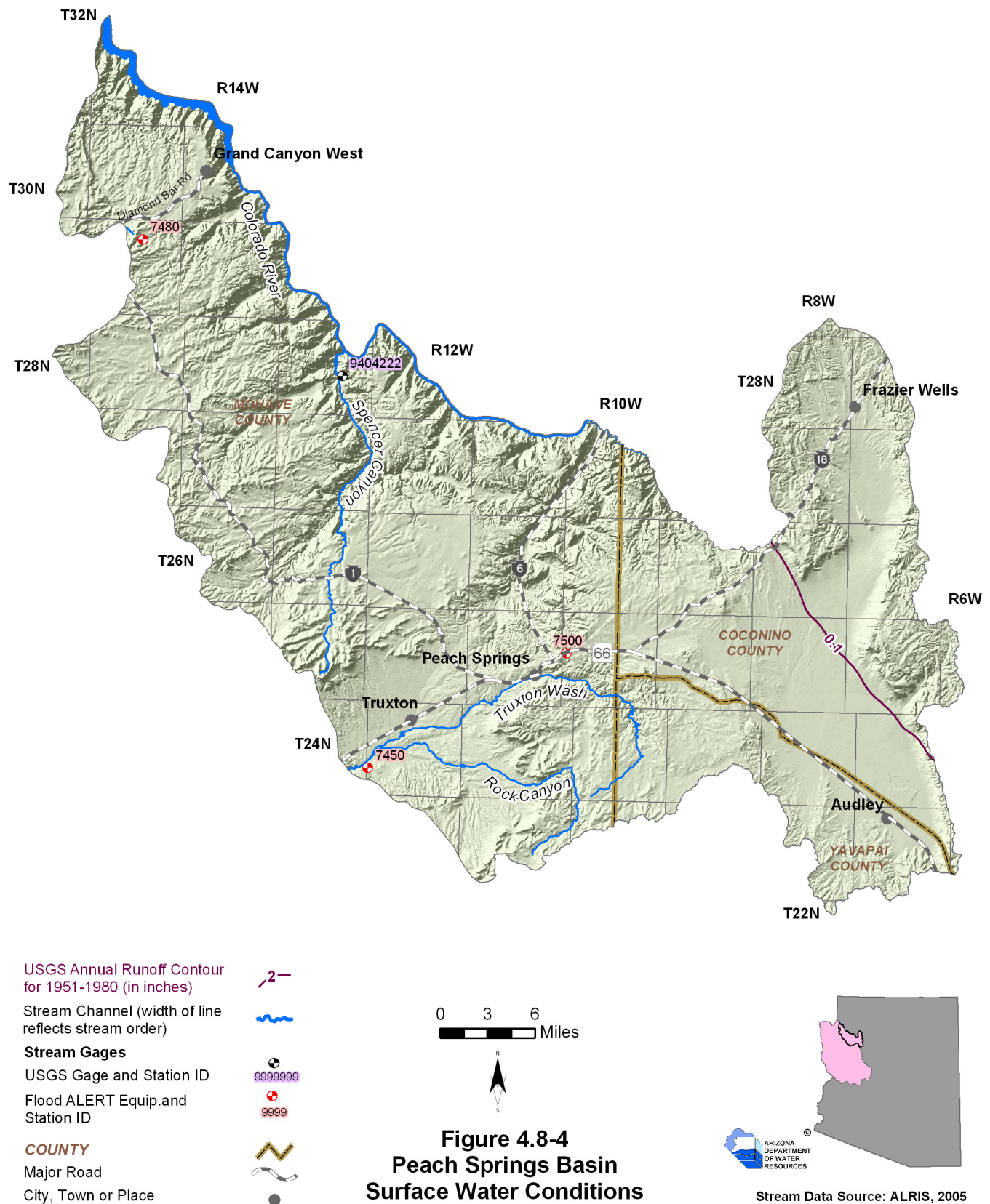
Total surface area: 93 acres

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

Total number: 135 (from water right filings)

Notes:

¹Capacity data not available to ADWR



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 4.8-4. The locations of major springs as well as perennial and intermittent streams are shown on Figure 4.8-5. Descriptions of data sources and methods for intermittent and perennial reaches and springs are found in Volume 1, Appendix A.

- 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 Department 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. The largest discharge rate was 1,730 gpm at Spencer spring.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 4.8-4B. There are five minor springs identified in this basin.
- Listed discharge rates may not be indicative of current conditions; however, all spring measurements in the basin are relatively recent with measurements taken between 1991 and 1995.
- The total number of springs identified by the USGS varies from 28 to 29, depending on the database reference.

Table 4.8-4 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

Source: Compilation of databases from ADWR & others

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005a and USGS, 2006a): 28 to 29

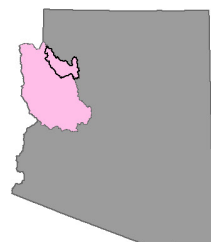
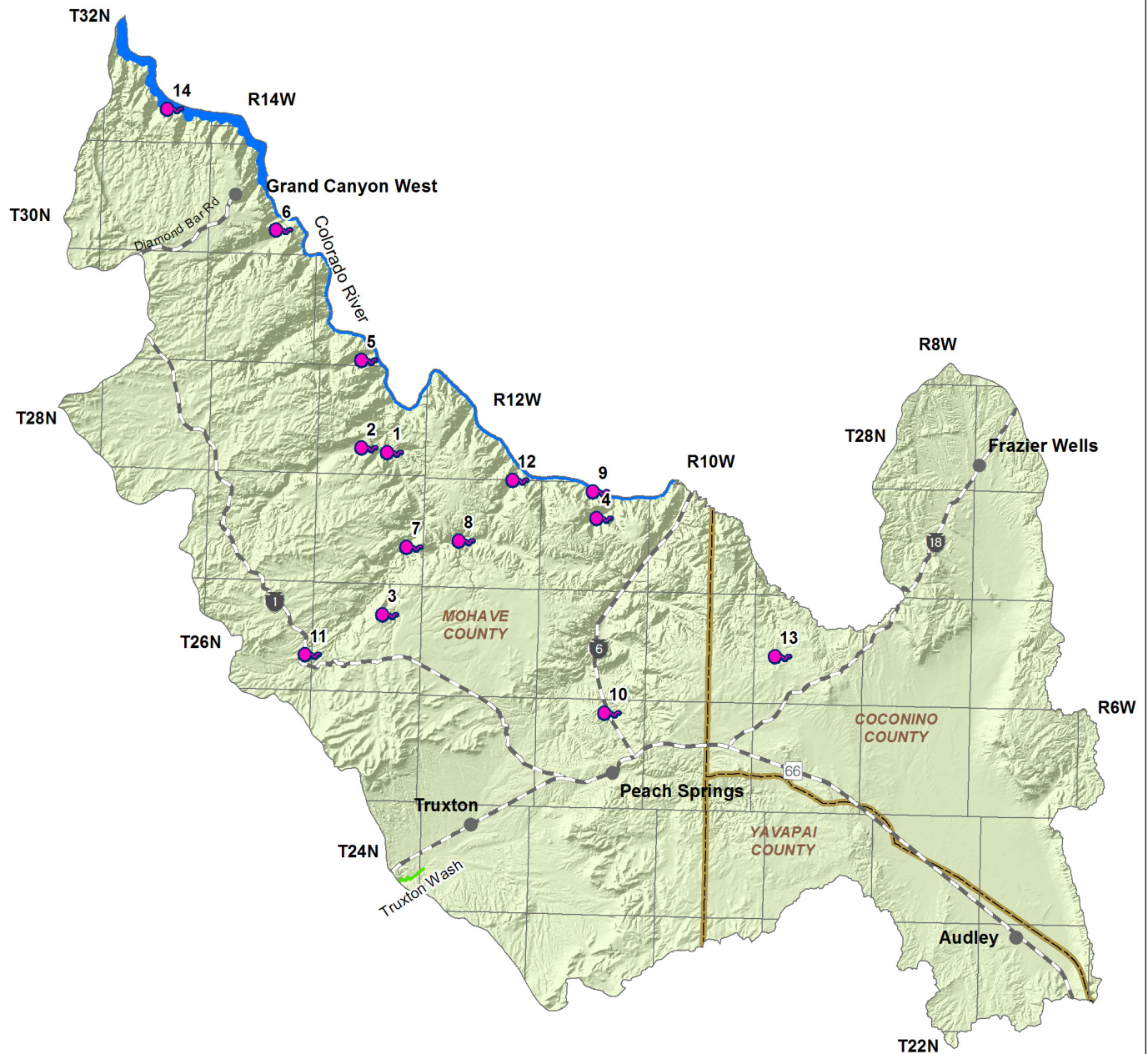
Notes:

¹Most recent measurement identified by ADWR

²Spring is not displayed on current USGS topo maps

³Discharge measurements vary. Shown is greatest measured discharge; most recent measurement < 10 gpm

⁴Discharge measurements vary. Shown is greatest measured discharge; most recent measurement < 1 gpm



Stream Data Source: AGFD, 1993 & 1997



Figure 4.8-5
Peach Springs Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

Springs
Intermittent Streams
Perennial Streams
COUNTY
Major Road
City, Town or Place



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 4.8-5. 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 as well as well data sources and methods, including water-level changes and well yields are found in Volume 1, Appendix A.

Major Aquifers

- Refer to Table 4.8-5 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 4.8-5 and Figure 4.8-8.
- As shown on Figure 4.8-8 well yields in this basin range from less than 100 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.

Water in Storage

- Refer to Table 4.8-5.
- Storage estimates for this basin range from 1.0 million acre-feet (maf) in the Truxton Valley alone to more than 4.0 maf for the entire basin 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 three index wells in this basin. Hydrographs for two index wells (C and D) and two other wells are shown in Figure 4.8-7.
- These data show the deepest recorded water level in the basin and planning area is 1,341 feet near the Yavapai/Coconino County boundary. The shallowest recorded water level is 60 feet east of Truxton.

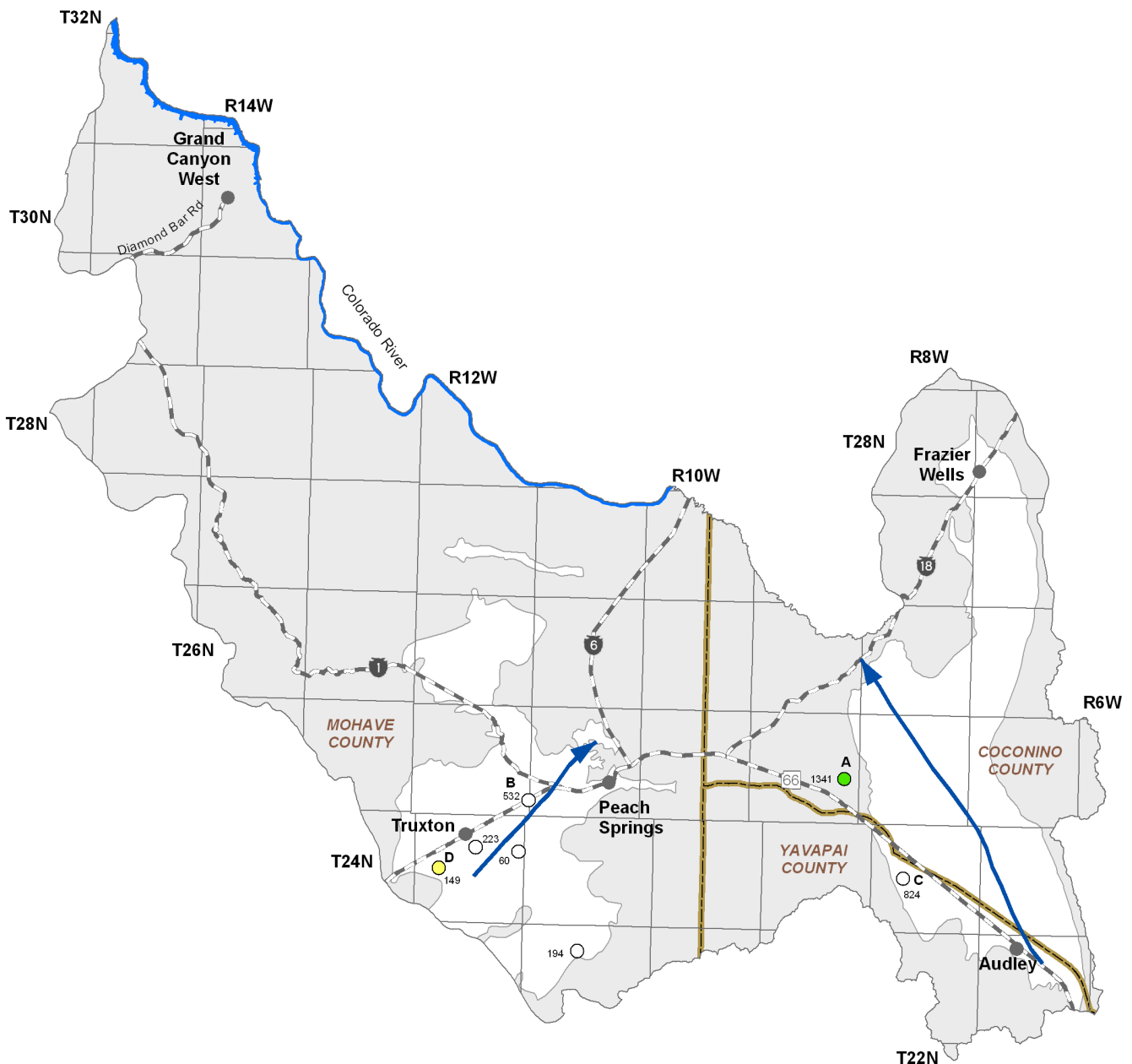
Table 4.8-5 Groundwater Data for the Peach Springs Basin

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 (GWSI) and/or USGS
	Range 45-650 Median 250 (7 wells reported)	Reported on registration forms for large (>10-inch) diameter wells (Wells55)
	Range 5-146	ADWR (1994b)
	Range 0-500	Anning and Duet (1994)
Estimated Natural Recharge, in acre-feet/year:	NA	
Estimated Water Currently in Storage, in acre-feet:	1,000,000 (Truxton Valley, to 1,200 ft)	ADWR (1994b)
	>1,000,000 ¹ (to 1,200 ft)	Freethy and Anderson (1986)
	>4,000,000	Arizona Water Commission (1975)
Current Number of Index Wells:	3	
Date of Last Well Sweep:	1995 (34 wells measured)	

Notes:

NA = Not Available

¹Predevelopment Estimate



Water-level change in feet between
1990-1991 and 2003-2004

H = number is depth to water in
feet during 2003-2004;
letter is hydrograph

Between -15 and -1

Between -1 and +1

Change Data Not Available



Generalized Flow Direction



Consolidated Crystalline
& Sedimentary Rocks



Unconsolidated Sediments



COUNTY



Major Road



City, Town or Place



0 3 6
Miles



Figure 4.8-6
Peach Springs Basin
Groundwater Conditions

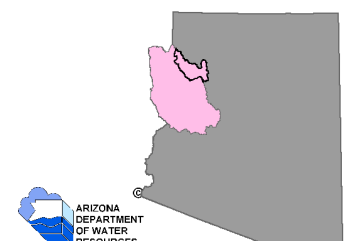
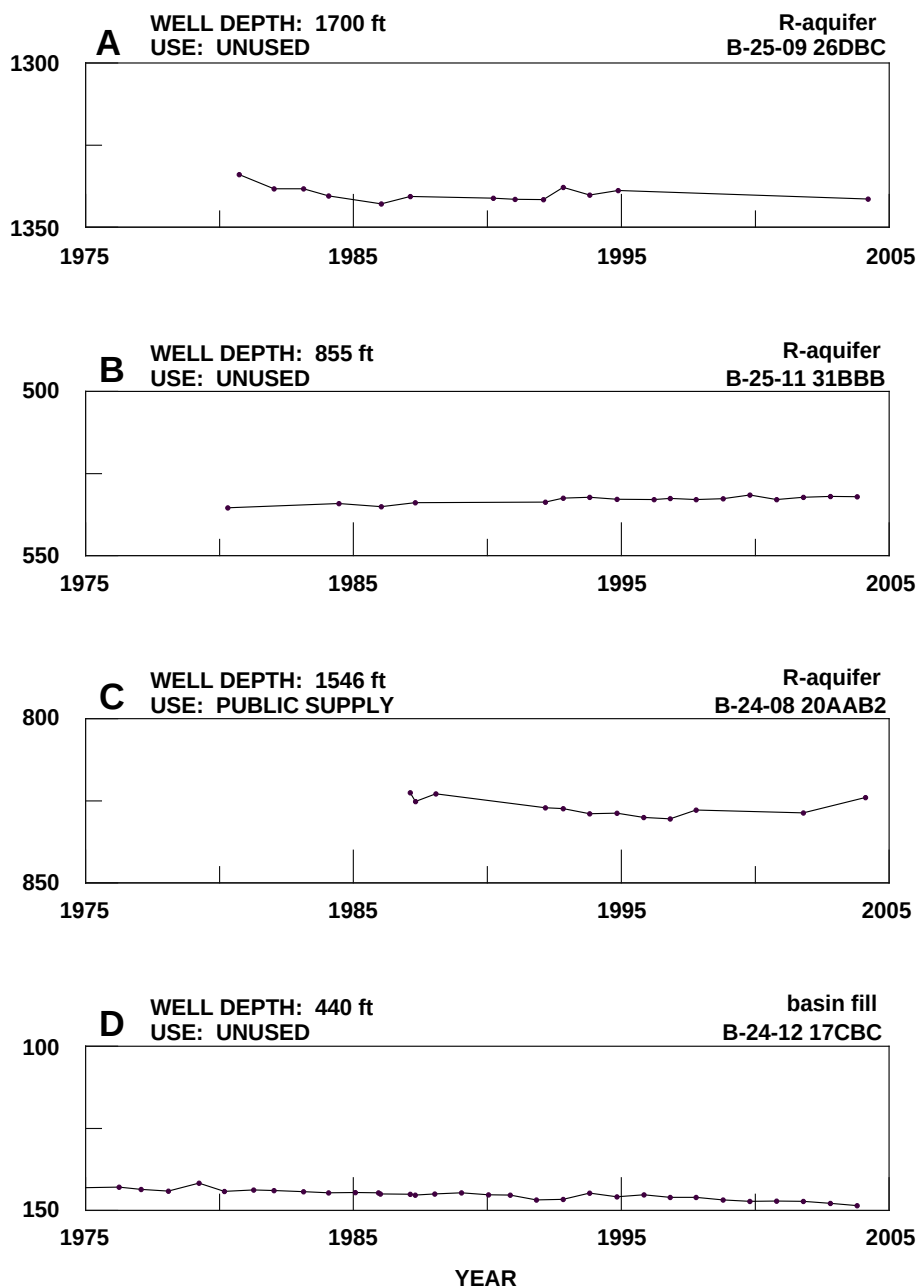
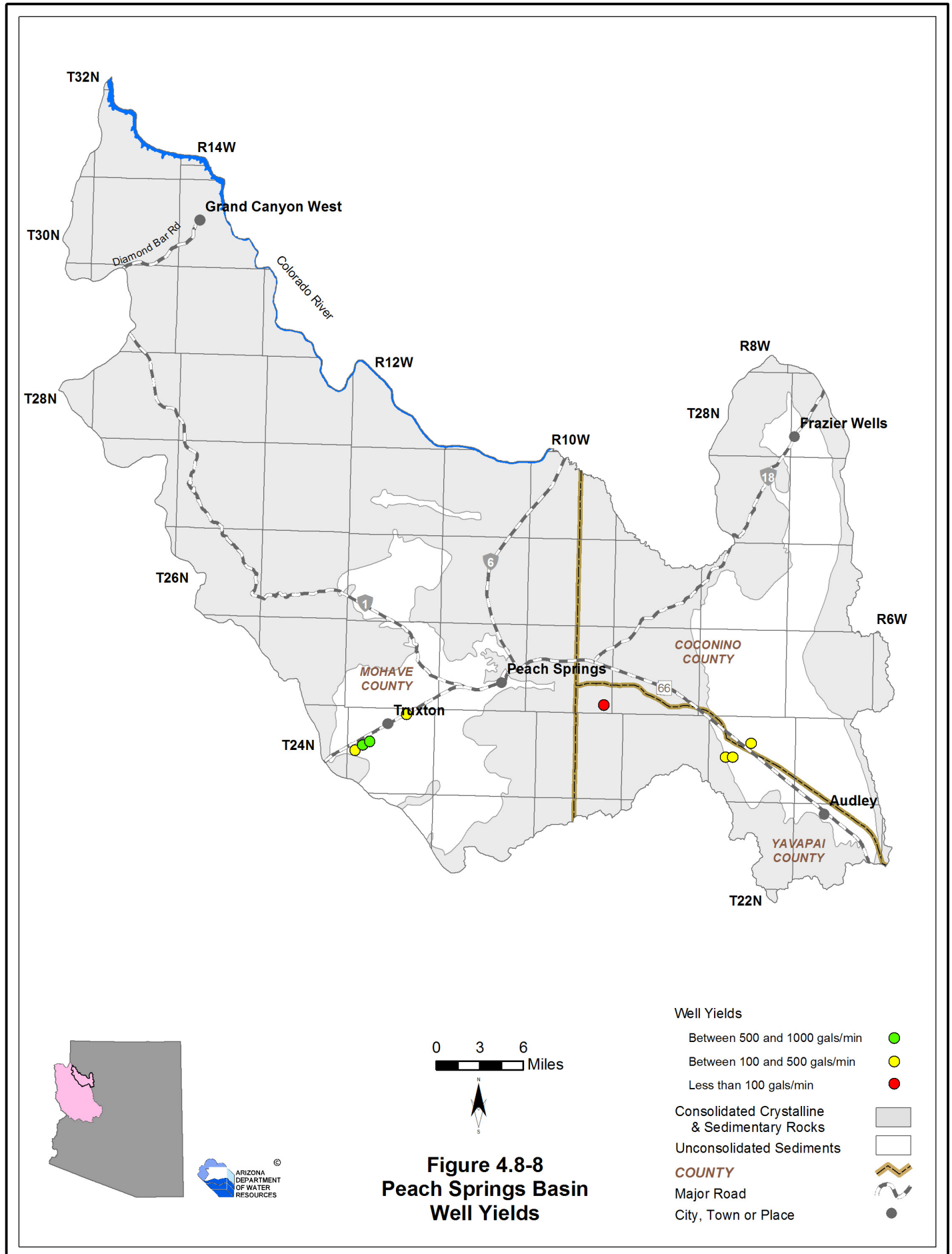


Figure 4.8-7
Peach Springs Basin
Hydrographs Showing Depth to Water in Selected Wells

Depth To Water In Feet Below Land Surface





4.8.7 Water Quality of the Peach Springs Basin

Sites with parameter concentrations that have equaled or exceeded drinking water standard(s) (DWS), including location and parameter(s) are shown in Table 4.8-6A. 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 4.8-6B. Figure 4.8-9 shows the location of exceedences and impairment keyed to Table 4.8-6. Not all parameters were measured at all sites; selective sampling for particular constituents is common. A description of water quality data sources and methods is found in Volume 1, Appendix A.

Well, Mine or Spring sites that have equaled or exceeded drinking water standards (DWS)

- Refer to Table 4.8-6A.
- Twenty-nine sites have parameter concentrations that have equaled or exceeded DWS.
- The most frequently equaled or exceeded parameter was arsenic. Other parameters equaled or exceeded in the sites measured in this basin were cadmium, fluoride, lead, nitrates and mercury.

Lakes and Streams with impaired waters

- Refer to Table 4.2-6B.
- Water quality standards for selenium and suspended sediment were equaled or 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 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 4.8-6 Water Quality Exceedences in the Peach Springs Basin¹

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded 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

Source: Compilation of databases from ADWR & others

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 (Parashant Canyon to Diamond Creek)	28	NA	A&W	Se, Suspended Sediment

Source: ADEQ 2005d

Notes:

¹ Water quality samples collected between 1967 and 2001.

² As = Arsenic

Cd = Cadmium

F = Fluoride

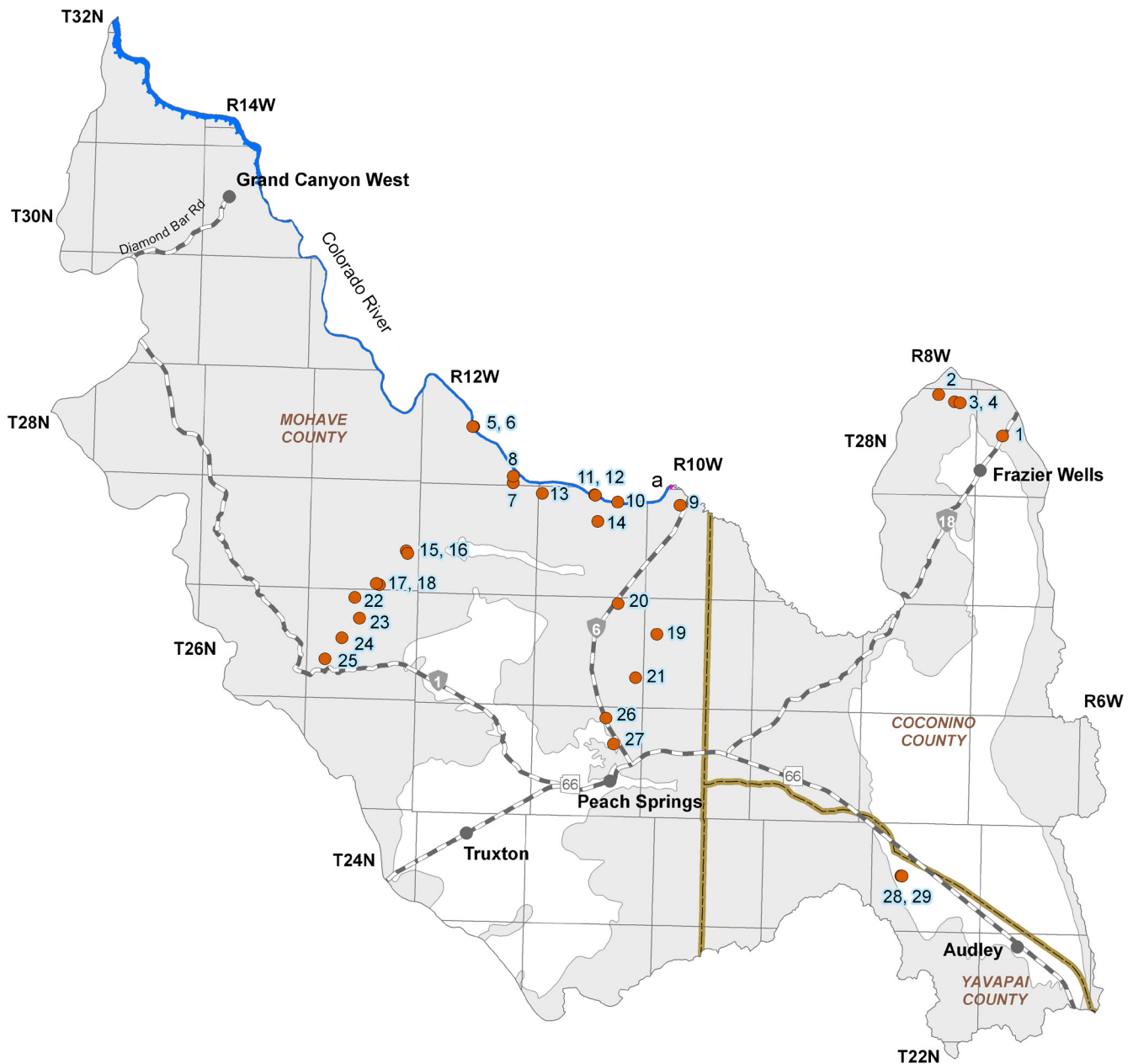
Pb = Lead

NO3 = Nitrate

Hg = Mercury

Se = Selenium

³ A&W = Aquatic and Wildlife



**Figure 4.8-9
Peach Springs Basin
Water Quality Conditions**

- Well, Spring or Mine Site that has Equaled or Exceeded DWS ● 1
- Impaired Stream or Lake a
- Consolidated Crystalline & Sedimentary Rocks
- Unconsolidated Sediments
- COUNTY** —
- Major Road —
- City, Town or Place ●

4.8.8 Cultural Water Demand 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 4.8-7. Effluent generation including facility ownership, location, population served and not served, volume treated, disposal method and treatment level is shown in Table 4.8-8. 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, Appendix A. More detailed information on cultural water demand is found in Section 4.0.7.

Cultural Water Demand

- Refer to Table 4.8-7 and Figure 4.8-10.
- Population in this basin declined in the 1980s and increased minimally between 1990 and 2000. Overall, the population remained virtually unchanged between 1980 and 2000, with a population of 1,804 in 1980 and 1,780 in 2000.
- There are no recorded surface water diversions in this basin. Groundwater use has remained relatively constant from the 1970s to the present, with an average of approximately 650 AFA from 2001-2005 and less than 300 AFA for industrial use and 350 AFA for municipal use.
- 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 2005 there were 36 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 18 wells with a pumping capacity of more than 35 gallons per minute.

Effluent Generation

- Refer to Table 4.8-8.
- 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 4.8-7 Cultural Water Demand in the Peach Springs Basin ¹

Year	Estimated and Projected 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	Agricultural	Municipal	Industrial	Agricultural	
1971		23 ²	14 ²	<500			NR			ADWR (1994a)
1972										
1973										
1974				<500			NR			
1975										
1976										
1977				<500			NR			
1978										
1979										
1980	1,804	1	1	<500			NR			
1981	1,720									
1982	1,636									
1983	1,552									
1984	1,468									
1985	1,384	1	0	<500			NR			
1986	1,301									
1987	1,217									
1988	1,133									
1989	1,049									
1990	965	0	1	<300	<300	NR	NR			
1991	1,046									
1992	1,128									
1993	1,209									
1994	1,291									
1995	1,372	4	2	<300	<300	NR	NR			
1996	1,454									
1997	1,535									
1998	1,617									
1999	1,698									
2000	1,780	7	0	350	<300	NR	NR			
2001	1,869									
2002	1,959									
2003	2,048									
2004	2,138									
2005	2,228									
2010	2,676									
2020	3,391									
2030	3,969									
WELL TOTALS:		36	18							

Notes:

NR - Not reported

¹ Does not include effluent or evaporation losses from stockponds and reservoirs.

² Includes all wells through 1980.

Table 4.8-8 Effluent Generation in the Peach Springs Basin

Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet/year)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water-course	Evaporation Pond	Irrigation	Golf Course/Turf/Landscape	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

Source: Compilation of databases from ADWR & others

Notes:

Year of Record is for the volume of effluent treated/generated

WWTP: Waste Water Treatment Plant

NA: Data not currently available to ADWR



Primary Data Source: USGS National Gap Analysis Program, 2004

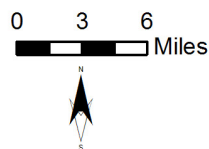


Figure 4.8-10
Peach Springs Basin
Cultural Water Demand

Demand Centers

M&I - High Intensity
Indian Reservation
Indian Reservation
Boundary
COUNTY
Major Road
City, Town or Place



4.8.9 Water Adequacy Determinations in the Peach Springs 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 4.8-9. Figure 4.8-11 shows the locations of subdivisions keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix C. Adequacy determination data sources and methods are found in Volume 1, Appendix A.

- All subdivisions receiving an adequacy determination are in Yavapai County. Two water adequacy determinations for 51 lots have been made in this basin through December 2008.
- All lots were determined to be inadequate. Water inadequacy determinations were issued because the applicant chose not to submit the necessary information and/or available hydrologic data were insufficient to make a determination.

Table 4.8-9 Adequacy Determinations in the Peach Springs Basin¹

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	Antelope Valley Ranches	Yavapai	24 North	9 West	5, 7, 8, 9, 14, 19, 20, 21, 25, 29, 30	44	53-402017	Inadequate	A1	2/9/2006	Dry Lot Subdivision
			24 North	10 West	11, 13						
2	Bridge Canyon Country Estates Unit 24	Yavapai	23 North	8 West	11	7	53-700224	Inadequate	A1	3/16/2007	Dry Lot Subdivision

Source: ADWR 2008

Notes:

¹Each 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. Between 1995-2006 all applications for adequacy were given a file number with a 22 prefix.

In 2006 a 53 prefix was assigned to all water adequacy reports and applications regardless of their issue date.

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)

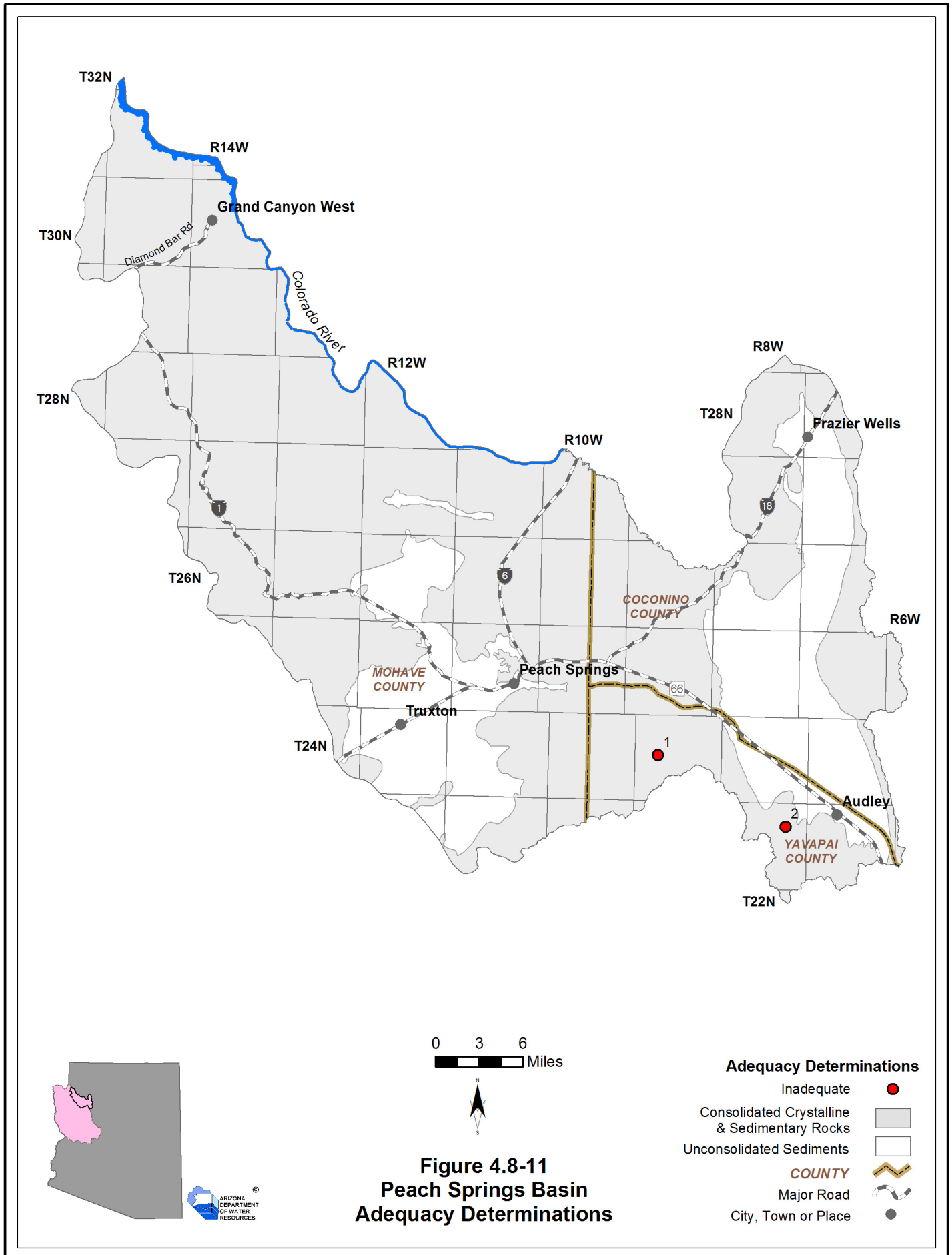
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)

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= not currently available to ADWR



Peach Springs Basin

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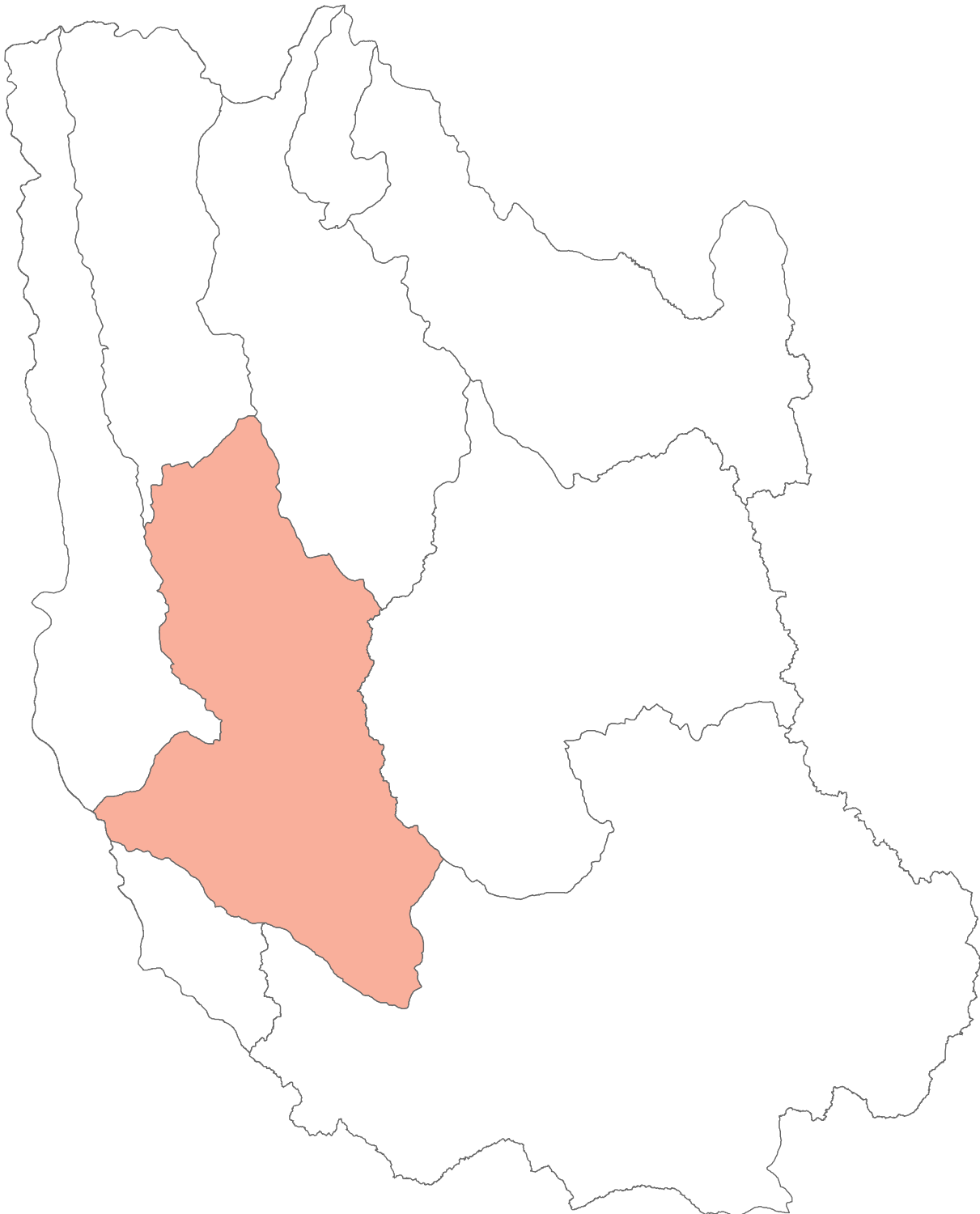
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Section 4.9

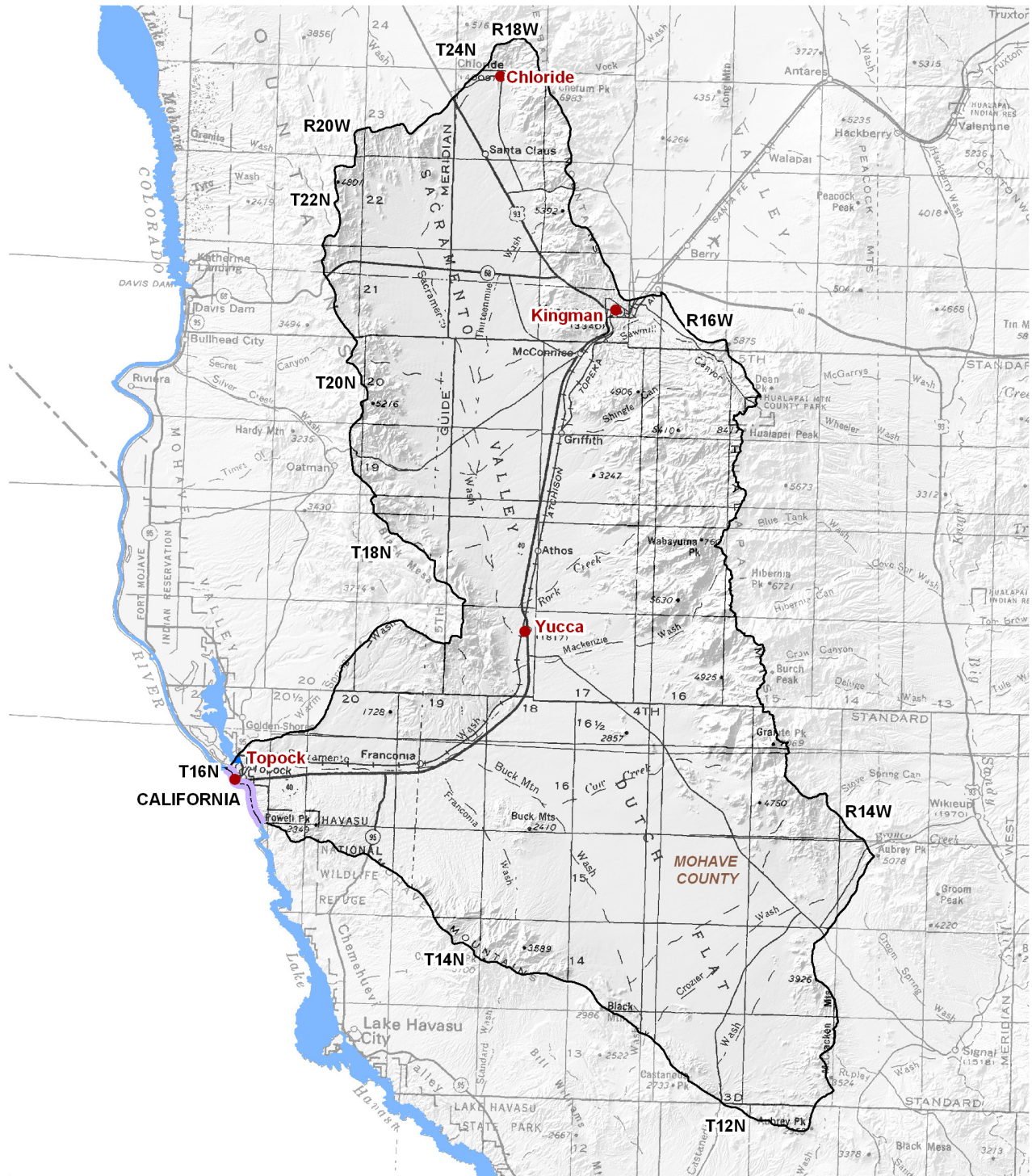
Sacramento Valley Basin



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 is primarily semi-desert grassland with smaller areas Arizona upland and lower Colorado River Sonoran desertscrub, semi-desert grassland, of Great Basin conifer woodland, interior chaparral and montane conifer forest. (see Figure 4.0-9) 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 north-south trending Sacramento Valley and Dutch Flat in the center of the basin
 - Sacramento Wash running north to south, then east to west near Yucca to the Colorado River
 - Cerbat Mountains on the northeast basin boundary
 - Black Mountains on the western basin boundary north of Yucca and the Mohave Mountains on the southwestern basin boundary
 - Hualapai Mountains on the east central basin boundary with the highest point in the basin, Wabayuma Peak, at 7,601 feet
 - The lowest point in the basin, about 500 feet near Topock



Base Map: USGS 1:500,000, 1981

Figure 4.9-1
Sacramento Valley Basin
Geographic Features

California State Boundary
City, Town or Place



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, Appendix A. More detailed information on protected areas is found in Section 4.0.4. Land ownership categories are discussed below in the order from largest to smallest percentage 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 BLM.
- The basin contains two wilderness areas, a portion of the 112,400 acre Warm Springs Wilderness and the entire 40,000 acre Wabayuma Peak Wilderness (see Figure 4.0-12).
- BLM lands are located throughout the basin, and are interspersed with private lands.
- 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

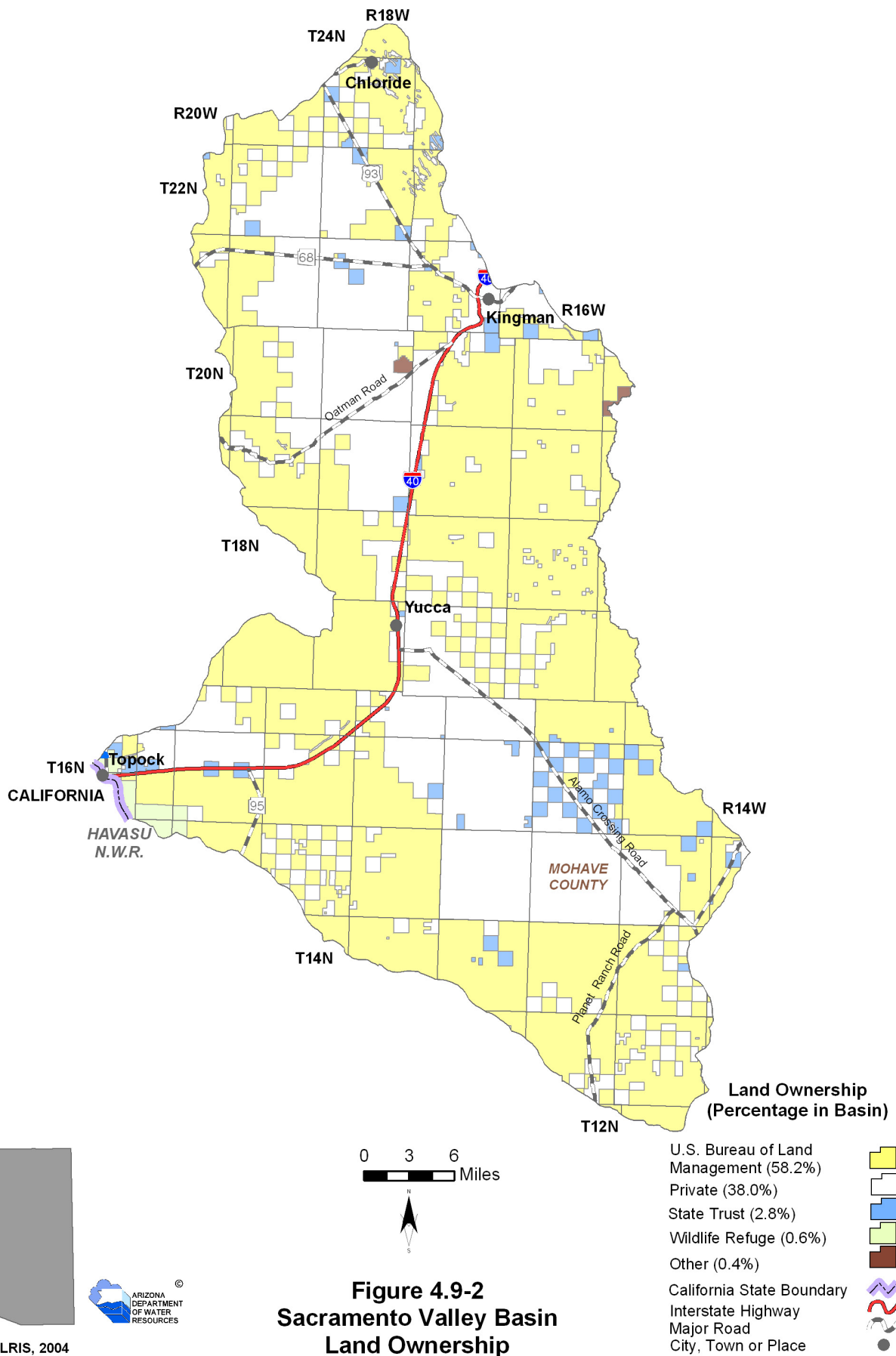
- 2.8% of the land in this basin is held in trust for the public schools under the State Trust Land system.
- State trust lands are found interspersed with private lands throughout the basin.
- Primary land use is grazing.

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.



Source: ALRIS, 2004



4.9.3 Climate of the Sacramento Valley Basin

Climate data from NOAA/NWS Co-op Network stations are compiled 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. More detailed information on climate in the planning area is found in Section 4.0.3. A description of the climate data sources and methods is found in Volume 1, Appendix A.

NOAA/NWS Co-op Network

- Refer to Table 4.9-1A
- There are three NOAA/NWS Co-op network climate stations in the basin. The average monthly maximum temperature occurs in July at all stations and ranges between 82.4°F at Kingman and 90.9°F at Yucca. The average monthly minimum temperature occurs in January or December and ranges between 42.9°F at Kingman 2 and 49.9°F at Yucca.
- Highest average seasonal rainfall occurs in the winter (January – March). For the period of record used, the highest annual rainfall is 10.36 inches per year at the Kingman station and the lowest is 8.13 inches per year at Yucca.

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.

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, 2005

B. Evaporation Pan:

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

C. AZMET:

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

D. SNOTEL/Snowcourse:

Station Name	Elevation (in feet)	Period of Record	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								



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 identified by USGS number, flood ALERT equipment and USGS runoff contours are shown on Figure 4.9-4. Descriptions of stream, reservoir and stockpond data sources and methods are found in Volume 1, Appendix A.

Streamflow Data

- Refer to Table 4.9-2.
- Data from one discontinued 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 was highest in the spring (April-June) and 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.

Reservoirs and Stockponds

- Refer to Table 4.9-4.
- The basin contains five small reservoirs.
- There are 44 registered stockponds in this basin.

Runoff Contour

- Refer to Figure 4.9-4.
- Average annual runoff is 0.5 inches per year, or 26.65 acre-feet per square mile, in the northeastern portion of the basin and decreases to 0.1 inches, or 5.33 acre-feet per square mile, in the center of the basin.

Table 4.9-2 Streamflow Data for the Sacramento Valley Basin

Station Number	USGS Station Name	Drainage Area (in mi ²)	Gage Elevation (in feet)	Period of Record	Average Seasonal Flow (% of annual flow)				Annual Flow/Year (in acre-feet)				Years of Annual Flow Record
					Winter	Spring	Summer	Fall	Minimum	Median	Mean	Maximum	
9424000	Colorado River near Topock	176,300	423	2/1917-9/1982 (discontinued)	19	38	26	17	4,316,354 (1934)	8,926,643	10,636,610	21,827,922 (1921)	64

Source: USGS (NWIS) 2005 & 2008

Notes:

NA = Not available

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

In Period of Record, current equals November 2008

Seasonal and annual flow data used for the statistics was retrieved in 2005

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

Source: ADWR 2005b

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

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

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					

Source: Compilation of databases from ADWR & others

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)⁴

Total number: 2

Total surface area: 16 acres

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

Total number: 44 (from water right filings)

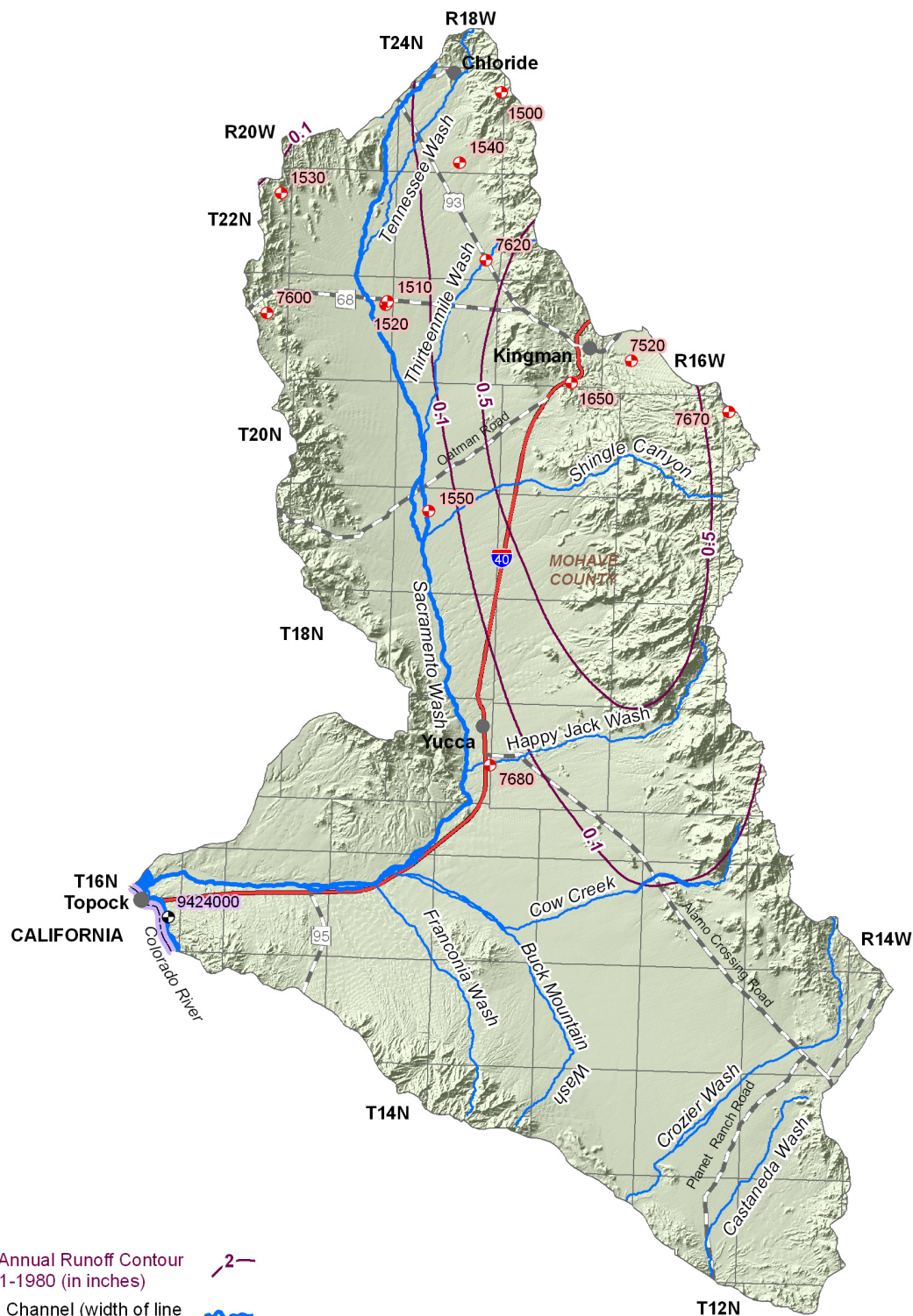
Notes:

¹H=hydroelectric; I=irrigation; S=water supply

²Dam is located in Parker Basin but lake storage is in Lake Havasu and Sacramento Valley Basins

³Includes 28,600 acre-feet of dead storage

⁴Capacity data not available to ADWR



USGS Annual Runoff Contour
for 1951-1980 (in inches)

Stream Channel (width of line
reflects stream order)

Stream Gages

USGS Gage and Station ID

Flood ALERT Equip. and
Station ID

California State Boundary

Interstate Highway

Major Road

City, Town or Place

0 3 6
Miles



Figure 4.9-4
Sacramento Valley Basin
Surface Water Conditions



Stream Data Source: ALRIS, 2005

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. Descriptions of data sources and methods for intermittent and perennial reaches and springs are found in Volume 1, Appendix A.

- 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. The largest measured discharge rate is 100 gpm at Johnston spring.
- 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.
- Listed discharge rates may not be indicative of current conditions. All measurements were taken prior to 1980.
- 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 (Cont)

B. Minor Springs (1 to 10 gpm): (Cont)

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

Source: Compilation of databases from ADWR & others

**C. Total number of springs, regardless of discharge, identified by USGS
(see ALRIS, 2005a and USGS, 2006a): 90 to 100**

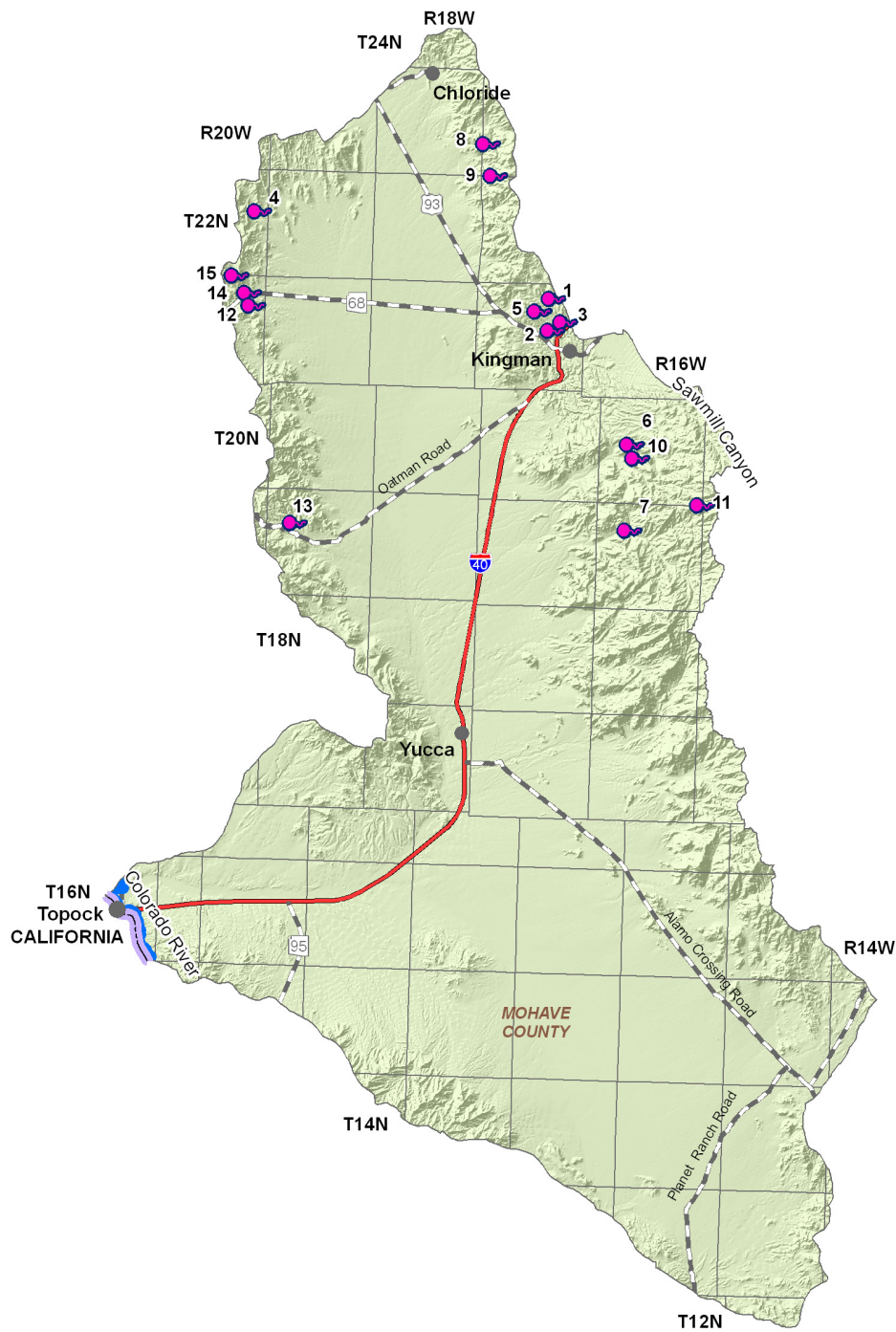
Notes:

¹Most recent measurement identified by ADWR

²Spring is not displayed on current USGS topo maps

³Discharge measurements vary. Shown is greatest measured discharge;
most recent measurement < 10 gpm

⁴Discharge measurements vary. Shown is greatest measured discharge;
most recent measurement < 1 gpm



Stream Data Source: AGFD, 1993 & 1997



0 3 6
Miles



Figure 4.9-5
Sacramento Valley Basin
Perennial/Intermittent Streams
and Major (>10 gpm) Springs

- Springs
- Intermittent Streams
- Perennial Streams
- California State Boundary
- Interstate Highway
- Major Road
- City, Town or Place



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 as well as well data sources and methods, including water-level changes and well yields are found in Volume 1, Appendix A.

Major Aquifers

- Refer to Table 4.9-6 and Figure 4.9-6.
- The major aquifers in this basin are basin fill and volcanic rock.
- 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 4.9-6.
- Natural recharge estimates range from 1,000 acre-feet per year (AFA) to 4,000 AFA.
- Most of the recharge in this basin comes from infiltration along the mountain fronts.

Water in Storage

- Refer to Table 4.9-6.
- Storage estimates for this basin range from 3.6 million acre-feet (maf) to 1,500 feet to 14 maf to 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 16 index wells in this basin. Hydrographs for three index wells (A,D and E) and two other wells are shown in Figure 4.9-7.
- The Department measures water levels four times daily at two automated groundwater monitoring site in the north-central portion of the basin.
- These data show the deepest recorded water level in the basin is 1,062 feet west of Kingman and the shallowest is 38 feet east of Topock.

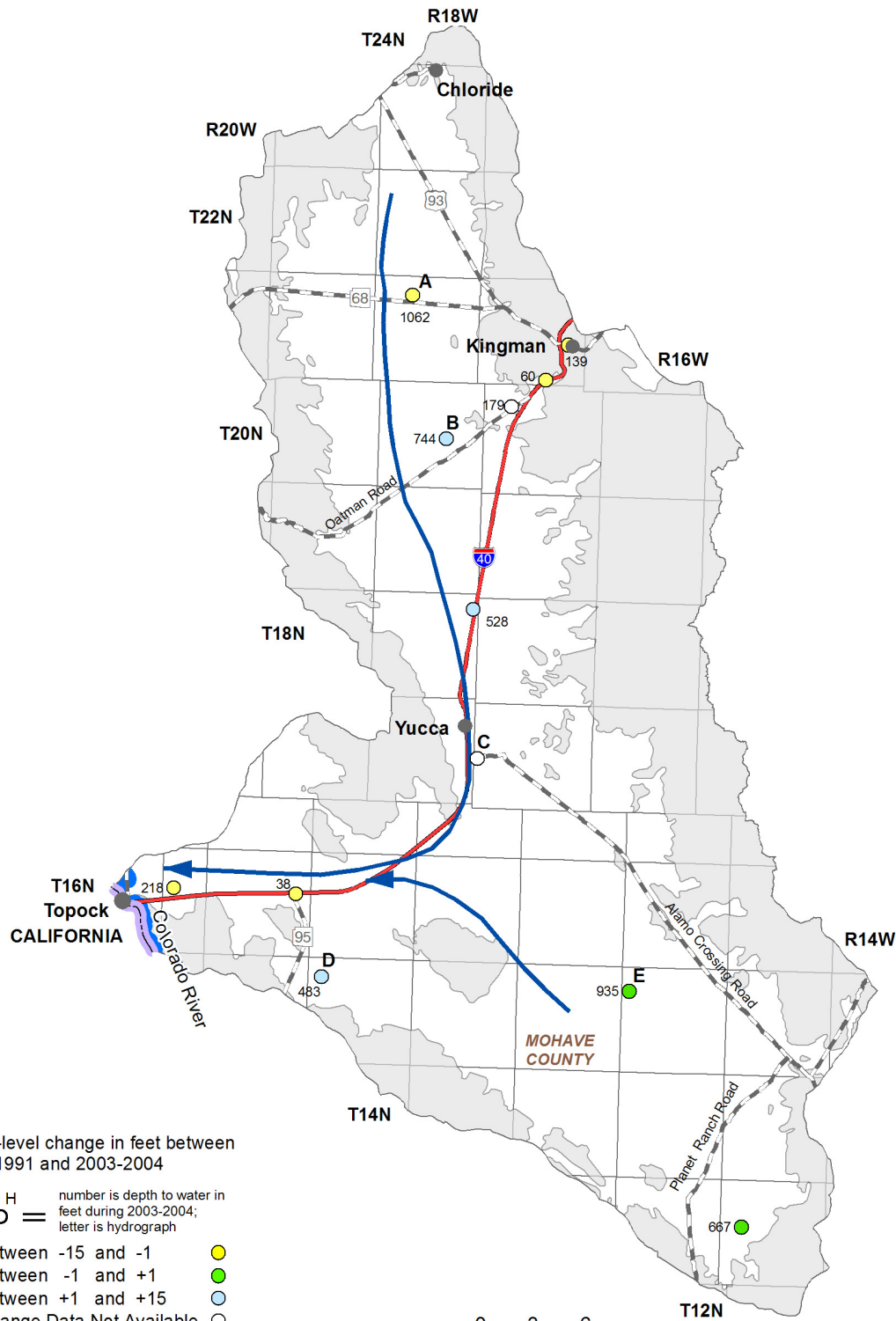
Table 4.9-6 Groundwater Data for the Sacramento Valley Basin

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 (GWSI) and/or USGS
	Range 5-1,000 Median 100 (36 wells reported)	Reported on registration forms for large (>10-inch) diameter wells (Wells55)
	Range 30-100	ADWR (1990)
	Range 0-2,500	Anning and Duet (1994)
Estimated Natural Recharge, in acre-feet/year:	1,000	Rascona (1991) (HMS 21)
	4,000	Freethy and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	3,600,000 - 9,500,000 ¹ (to 1,200 ft)	Conway and Ivanich (2008)
	7,000,000 - 8,300,000 (to 1,200 ft)	ADWR (1990 and 1994b)
	11,000,000 ² (to 1,200 ft)	Freethy and Anderson (1986)
	14,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
	6,500,000 - 13,000,000 (to 1,500 ft)	Gillespie and Bentley (1971)
Current Number of Index Wells:	16	
Date of Last Water-level Sweep:	2006 (177 wells measured)	

Notes:

¹ Range based on estimates of specific yield

² Predevelopment Estimate



Water-level change in feet between
1990-1991 and 2003-2004

H = number is depth to water in
feet during 2003-2004;
letter is hydrograph

- Between -15 and -1
- Between -1 and +1
- Between +1 and +15
- Change Data Not Available

- Generalized Flow Direction
- Consolidated Crystalline
& Sedimentary Rocks
- Unconsolidated Sediments
- California State Boundary
- Interstate Highway
- Major Road
- City, Town or Place

0 3 6
Miles



Figure 4.9-6
Sacramento Valley Basin
Groundwater Conditions

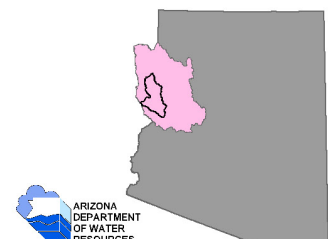
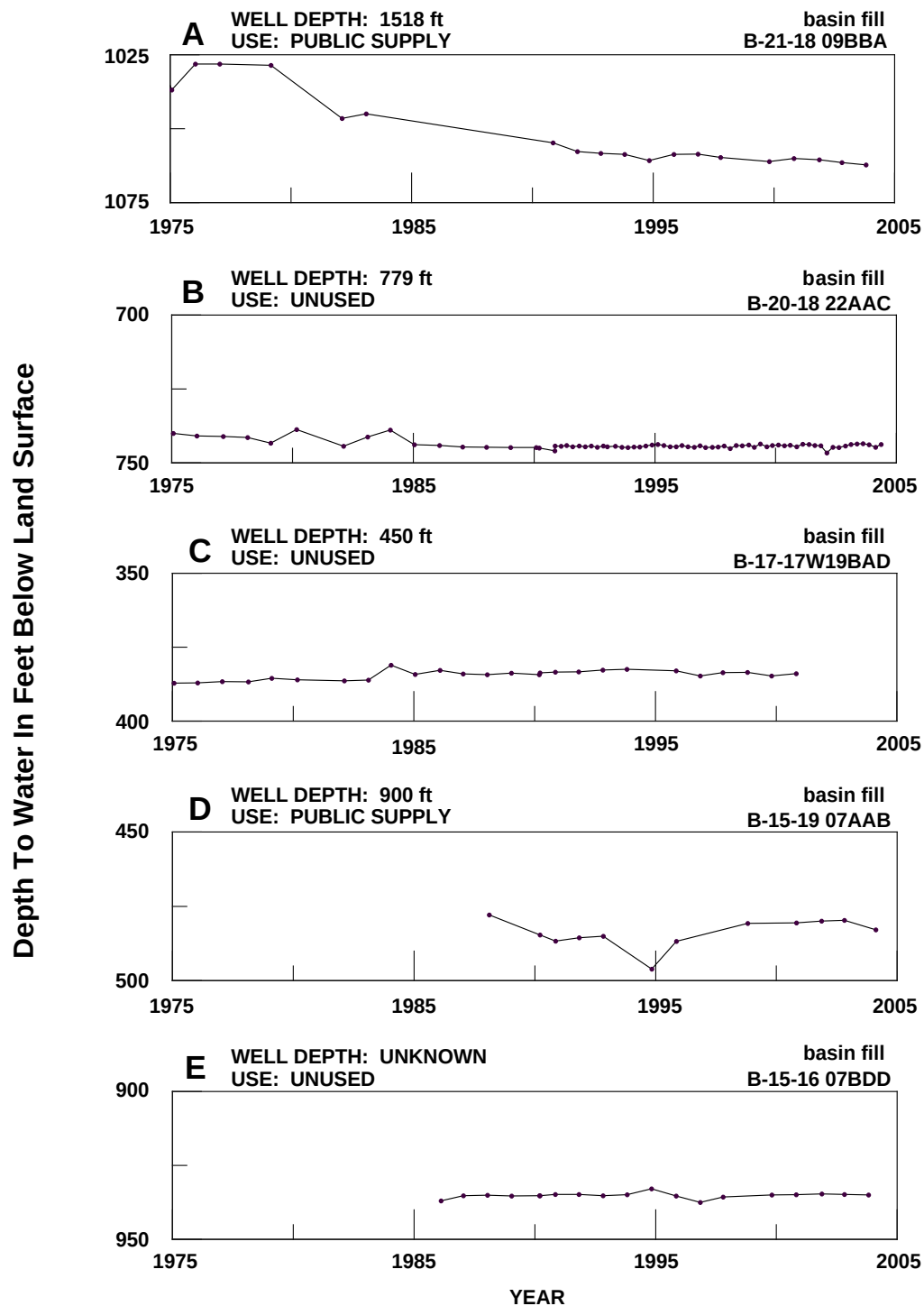
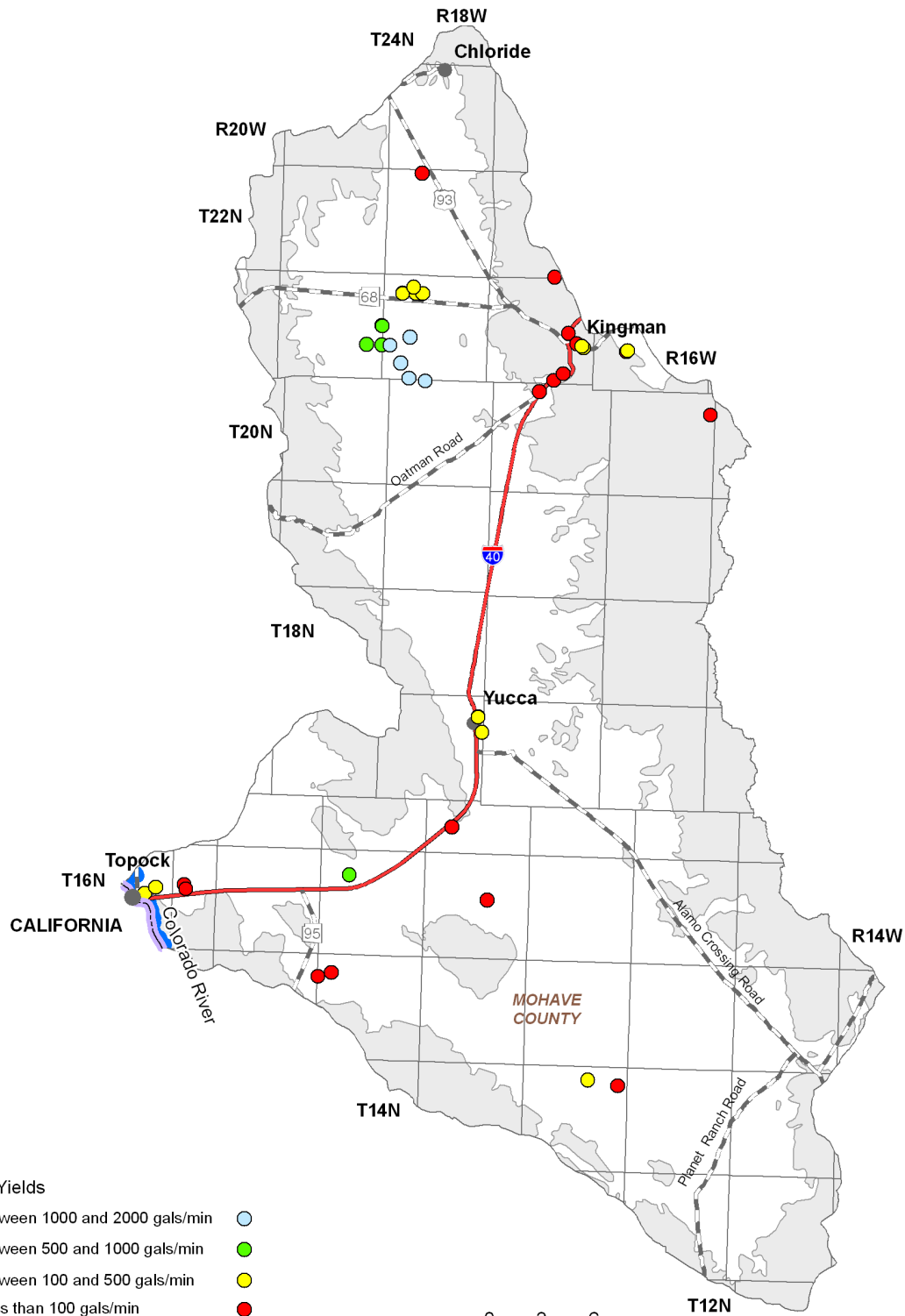


Figure 4.9-7
Sacramento Valley Basin
Hydrographs Showing Depth to Water in Selected Wells





Well Yields

- Between 1000 and 2000 gals/min
- Between 500 and 1000 gals/min
- Between 100 and 500 gals/min
- Less than 100 gals/min

Consolidated Crystalline
& Sedimentary Rocks

Unconsolidated Sediments

California State Boundary

Interstate Highway

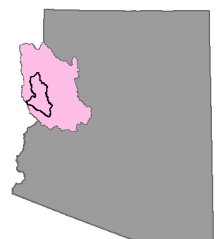
Major Road

City, Town or Place

0 3 6
Miles



**Figure 4.9-8
Sacramento Valley Basin
Well Yields**



4.9.7 Water Quality of the Sacramento Valley Basin

Sites with parameter concentrations that have equaled or exceeded drinking water standard(s) (DWS), including location and parameter(s) 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. All community water systems are regulated under the Safe Drinking Water Act and treat water supplies to meet drinking water standards. Not all parameters were measured at all sites; selective sampling for particular constituents is common. A description of water quality data sources and methods is found in Volume 1, Appendix A.

Well, Mine or Spring sites that have equaled or exceeded drinking water standards (DWS)

- Refer to Table 4.9-7A.
- Sixty-two sites have parameter concentrations that have equaled or exceeded DWS.
- Frequently equaled or exceeded parameters include arsenic, fluoride and radionuclides. Other parameters equaled or exceeded in the sites measured in this basin were beryllium, cadmium, copper, chromium, lead, nitrate and total dissolved solids.

Effluent Dependent Reaches

- Refer to Figure 4.9-9
- 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 Basin¹

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded 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	21 West	35	As, Cd, F
51	Well	16 North	21 West	35	As, Cd, F
52	Well	16 North	21 West	36	As, F
53	Well	15 North	14 West	8	F

Table 4.9-7 Water Quality Exceedences in the Sacramento Valley Basin (Cont)¹

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded 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

Source: Compilation of databases from ADWR & others

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

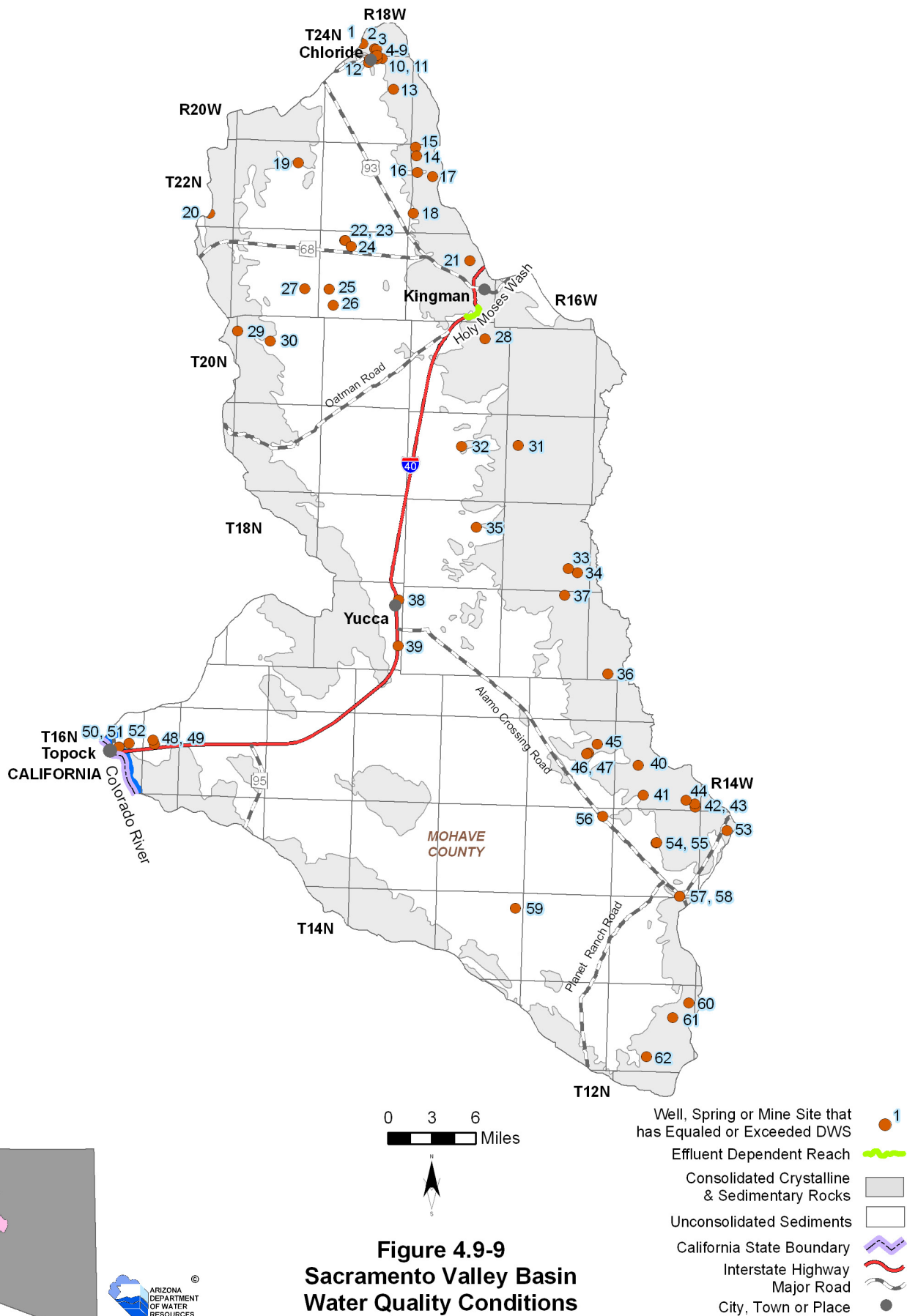
F = Fluoride

Pb = Lead

NO3 = Nitrate

TDS = Total Dissolved Solids

Rad = One or more of the following radionuclides - Gross Alpha, Gross Beta, Radium, and Uranium



4.9.8 Cultural Water Demand 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, Appendix A. More detailed information on cultural water demand is found in Section 4.0.7.

Cultural Water Demand

- 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 17,575 in 2000.
- Groundwater use in this basin decreased from 1971-1990. Between 1991-2005 groundwater demand has increased, with an average of 3,700 AFA from 2001-2005.
- 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 AFA in 1991-1995 to an average of 2,100 AFA in 2001-2005.
- Groundwater demand declines in the 1970s and 1980s 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 AFA in 1991-1995 to an average of 1,600 AFA in 2001-2005.
- 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 2005 there were 1,010 registered wells with a pumping capacity of less than or equal to 35 gallons per minute and 151 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 300 acre-feet of effluent per year.
- Of the two facilities with information on the effluent disposal method, one discharges to a watercourse and both discharge to an evaporation pond.

Table 4.9-8 Cultural Water Demand in the Sacramento Valley Basin¹

Year	Estimated and Projected Population	Number of Registered Water Supply Wells Drilled		Average Annual Demand (in acre-feet) ²						
				Well Pumpage			Surface-Water Diversions			Data Source
		Q ≤ 35 gpm	Q > 35 gpm	Municipal ³	Industrial	Agricultural	Municipal	Industrial	Agricultural	
1971		244 ⁴	70 ⁴	6,000			NR ⁵			ADWR (1994a)
1972										
1973				7,000			NR			
1974										
1975										
1976										
1977										
1978										
1979		3,000			NR					
1980	7,245									
1981	7,578									
1982	7,911									
1983	8,244									
1984	8,577	55	12	2,000			NR			
1985	8,910									
1986	9,243									
1987	9,576									
1988	9,909									
1989	10,242	91	13	NR						
1990	10,575									
1991	11,275									
1992	11,975									
1993	12,675									
1994	13,375	146	22	1,500	<300	NR	NR			
1995	14,075									
1996	14,775									
1997	15,475									
1998	16,175									
1999	16,875	184	25	1,800	350	NR	NR			
2000	17,575									
2001	18,498									
2002	19,422									
2003	20,345									
2004	21,268	290	9	2,100	1,600	NR	NR			
2005	22,192									
2010	26,808									
2020	34,099									
2030	40,020									
WELL TOTALS:		1,010	151							

Notes:

NR = Not reported

¹ Does not include effluent or 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 the Havasu National Wildlife Refuge in the surface water demand for this basin.

Table 4.9-9 Effluent Generation in the Sacramento Valley Basin

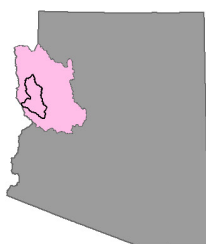
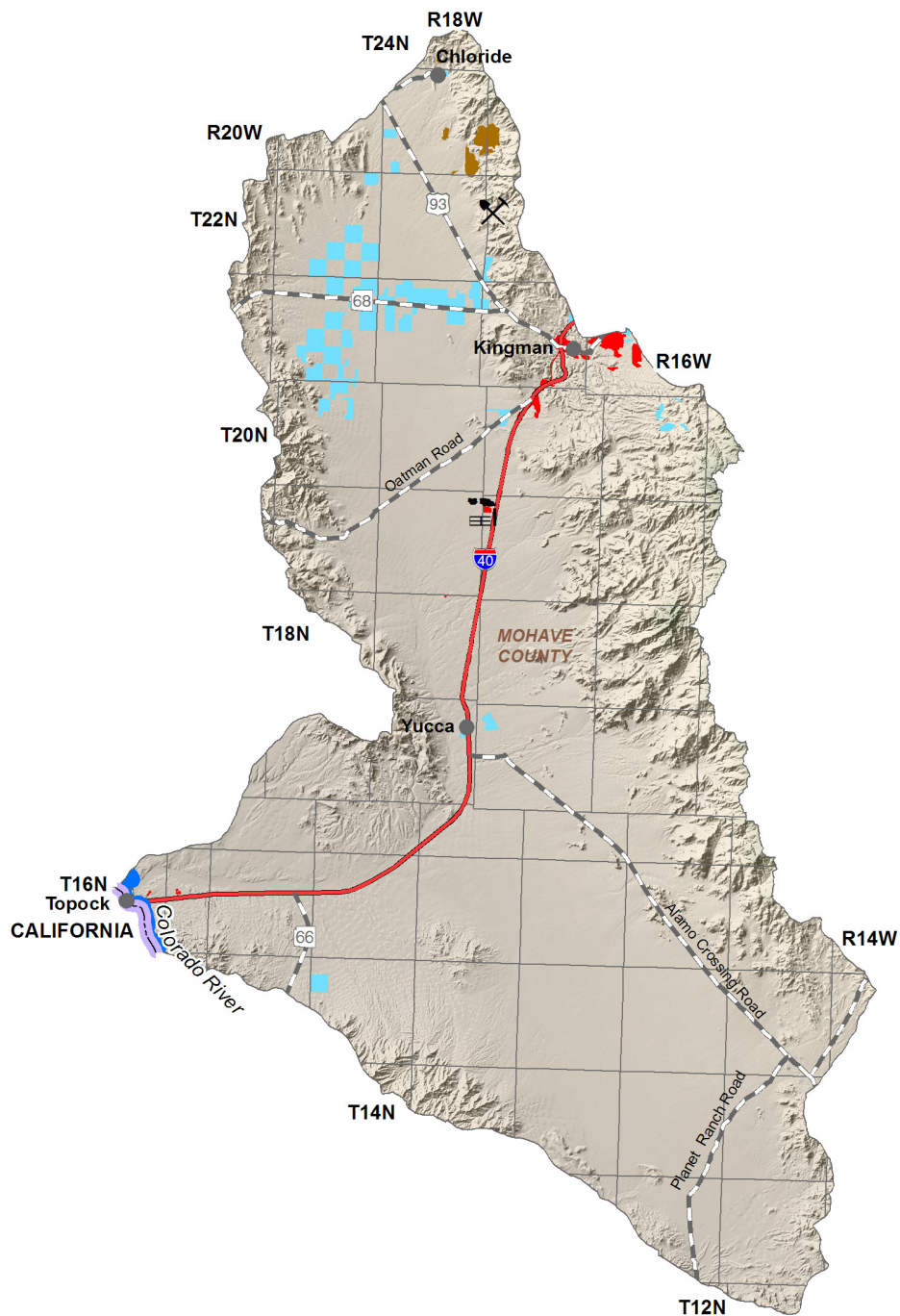
Facility Name	Ownership	City/Location Served	Population Served	Volume Treated/Generated (acre-feet/year)	Disposal Method							Current Treatment Level	Population Not Served	Year of Record
					Water - course	Evaporation Pond	Irrigation	Golf Course/Turf/ Landscape	Wildlife Area	Discharged to Another Facility	Infiltration Basins			
Arizona Gateway WWTP	AZ American Water	Franconia	3	2		X						Secondary	NA	2007
Kingman - Downtown WWTP	City of Kingman	Kingman	3,590	258	X	X						Secondary	5,335	2004
Pilot Travel Center #221	Private	Franconia	NA											
Sacramento Rd WWTP	Private	Griffith Power Plant	NA											
Total			3,593	260										

Notes:

Year of Record is for the volume of effluent treated/generated

NA: Data not currently available to ADWR

WWTP: Waste Water Treatment Plant



Primary Data Source: USGS National Gap Analysis Program, 2004

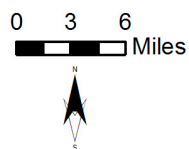


Figure 4.9-10
Sacramento Valley Basin
Cultural Water Demand

Demand Centers

- M&I - High Intensity 
- M&I - Low Intensity 
- Large Mine 
- Small Mine/Quarry 
- Power Plant 
- California State Boundary 
- Interstate Highway 
- Major Road 
- City, Town or Place 

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 4.9-10A and B for water reports and analysis of adequate water supply. Designated water provider information is shown in Table 4.9-10C with date of application, date the designation was issued and projected or annual estimated demand. Figure 4.9-11 shows the locations of subdivisions and designated providers keyed to the Table. A description of the Water Adequacy Program is found in Volume 1, Appendix C. Adequacy determination data sources and methods are found in Volume 1, Appendix A.

- All subdivisions receiving an adequacy determination are in Mohave County. Thirty-two water adequacy determinations have been made in this basin through December 2008. Of the 4,415 lots in 30 subdivisions for which lot information is available 1,200 lots, or 27%, were determined to be adequate.
- The most common reason for an inadequacy determination was because the applicant chose not to submit necessary information and/or available hydrologic data was insufficient to make a determination.
- Six Analysis of Adequate Water Supply applications for a total of 110,946 lots have been approved for this basin.
- There are four designated water providers with a total projected or annual estimated demand of 7,434.86 acre-feet. One provider, City of Kingman, does not have a projected or annual estimated demand.

Table 4.9-10 Adequacy Determinations in the Sacramento Valley Basin¹

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	AZ Gateway	Mohave	16 North	20 West	13	51	53-400703	Adequate		6/11/2002	Arizona American Water Company (Citizens)
2	Black Hills Ranchos Tract 3301	Mohave	21 North	19 West	14	23	53-500340	Adequate		3/15/1995	Golden Valley County Improvement District #1
3	Desert Shadows Ranchos	Mohave	17 North	17 West	9, 15, 25	947	53-500582	Inadequate	A1,A3	5/20/1988	Dry Lot Subdivision
4	Desert Shadows Ranchos of Az #02	Mohave	17 North	17 West	31	12	53-500584	Adequate		8/23/1991	Dry Lot Subdivision
5	Friendly Golden Valley #1	Mohave	21 North	18 West	17	63	53-500688	Adequate		9/14/1993	Valley Pioneer Water Company
7	Golden Valley Ranchos	Mohave	20 North	19 West	23, 35	61	53-500005	Inadequate	A1	2/13/2007	Dry Lot Subdivision
10	Holiday Shores #7	Mohave	20 North	18 West	18	92	53-500801	Adequate		7/29/1977	Oasis Utility Company
11	Lake Havasu Estates #08	Mohave	17 North	17 West	35	NA	53-500873	Inadequate	A1	10/14/1993	Dry Lot Subdivision
12	Lake Havasu Estates Unit 9	Mohave	17 North	17 West	25	120	53-400425	Inadequate	A1	11/21/2000	Dry Lot Subdivision
13	Lake Havasu Estates Unit 9	Mohave	17 North	17 West	25	27	53-401941	Inadequate	A1	12/13/2005	Dry Lot Subdivision
14	Lake Havasu Estates Unit 13	Mohave	17 North	16 West	31	184	53-400427	Inadequate	A1	11/21/2000	Dry Lot Subdivision
15	Lake Havasu Estates Unit 14	Mohave	17 North	16 West	29	372	53-400428	Inadequate	A1	11/21/2000	Dry Lot Subdivision
16	Lake Havasu Estates #15	Mohave	17 North	16 West	17	NA	53-500874	Inadequate	A1	10/21/1993	Dry Lot Subdivision
17	Lake Havasu Heights	Mohave	15 North	19 West	7	21	53-400745	Inadequate	A2, B, C	8/16/2002	Havasut Heights Domestic Water ID
18	Lake Mohave Heights Estates	Mohave	23 North	19 West	25	83	53-700265	Inadequate	A1	3/19/2007	Dry Lot Subdivision
19	Lake Mohave Knoll Estates	Mohave	23 North	18 West	21	127	53-401592	Inadequate	D	12/7/2004	Dry Lot Subdivision
20	Last Lap Subdivision	Mohave	15 North	17 West	31	23	53-400014	Inadequate	A1	2/22/1999	Dry Lot Subdivision
21	Paradise(Units)/Sun West(Unit 3)Acres	Mohave	20 North	18 West	19, 21, 27, 29, 31, 33, 35	862	53-300149	Inadequate	A1, A2	6/25/1996	Dry Lot Subdivision
22	Pioneer Valley	Mohave	18 North	18 West	35	64	53-401383	Adequate		8/2/2004	Dry Lot Subdivision
23	Pioneer Valley and Paradise Trail's Tr. 3802	Mohave	18 North	18 West	25, 35	232	53-401816	Adequate		8/15/2005	Double R Water Distributors, Inc.
25	Rancho Verde Estates	Mohave	21 North	18 West	17	60	53-501273	Adequate		8/11/1986	Valley Pioneer Water Company
26	Rancho Verde Estates #2	Mohave	21 North	18 West	17	263	53-501274	Adequate		2/5/1988	Valley Pioneer Water Company
27	Ranchos Havasu Tract 3705	Mohave	15 North	19 West	5	188	53-700429	Adequate		11/9/2007	Rancho Havasu DWID
29	Sagebrush Trails Estates	Mohave	14 North	17 West	3	97	53-401821	Adequate		10/6/2005	Sagebrush Trails Domestic Water ID
30	Santa Claus Acres #2	Mohave	23 North	18 West	19	64	53-501369	Inadequate	A2, A3	9/10/1992	Dry Lot Subdivision
31	Sawmill Creek Tract 3049	Mohave	20 North	16 West	2	13	53-300039	Inadequate	A1	8/4/1995	Dry Lot Subdivision
33	Walnut Creek Estates #1	Mohave	20 North	17 West	7	42	53-501662	Inadequate	A1	2/22/1985	Unformed Water Company
34	Walnut Creek Estates #2	Mohave	20 North	17 West	7	109	NA	Inadequate	A1	3/14/1988	Walnut Creek Water Co.
35	Walnut Creek Estates Unit 3 Tract 3043-B	Mohave	20 North	17 West	7	44	53-400258	Inadequate	A1	3/28/2000	Walnut Creek Water Co.
36	Walnut Creek Subdivision	Mohave	20 North	17 West	7	73	53-400727	Inadequate	D	5/29/2002	Walnut Creek Water Co.
37	Walnut Creek Unit 2, Tract 3043-A	Mohave	20 North	17 West	7	43	53-501661	Inadequate	A1	11/30/1994	Walnut Creek Water Co.
38	Yucca Vista #2	Mohave	16 North	19 West	11	55	53-501709	Adequate		2/21/1992	Dry Lot Subdivision

Table 4.9-10 Adequacy Determinations in the Sacramento Valley Basin (Cont)¹

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				
6	Golden Valley 5800	Mohave	20 North	18 West	2, 3, 4, 8, 9, 10, 11, 14, 16	32000	43-401823	10/19/2005	NA
			21 North	18 West	34				
8	Golden Valley South	Mohave	20 North	18 West	3, 4, 8, 9, 10, 16	26433	43-402190	8/14/2006	Undetermined
9	Golden Valley South 2	Mohave	20 North	18 West	6, 13, 22, 24, 26, 28	17544	43-700253	10/10/2007	NA
			20 North	19 West	26, 33				
			21 North	18 West	22, 23, 24, 26, 27, 33, 34, 36				
24	Rancho Havasu	Mohave	15 North	19 West	5	189	43-700286	5/25/2007	NA
28	Sacramento Centre & Apache Centre	Mohave	19 North	18 West	4	640	43-700514	7/10/2008	NA
			20 North	18 West	25				
32	Sterling Arizona Villages I, II, III and IV	Mohave	16 North	19 West	18	33500	43-300230	11/8/2006	Sterling Water Company

C. Designated Adequate Water Supply

Map Key	Water Provider Name	County	Designation No.	Projected or Annual Estimated Demand (af/yr)	Date Application Received	Date Application Issued	Year of Projected or Annual Demand
a	Cerbat Water Company	Mohave	40-300106.0000	882	NA	6/14/1998	NA
b	Golden Valley Water Improvement District	Mohave	41-500088.0000	5332	10/14/2006	1/22/2008	2017
c	City of Kingman	Mohave	40-900007.0000	No amount designated	NA	5/17/1973	No data, hydrologic study needed
d	Valley Pioneer Water Company	Mohave	40-900015.0000	844	NA	2/1/1995	NA
e	Walnut Creek Water Company	Mohave	40-401425.0000	376.86	7/24/2004	6/27/2005	2015

Source: ADWR 2008a

Notes:

¹Each 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. Between 1995-2006 all applications for adequacy were given a file number with a 22 prefix.

In 2006 a 53 prefix was assigned to all water adequacy reports and applications regardless of their issue date.

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)

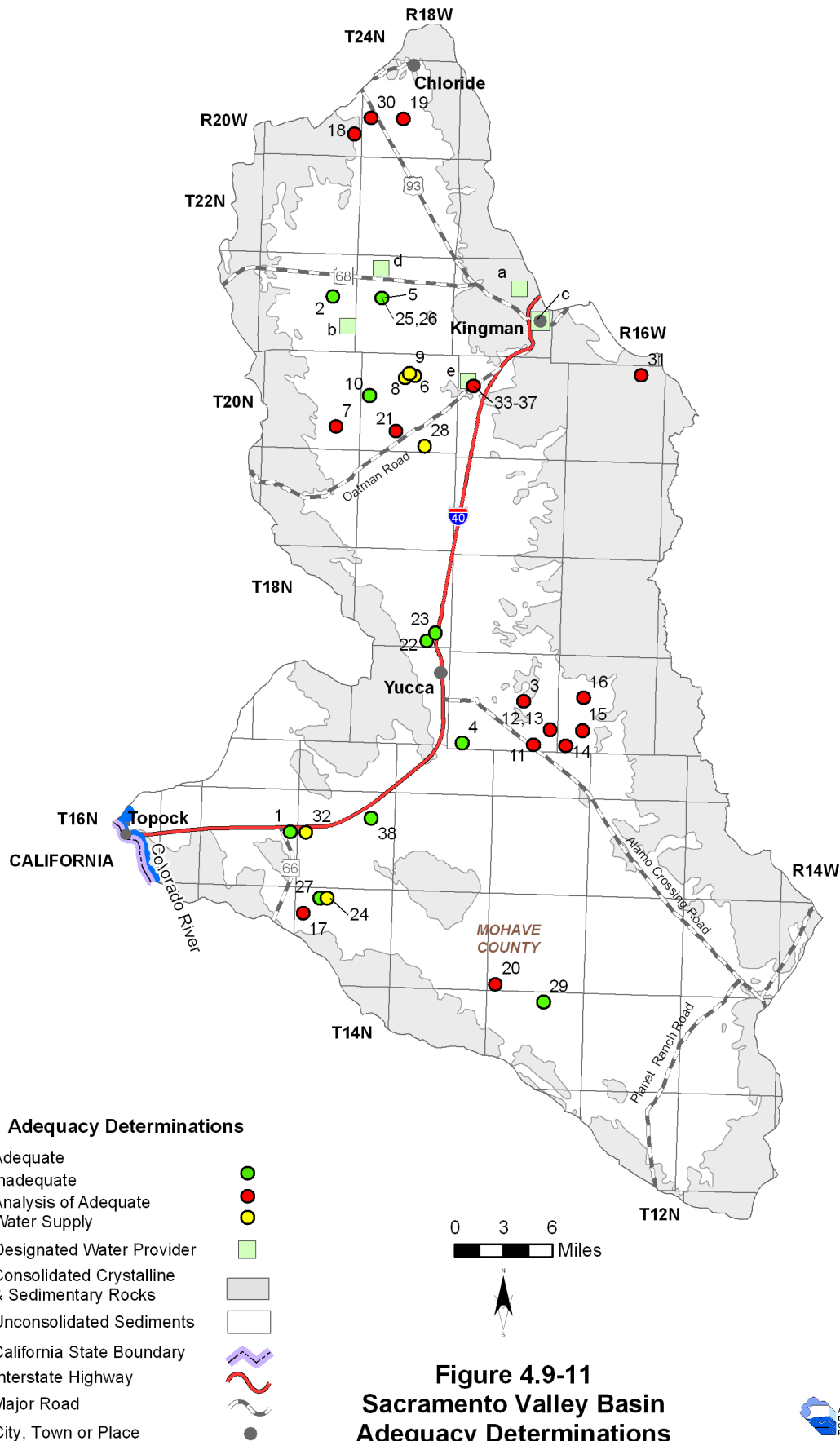
3) Insufficient Infrastructure (distribution system is insufficient to meet demands or applicant proposed water hauling)

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



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
BCPA	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
DWID	Domestic Water Improvement District
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
MHP	Mobile Home Park
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 Evapotranspiration
PCC	Permit Certificate Conveyance
PDO	Pacific Decadal Oscillation
RCRA	Resource Conservation and Recovery Act
SCAS	Spatial Climate Analysis Service
SNOTEL	SNOpack TELelemetry
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
WC	Water Company
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 2008

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

Appendix B

Appendix B: Community Water System Annual Report Data 2006-2007 and Submitted Plans

PCC	FACILITY	Basin	2006 Withdrawn	2006 Diverted	2006 Received	2006 Total Demand	2006 Delivered	2006 Delivered to	2007 Withdrawn	2007 Diverted	2007 Received	2007 Total Demand	2007 Delivered	2007 Delivered to
91-000608	PHELPS DODGE - TOWN OF BAGDAD	Big Sandy			446	446			991			991	991	CUSTOMER
91-000653	PEEPLES VALLEY WATER CO	Bill Williams			50	50	44	CUSTOMER	46			46	41	CUSTOMER
91-000676	WALDEN MEADOWS COMM COOP	Bill Williams			62	62	61/8	CUSTOMER/ SYSTEM	65			65	57/7	CUSTOMER/ SYSTEM
91-000333	MT TIPTON WATER CO INC	Detrital Valley	NR						106			106	106	CUSTOMER
91-000327	WHITE HILLS WC, INC.	Detrital Valley	NR						NR					
91-000358	CERBAT WATER CO	Hualapai Valley	NR						73		27			
91-000360	JOSHUA HILLS WATER CO	Hualapai Valley			23	23			26			26	26	CUSTOMER
91-000344	RANCH WATER SERVICE INC	Hualapai Valley			12	12	12	CUSTOMER	30			30	29	CUSTOMER
91-000324	TRUXTON CANYON WATER CO	Hualapai Valley	NR						150			150	211	CUSTOMER
91-000325	ARIZONA AMERICAN (CAMP MOHAVE)	Lake Havasu			81	81	79	CUSTOMER	86			86	85	CUSTOMER
91-000313	ARIZONA AMERICAN (HAVASU WATER)	Lake Havasu			795	795	788	CUSTOMER	902			902	751	CUSTOMER
91-000321	HAVASU HEIGHTS DWID	Lake Havasu			57	57	58	CUSTOMER	65			65	59	CUSTOMER
91-000361	LAKE MEAD NRA KATHERINE	Lake Havasu	201			201	201	CUSTOMER		177		177	177	CUSTOMER
91-000350	SUNRISE VISTA UTILITIES	Lake Havasu		229		229	229	CUSTOMER			176	176	176	CUSTOMER
91-000328	WILLOW VALLEY WC- KING STREET	Lake Havasu			356	356	339	CUSTOMER	348			348	335	CUSTOMER
91-000349	WILLOW VALLEY WC- LAKE CIMARRON	Lake Havasu			40	40	31	CUSTOMER	66			66	52	CUSTOMER
91-000314	JOSHUA VALLEY UTIL CO	Meadview			140	140	121	CUSTOMER	163			163	141	CUSTOMER
91-000351	ARIZONA AMERICAN (DESERT FOOTHILLS)	Lake Mohave			640	640	632	CUSTOMER	788			788	703	CUSTOMER
91-000335	ARIZONA AMERICAN (LAKE MOHAVE HIGHLANDS)	Lake Mohave			87	87	78	CUSTOMER	88			88	79	CUSTOMER
91-000322	ARIZONA AMERICAN (MOHAVE WATER)	Lake Mohave			6,733	6,733	6,699	CUSTOMER	6,642			6,642	6621	CUSTOMER
91-000336	BERMUDA WATER CO INC	Lake Mohave			3,883	3,883	3,521/318	CUSTOMER/ SYSTEM	4,017			4,017	3,677/339	CUSTOMER/ SYSTEM
91-000308	FORT MOHAVE TRIBAL UTIL	Lake Mohave		69	518	587	278	CUSTOMER	NR					
91-000354	GHR LANDOWNERS ASSN WATER COOP	Lake Mohave			9	9			11			11	11	CUSTOMER
91-000319	GOLDEN SHORES WATER CO	Lake Mohave			493	493			492			492	491	CUSTOMER

PCC	FACILITY	Basin	2006 Withdrawn	2006 Diverted	2006 Received	2006 Total Demand	2006 Delivered	2006 Delivered to	2007 Withdrawn	2007 Diverted	2007 Received	2007 Total Demand	2007 Delivered	2007 Delivered to
91-000359	HARDYVILLE MANOR	Lake Mohave	NR						NR					
91-000355	I-40 INDUSTRIAL WATER SYS	Lake Mohave			1,636	1,636	1,460	CUSTOMER	2,258			2,258	2063	CUSTOMER
91-000315	KATHERINE RESORT WATER COMPANY	Lake Mohave			9	9	9	CUSTOMER	8			8	8	CUSTOMER
91-000317	LAGOON ESTATES WATER CO	Lake Mohave	NR						136			136	120	CUSTOMER
91-000332	LAGOON ESTATES WATER CO	Lake Mohave	NR						11			11	9	CUSTOMER
91-000318	LAKE HAVASU, CITY OF	Lake Mohave	14,534			14,534	14,363/1,500	CUSTOMER/ OTHER	15,500	349		15,849	13963/1695	CUSTOMER/ OTHER
91-000339	NORTH MOHAVE VALLEY WATER CORPORATION	Lake Mohave	1,150			1,150	1,089	CUSTOMER		1,029		1,029	946	CUSTOMER
91-000337	SILVER CREEK RV	Lake Mohave	NR						NR					
91-000338	SNOWBIRD RV PARK	Lake Mohave	NR						NR					
91-000258	SNOWBIRDS MOBILE HOME PA	Lake Mohave	NR						NR					
91-000334	SUNCREST APARTMENTS	Lake Mohave	NR						NR					
91-000312	HATCH VALLEY WATER CO	Peach Springs			30	30	23	CUSTOMER	23			23	22	CUSTOMER
91-000309	CHLORIDE DWID	Sacramento Valley	NR						14		4	18	15	CUSTOMER
91-000343	GOLDEN VALLEY IMP DIST #1	Sacramento Valley			330	330	408	CUSTOMER	451			451	403	CUSTOMER
91-000316	KINGMAN MUNICIPAL WATER	Sacramento Valley			9,078	9,078	8,504	CUSTOMER	9,382			9,382	9,382/29	CUSTOMER/ SYSTEM
91-000307	OATMAN WATER COMPANY	Sacramento Valley	NR						14			14	14	CUSTOMER
91-000329	SO HI DWID	Sacramento Valley			42	42	40	CUSTOMER	47			47	42	CUSTOMER
91-000323	TOPOCK WATER SYSTEM	Sacramento Valley	NR						NR					
91-000326	VALLEY PIONEERS WC, INC	Sacramento Valley			688	688	659	CUSTOMER	930			930	800	CUSTOMER
91-000341	WALNUT CREEK WATER CO	Sacramento Valley			98	98	99	CUSTOMER	103			103	89	CUSTOMER
91-000330	YUCCA WATER ASSOCIATION	Sacramento Valley	NR						48			48	49	CUSTOMER

PCC = Program Certificate Conveyance (used as the community water system ID number)

**Community Water Systems that have submitted a plan to the
Department as of 12/2008**

PCC	Name	Basin
91-000608	PHELPS DODGE - TOWN OF BAGDAD	Big Sandy
91-000653	PEEPLES VALLEY WATER CO	Bill Williams
91-000676	WALDEN MEADOWS COMM COOP	Bill Williams
91-000333	MT TIPTON WATER CO INC	Detrital Valley
91-000360	JOSHUA HILLS WATER CO	Hualapai Valley
91-000313	ARIZONA AMERICAN (HAVASU WATER)	Lake Havasu
91-000321	HAVASU HEIGHTS DWID	Lake Havasu
91-000325	ARIZONA AMERICAN (CAMP MOHAVE)	Lake Havasu
91-000328	WILLOW VALLEY WC-KING STREET	Lake Havasu
91-000349	WILLOW VALLEY WC-LAKE CIMARRON	Lake Havasu
91-000350	SUNRISE VISTA UTILITIES	Lake Havasu
91-000314	JOSHUA VALLEY UTIL CO	Meadview
91-000308	FORT MOHAVE TRIBAL UTILITY	Lake Mohave
91-000315	KATHERINE RESORT WATER COMPANY	Lake Mohave
91-000317	LAGOON ESTATES WATER CO	Lake Mohave
91-000318	LAKE HAVASU, CITY OF	Lake Mohave
91-000319	GOLDEN SHORES WATER CO	Lake Mohave
91-000322	ARIZONA AMERICAN (MOHAVE WATER)	Lake Mohave
91-000332	LAGOON ESTATES WATER CO	Lake Mohave
91-000335	ARIZONA AMERICAN (LAKE MOHAVE HIGHLANDS)	Lake Mohave
91-000336	BERMUDA WATER CO INC	Lake Mohave
91-000339	NORTH MOHAVE VALLEY WATER CORPORATION	Lake Mohave
91-000351	ARIZONA AMERICAN (DESERT FOOTHILLS)	Lake Mohave
91-000354	GHR LANDOWNERS ASSN WATER COOP	Lake Mohave
91-000355	I-40 INDUSTRIAL WATER SYS	Lake Mohave
91-000357	AZ AMERICAN WTR CO	Lake Mohave
91-000359	HARDYVILLE MANOR	Lake Mohave
91-000312	HATCH VALLEY WATER CO	Peach Springs
91-000309	CHLORIDE DWID	Sacramento Valley
91-000316	KINGMAN MUNICIPAL WATER	Sacramento Valley
91-000326	VALLEY PIONEERS WC, INC	Sacramento Valley
91-000329	SO HI DWID	Sacramento Valley
91-000341	WALNUT CREEK WATER CO	Sacramento Valley
91-000343	GOLDEN VALLEY IMP DIST #1	Sacramento Valley

PCC = Program Certificate Conveyance (used as the community water system ID number)

Appendix C

APPENDIX C

SURFACE WATER RIGHT AND ADJUDICATION FILINGS

Surface water is defined in Arizona as “waters of all sources, flowing in streams, canyons, ravines or other natural channels, or in definite underground channels, whether perennial or intermittent, floodwaters, wastewaters, or surplus water, and of lakes, ponds and springs on the surface” (A.R.S. § 45-101).

In 1864, the first territorial legislature of Arizona adopted the doctrine of prior appropriation to govern the use of surface water. The doctrine is based on the tenet of “first in time, first in right” which means that the person who first puts the water to beneficial use acquires a right that is superior to later appropriators of the water. Since the population and water use were both relatively small at that time, no method was initially specified by the legislature for filing surface water right claims or granting rights. By the late 1800s, rapid development of irrigated agriculture combined with drought years had resulted in severe water shortages along the Salt and Gila Rivers. The territorial legislature responded in 1893 with a requirement that new water appropriations be posted at the point of diversion. However, until 1919, a person could acquire a surface water right simply by applying the water to beneficial use and recording a notice of appropriation at the state and country recorder’s office. There still was not a mechanism for granting surface water rights (ADWR, 1992).

On June 12, 1919, the state legislature enacted a surface water code. Now known as the Public Water Code, the law generally requires that a person apply for and obtain a permit in order to appropriate surface water. There is an exception for water use from the mainstem of the Colorado River, which requires a contract with the Secretary of the Interior. In addition, most persons claiming surface water rights prior to the code have been required to file a statement of claim under the Water Rights Registration Act of 1974, although the act did not provide a process for determining the validity of these claims. The legislature also enacted the Stockpond Registration Act in 1977 to recognize certain unpermitted stockponds constructed after 1919 that had not gone through the application process.

The Public Water Code provides that beneficial use shall be the basis, measure and limit to the use of water within the state. Beneficial uses are domestic (which includes the watering of gardens and lawns not exceeding one-half acre), municipal, irrigation, stockwatering, water power, recreation, wildlife including fish, nonrecoverable water storage, and mining uses (A.R.S. § 45-151(A)). The quantity of water that is reasonable for a particular beneficial use depends on a number of factors, including the location of the use.

The Department maintains a registry of surface water right applications and claims filed in Arizona since the Public Water Code was enacted. Each filing is assigned a unique number with one of the following prefixes

- “3R” – application to construct a reservoir filed before 1972;
- “4A” – application to appropriate surface water filed before 1972;
- “33” – application for permit to appropriate public water or construct a reservoir filed after

1972. In addition to surface water diversions and reservoirs, instream flow maintenance can be applied for and is defined as a surface water right that remains in-situ or “in-stream”, is not physically diverted or consumptively used, and is for maintaining the flow of water necessary to preserve wildlife, including fish, and/or recreation;

- “36” – statement of claim of rights to use public waters of the state. To make this claim, an applicant or predecessor-in-interest must have initiated a water use based on state law before March 17, 1995;
- “38” – claim of water right for a stockpond and application for certification filed for stockponds constructed after June 12, 1919 and before August 27, 1977. To file this claim and application, the stockpond should have been used exclusively for watering of livestock and/or wildlife, have a maximum capacity of 15 acre-feet, and not be subject to water rights litigation or protests prior to August 27, 1977;
- “39” – statement of claimant filed in *The General Adjudication of the Gila River System and Source* (Gila Adjudication) and *The General Adjudication of the Little Colorado River System and Source* (LCR Adjudication). As explained further below, the Department maintains a separate registry of these filings on behalf of the Superior Court of Arizona; and,
- “BB” – decreed water rights determined through judicial action in state or federal court.

These filings specify the source of water, its point of diversion (POD) and place of use (POU), the type and quantity of water use, and date of first use or priority.

If, after moving through a number of administrative steps, an application to appropriate surface water or construct a reservoir (3R, 4A, or 33) is determined to be for beneficial use and not conflict with vested rights or be a menace to public safety or against the interests and welfare of the public, it may be approved and the applicant issued a permit to appropriate. The permit allows the permit holder to construct diversion works, as needed, and put the water to beneficial use. If the terms of the permit are met, the applicant can submit proof of appropriation through an application of certification and may be issued a Certificate of Water Right (CWR). The CWR has a priority date that relates back to the date of application and is evidence of a perfected surface water right that is superior to all other surface water rights with a later priority date, but junior to all rights with an earlier (older) priority date. The CWR also specifies the extent and purpose of the right and may be subject to abandonment and forfeiture if not beneficially used. There are currently approximately 850 applications to appropriate pending with ADWR, and approximately 420 permits and over 7,000 certificates have been issued by ADWR or its predecessors.

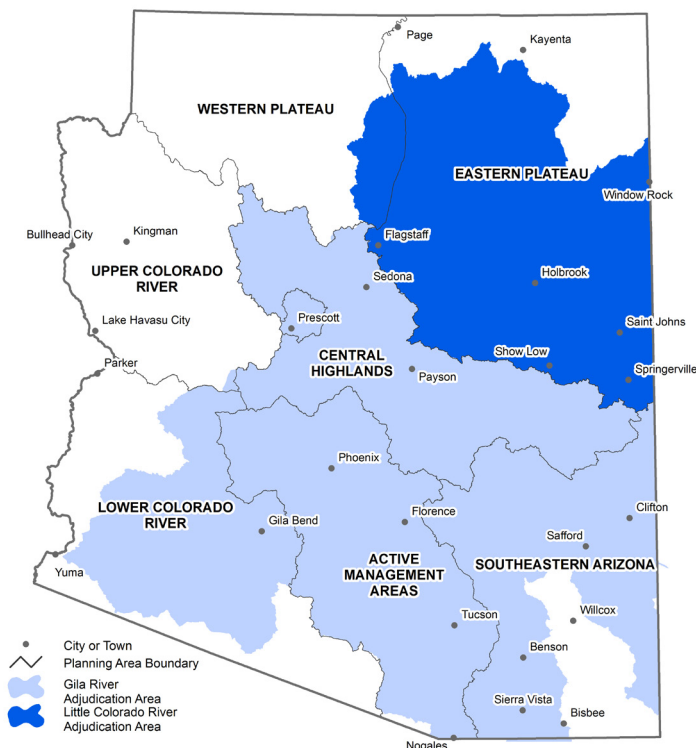
A CWR may also be issued based on a stockpond claim (38) if it is found that the facts stated in the claim are true and entitle the claimant to a water right for the stockpond. The priority date depends on the date that the owner of the stockpond filed the claim. If filed prior to March 17, 1996, the priority date is the date of construction. Otherwise, the priority date is the date of filing the claim. Regardless of the date, the CWR for a stockpond claim is junior to (a) Colorado River and other court decreed rights; (b) other rights acquired prior to June 12, 1919 and registered as a statement of claim; and (c) any other CWR issued pursuant to an application filed before August 27, 1977. To date, nearly 20,000 stockpond claims have been filed of which over 3,000 stockpond certificates have been issued by ADWR or its predecessors.

Unlike a CWR, the act of filing a statement of claim (36) does not in itself create a water right, nor does it constitute a judicial determination of the claim. Statements of claim are subject to challenge, but can be admitted “in evidence as a rebuttal presumption of the truth and accuracy of the information contained in the claim” (A.R.S. § 45-185). To date, nearly 30,000 statements of claim have been filed in Arizona.

In addition to the applications and claims described above, ADWR’s registry of surface water right filings includes several rights determined through judicial action in state or federal court. These ‘adjudications’, in which a water right is determined by court action, may be initiated when one or more water users seek to know how their rights compare to the rights of other water users and/or seek judicial relief from alleged interference with their rights by other water users. The court process establishes or confirms the validity of surface water rights and claims, determines whether these have been properly maintained over the years, and ranks them according to their priority. The result is a decree that may, in addition to establishing and confirming rights, specifies terms under which the decreed rights may be exercised if water shortages occur. Court decreed rights are considered the most valued or certain surface water rights because in the absence of abandonment or forfeiture, they are normally accepted as to their validity. More than 1,000 court-decreed rights are listed in ADWR’s registry and given the prefix “BB”. Further discussion of the major court decrees is provided in Volume 1.

Although several surface water uses have been decreed, many claims and rights established before and after statehood have still not been examined to see if they remain valid. In addition, many

Figure C-1 General Stream Adjudications in Arizona



water rights established under federal law and claimed by Indian tribes and the United States have not been quantified or prioritized. To better manage water resources in the state, these diverse rights and claims have been joined into large, comprehensive determinations.

Arizona currently has two general stream adjudications – the Gila Adjudication and the LCR Adjudication. The purpose of these judicial proceedings is to determine the nature, extent, and priority of water rights across the entire river systems. In addition to confirming existing state-based surface water rights, the adjudications will quantify and prioritize reserved water rights for Indian and non-Indian federal lands. The latter include military bases, national parks and monuments, and national forests. The adjudications will also determine which wells are

pumping appropriable underground water (subflow) and therefore are subject to the jurisdiction of the court. The Gila and LCR Adjudications are being conducted in the Superior Court of Arizona in Maricopa and Apache Counties, respectively. ADWR provides technical, legal and administrative support to the adjudication court, as described in A.R.S. § 45-256.

The Gila Adjudication was initiated in 1974 when SRP filed a petition to determine the water rights in the Salt River Watershed above the Granite Reef Diversion. Since that time, the adjudication area has grown and now covers over 53,000 square miles. It is divided into 7 watersheds and includes 12 Indian reservations and over 24,000 parties. The LCR Adjudication was initiated by a petition filed by Phelps Dodge in 1978. This adjudication now covers 27,000 square miles and includes 3 watersheds, 5 Indian reservations, and over 3,000 parties. A party is a person or entity that has filed one or more statement of claimant (SOC) in the adjudication.

All parties who claim to have a water right within the river systems are required to file an SOC or risk the loss of their right. Well owners are also encouraged to file an SOC since the adjudication process may include water use from a well depending on the well's location relative to streams and other factors. However, a person does not obtain a right to use water by filing an SOC nor is an SOC a legal permit to use water. Rights to use water must be acquired in accordance with state or federal law.

Each year, ADWR sends summons to new surface water appropriators and well owners in the adjudication areas that direct them to file an SOC. In response, the number of SOC's filed in the adjudications continues to increase as new water uses are initiated. To date, nearly 81,000 SOC's have been filed in the Gila Adjudication and over 14,000 SOC's have been filed in the LCR Adjudication. ADWR maintains a separate registry of these adjudication filings on behalf of the Superior Court and assigns each a unique number with the prefix "39".

Table C-1 summarizes the number of surface water right and adjudication filings for each planning area. The table was generated by querying ADWR's surface water right and SOC registries in February 2009. Files are only counted in the table if they include sufficient locational information (Township, Range, and Section) to allow a POD and/or POU to be mapped within the planning area. If a file lists more than one POD or POU in a planning area, it is only counted once in the table for that planning area. However, no attempt was made to avoid counting multiple filings for the same POD/POU which can result if a landowner or lessee has two or more filings or if different applicants each have at least one filing. Since many SOC's list surface water right filings as their basis of claim, multiple filings are common and account, in part, for the large number of filings. Sorting through multiple filings is one of the challenges facing the Department and the adjudication courts. Results from the Department's investigation of surface water right and adjudication filings are presented in Hydrographic Survey Reports (HSRs).

Figure C-2 shows the location of surface water diversion points listed in the Department's surface water rights registry. The numerous points mapped reflect the relatively large number of stockpounds and reservoirs that have been constructed across the state as well as diversions from streams and springs. Locations for registered wells, many of which are referenced as the basis of claim in SOC's, are also shown in Figure C-2. Instream flow filings are not shown as these filings do not have points of diversion.

Table C-1 Count of Surface Water Right and Adjudication Filings by Planning Area¹

PLANNING AREA	TYPE OF FILING							TOTAL
	BB ²	3R ³	4A ³	33 ³	36 ⁴	38 ⁵	39 ⁶	
Eastern Plateau	134	163	196	373	3,289	3,275	12,099	19,529
Southeastern	483	395	716	898	8,288	6,415	19,288	36,483
Upper Colorado River	0	224	329	469	2,858	2,084	0	5,964
Central Highlands	1	287	625	897	8,517	3,928	25,443	39,698
Western Plateau	0	415	207	554	1,177	1,270	324	3,947
Lower Colorado River	0	26	48	86	355	304	2,323	3,142
Active Management Areas	1	269	341	687	4,072	2,913	27,134	35,417
Total	619	1,779	2,462	3,964	28,556	20,189	86,611	144,180

Notes:

¹ Based on a query of ADWR's surface water right and adjudication registries in February 2009. A file is only counted in this table if it provides sufficient information to allow a Point of Diversion (POD) and/or Place of Use (POU) to be mapped within the planning area. If a file lists more than one POD or POU in a given planning area, it is only counted once in the table for that planning area. Several surface water right and adjudication filings are not counted here due to insufficient locational information. However, multiple filings for the same POD/POU are counted.

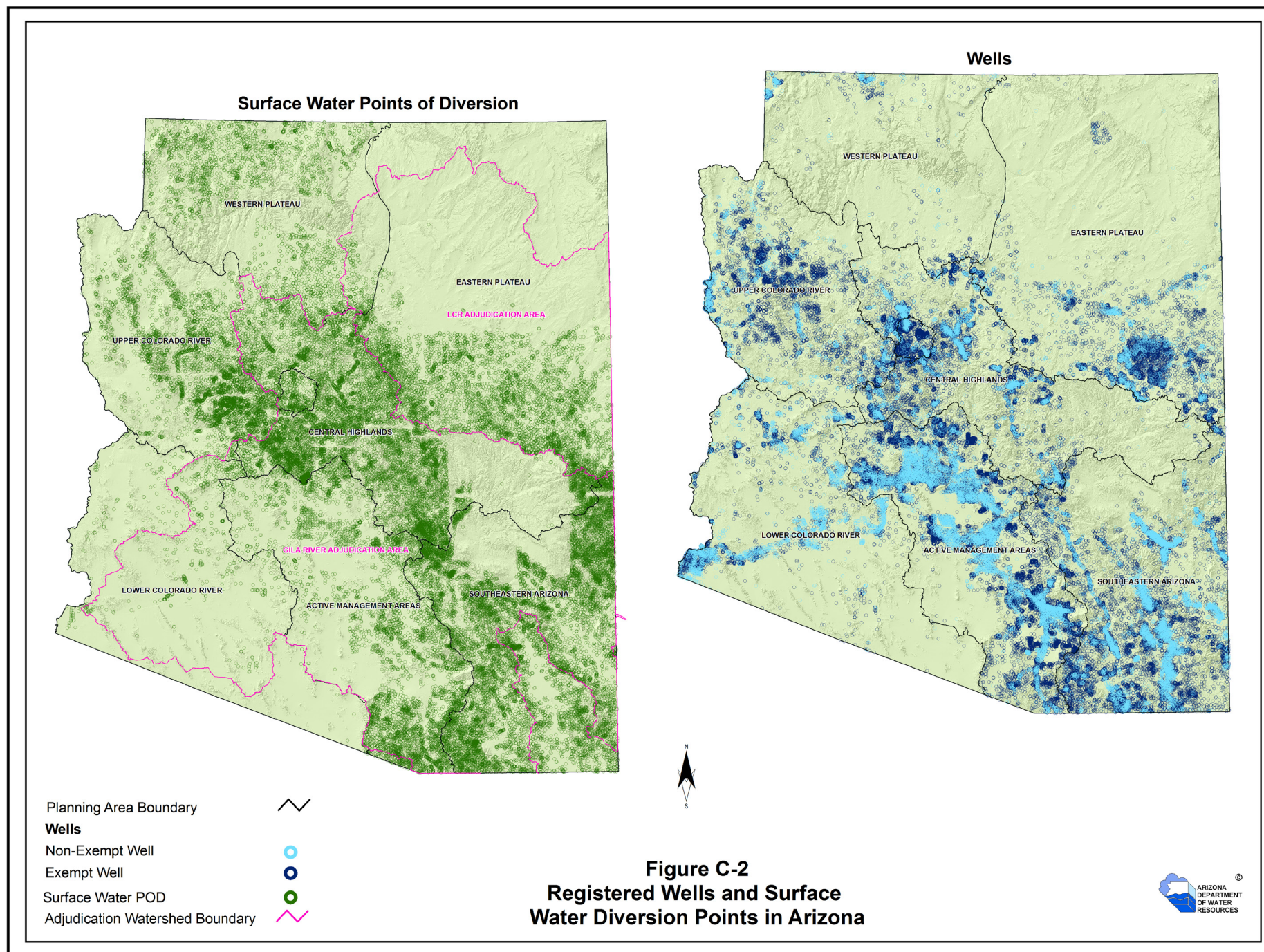
² Court decreed rights; not all of these rights have been identified and/or entered into ADWR's surface water rights registry.

³ Application to construct a reservoir, filed before 1972 (3R); application to appropriate surface water, filed before 1972 (4A); and application for permit to appropriate public water or construct a reservoir, filed after 1972 (33).

⁴ Statement of claimant of rights to use public waters of the state, filed pursuant to the Water Rights Registration Act of 1974.

⁵ Claim of water right for a stockpond and application for certification, filed pursuant to the Stockpond Registration Act of 1977.

⁶ Statement of claimant, filed in the Gila or LCR General Stream Adjudications.





Appendix D

APPENDIX D: Rural Watershed Partnerships in the Upper Colorado River Planning Area - participants, projects, accomplishments and issues (2008)

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	- Groundwater reconnaissance survey of 3 basin area. - Coordinated the clean-up of numerous wildcat dumpsites. - Comprehensive groundwater study and conceptual model initiated. - Relative gravity survey of Detrital, Sacramento, and Hualapai Basins initiated. - Completed sampling of groundwater for age dating study - Established micro-gravity data collection stations for monitoring changes in groundwater elevations	- 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
Mohave County Water Authority	Lake Havasu Kingman Bullhead City Mohave County Mohave Valley Irrigation Dist	- Obtained a portion of the Cibola Irrigation District's Colorado River Allocation - Obtained Kingman's Colorado River Allocation	- Growth - Limited Colorado River water supplies - Competition from Phoenix/Tucson for additional Colorado River supplies - Water quality concerns