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

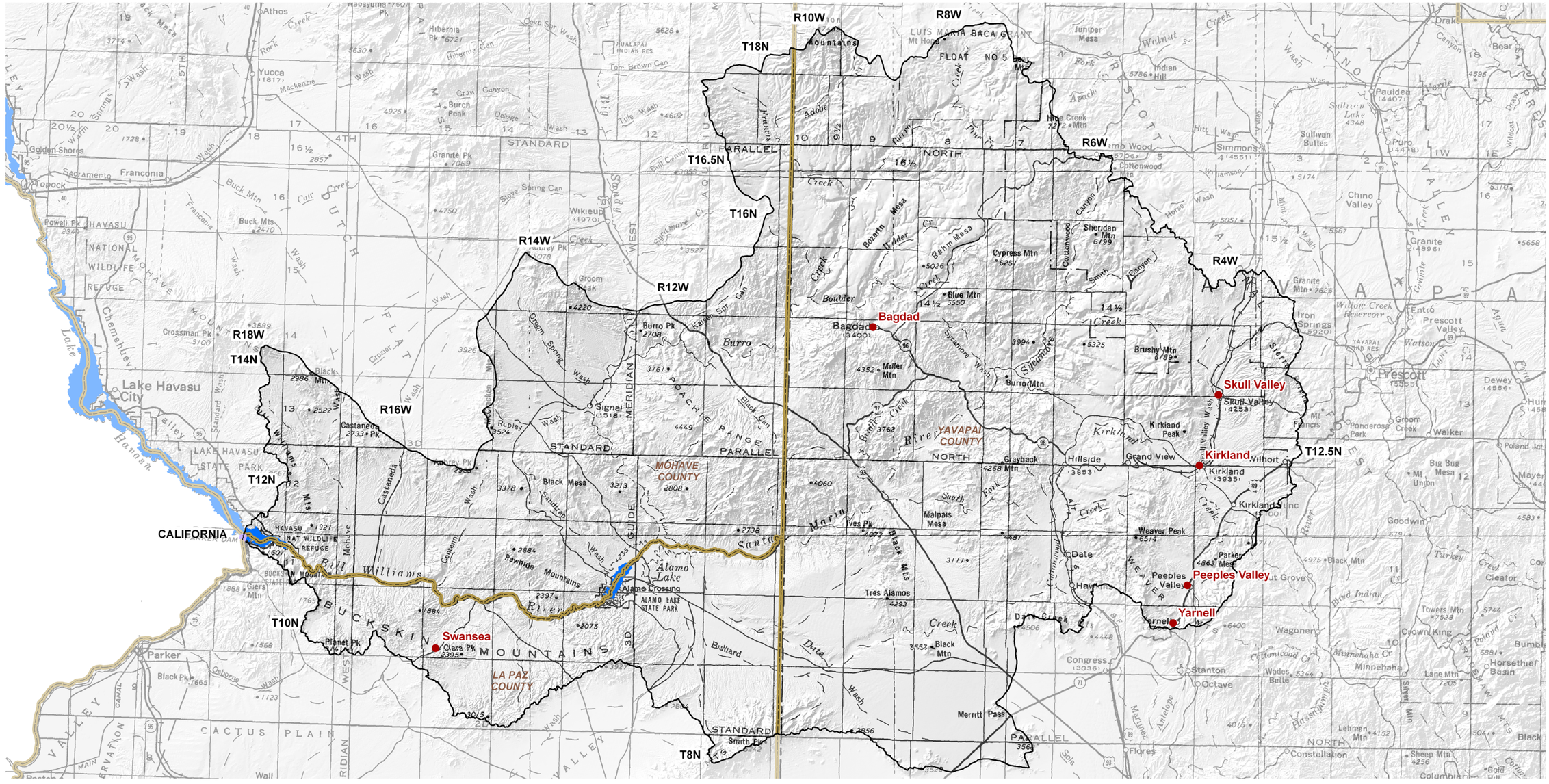


Figure 4.2-1
Bill Williams Basin
Geographic Features

4.2.2 Land Ownership in the Bill Williams Basin

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

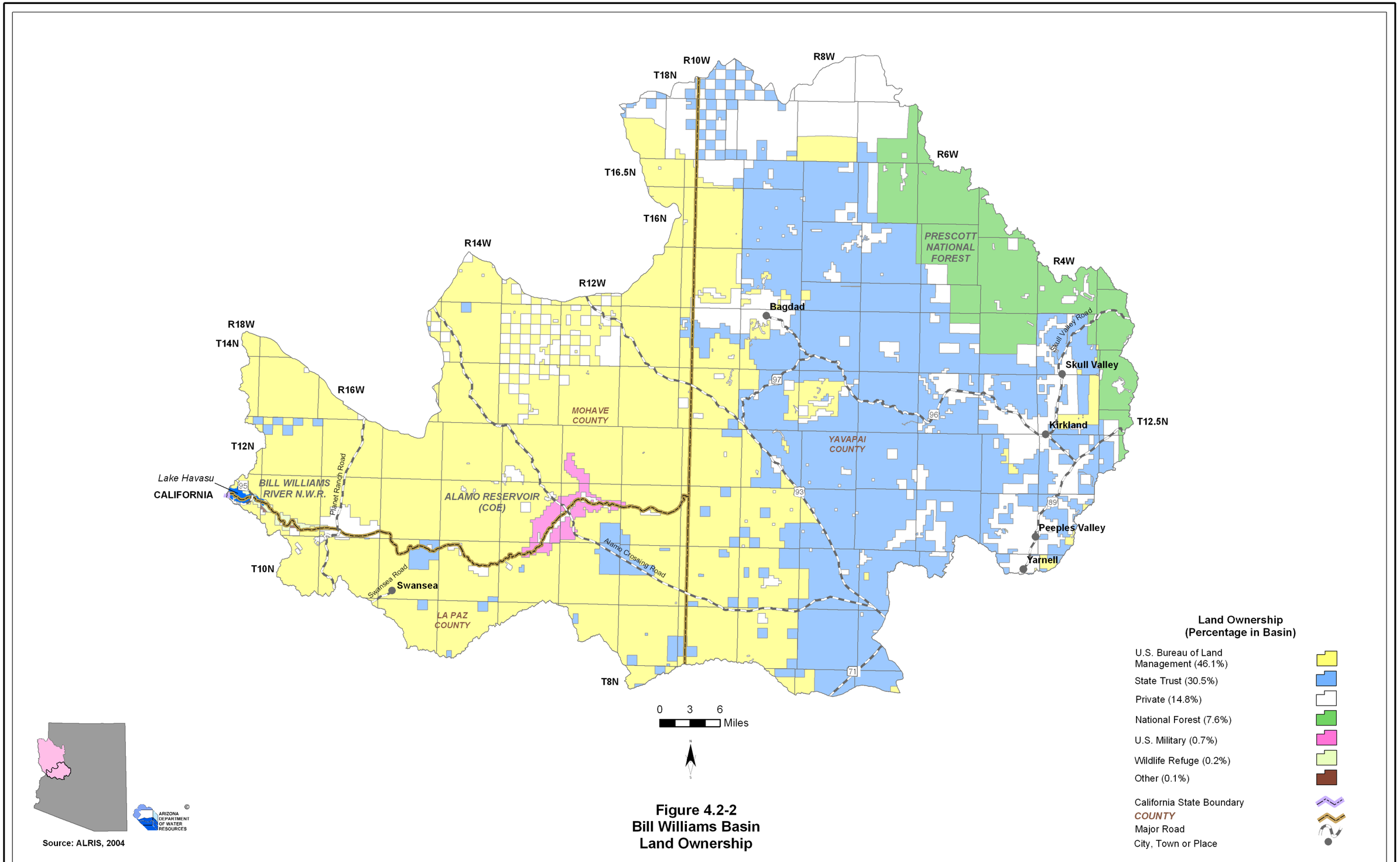


Figure 4.2-2
Bill Williams Basin
Land Ownership

4.2.3 Climate of the Bill Williams Basin

Climate data from NOAA/NWS Co-op Network stations are complied in Table 4.2-1 and the locations are shown on Figure 4.2-3. Figure 4.2-3 also shows precipitation data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. The Bill Williams Basin does not contain Evaporation Pan, AZMET and SNOTEL/Snowcourse stations. 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:
[1]Average temperature for period of record shown; average precipitation from 1971-2000

B. Evaporation Pan:

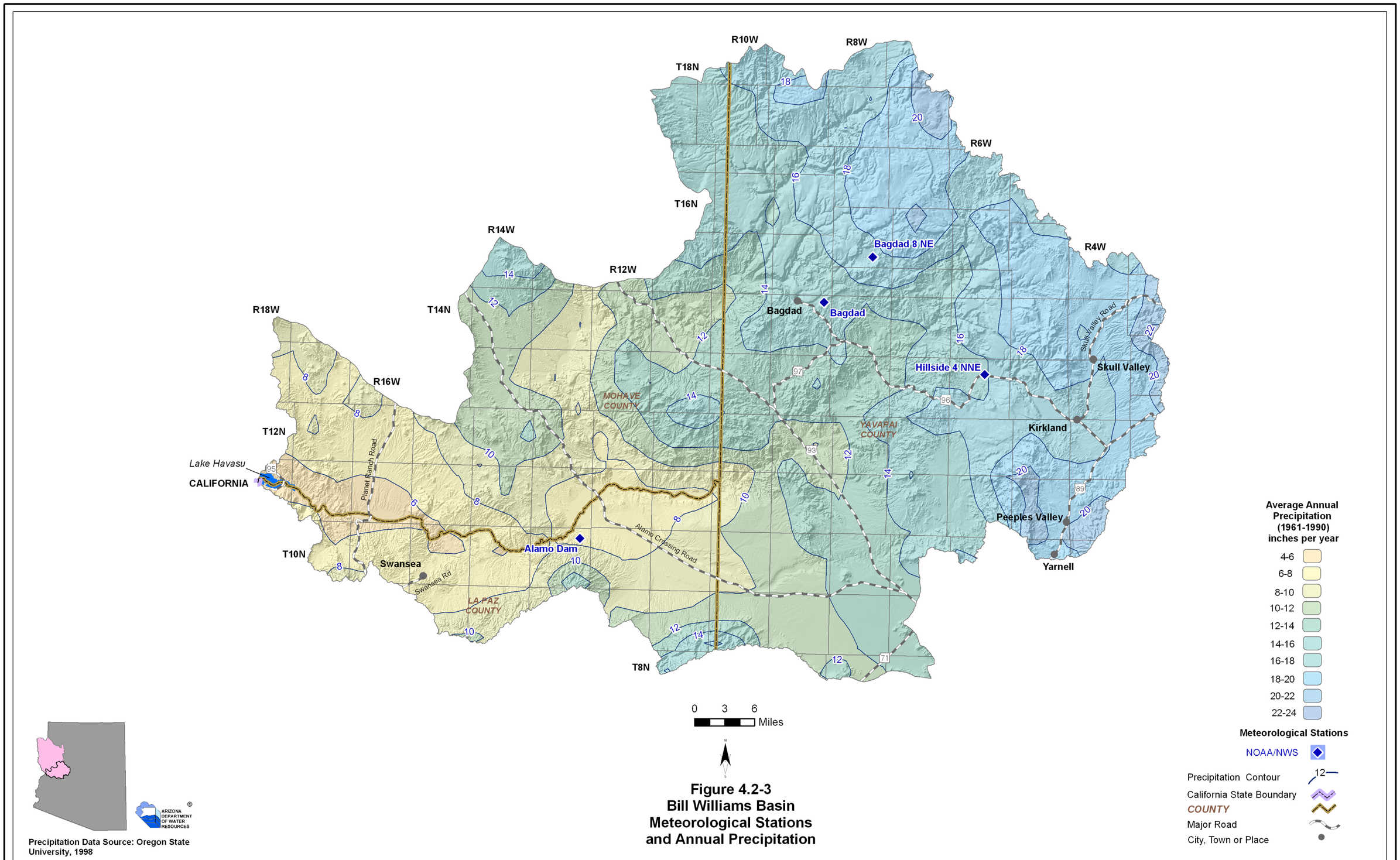
Station Name	Elevation (in feet)	Period of Record Used for Averages	Avg. Annual Evap (in inches)
None			

C. AZMET:

Station Name	Elevation (in feet)	Period of Record	Average Annual Reference Evaportranspiration, 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

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

4.2.4 Surface Water Conditions in the Bill Williams Basin

Streamflow data, including average seasonal flow, average annual flow and other information is shown in Table 4.2-2. Flood ALERT equipment in the basin is shown in Table 4.2-3. Reservoir and stockpond data, including maximum storage or maximum surface area, are shown in Table 4.2-4. The location of streamflow gages 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:

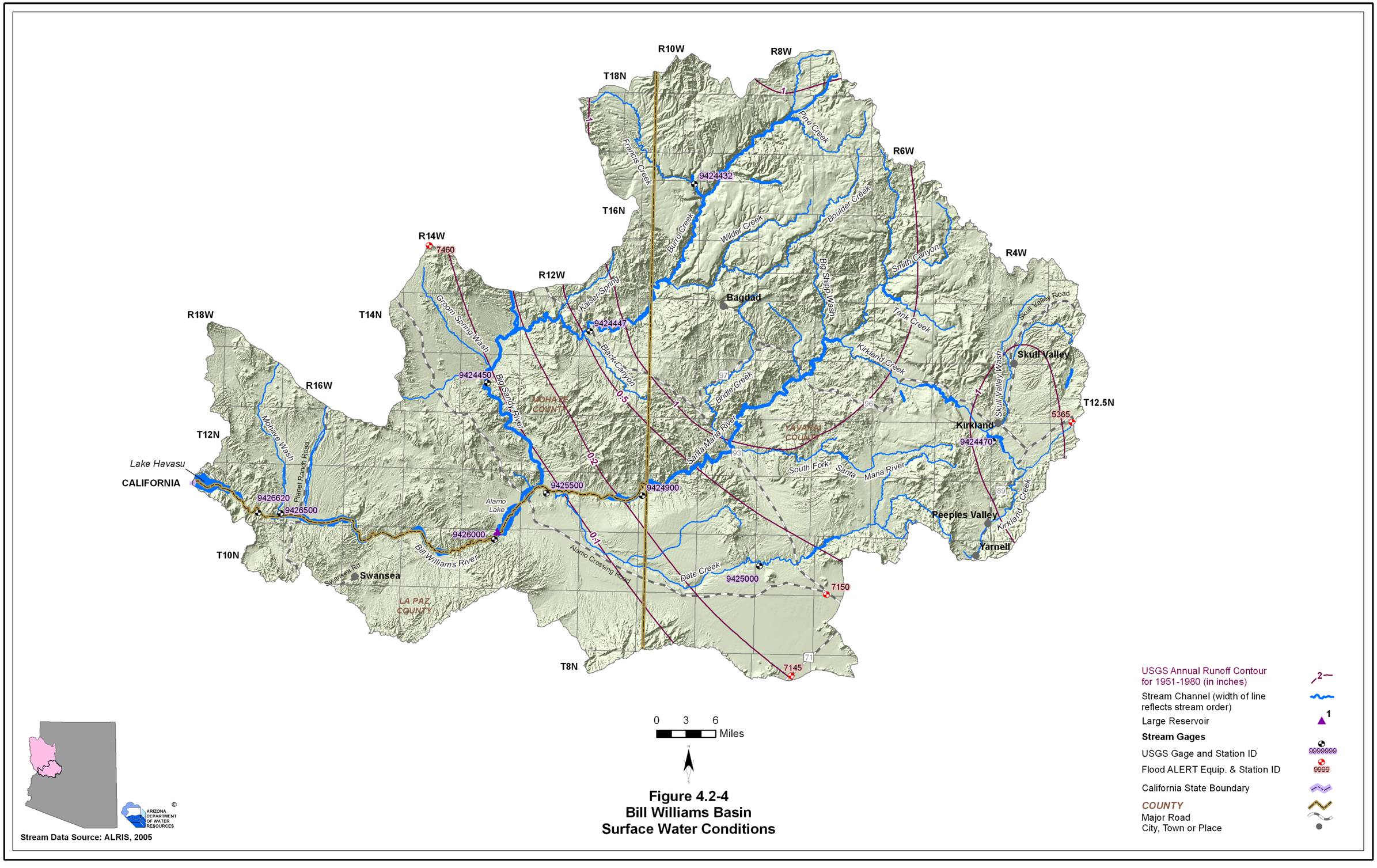
[1]C=flood control; R=recreation; H=hydroelectric power; I=irrigation; S=supply

[2]Normal capacity < 500 acre-feet

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

[4]Includes 28,600 acre-feet of dead storage

[5]Capacity data not available to ADWR



0 3 6 Miles

N

Figure 4.2-4
Bill Williams Basin
Surface Water Conditions

USGS Annual Runoff Contour for 1951-1980 (in inches)
Stream Channel (width of line reflects stream order)
Large Reservoir
Stream Gages
USGS Gage and Station ID
Flood ALERT Equip. & Station ID
California State Boundary
COUNTY
Major Road
City, Town or Place

ARIZONA DEPARTMENT OF WATER RESOURCES ©

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

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

Stream Data Source: AGFD, 1993 & 1997
Brown and Carmony, 1981

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 Peeples 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 Peeples 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	Freethey and Anderson (1986)
Estimated Water Currently in Storage, in acre-feet:	23,000,000 (to 1,200 ft)	ADWR (1990)
	10,000,000[1] (to 1,200 ft)	Freethey and Anderson (1986)
	20,000,000 (to 1,200 ft)	Arizona Water Commission (1975)
Current Number of Index Wells:	24	
Date of Last Water-level Sweep:	1979 (117 wells measured)	

Notes:
[1]Predevelopment Estimate

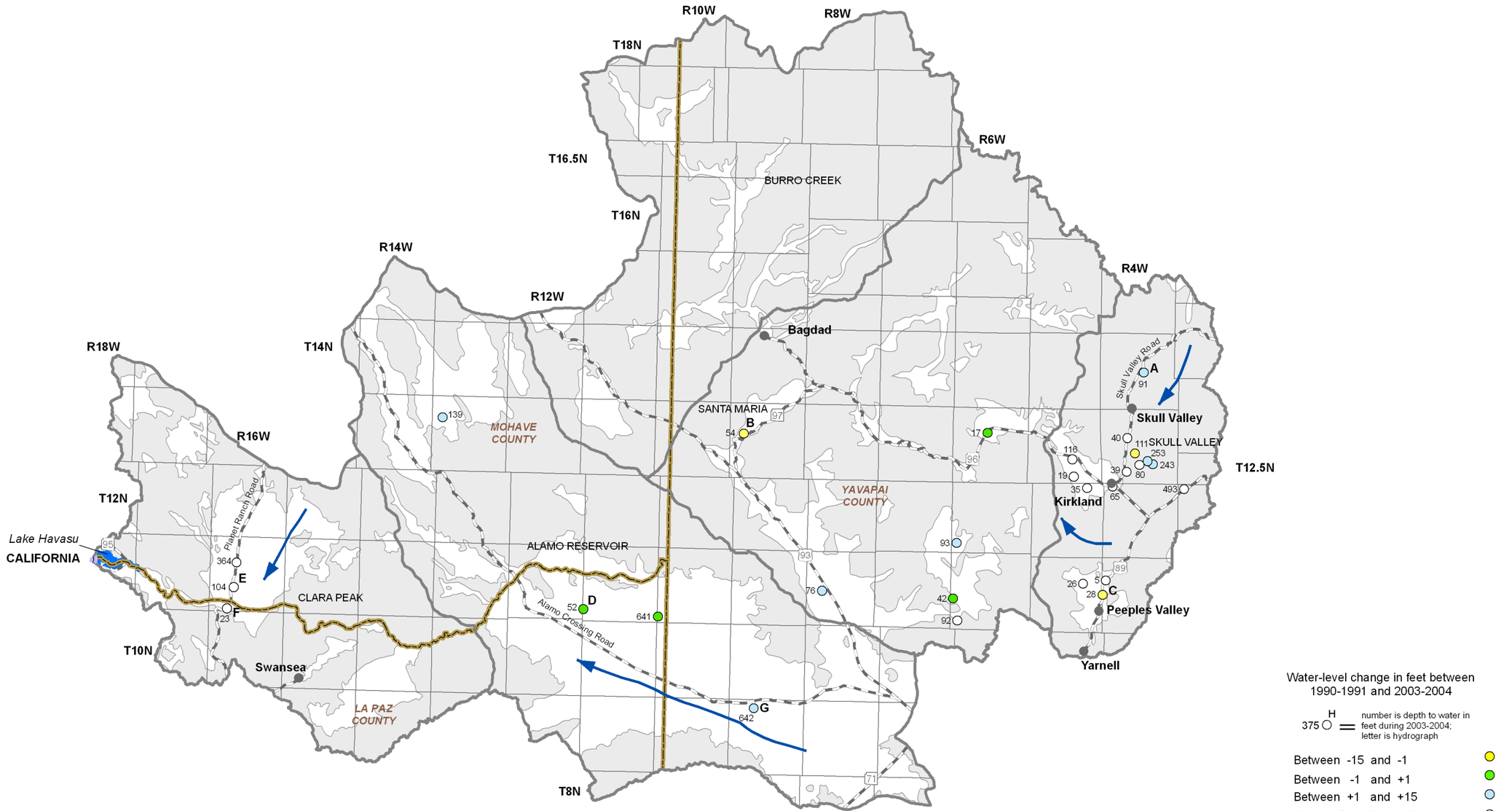


Figure 4.2-6
Bill Williams Basin
Groundwater Conditions

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

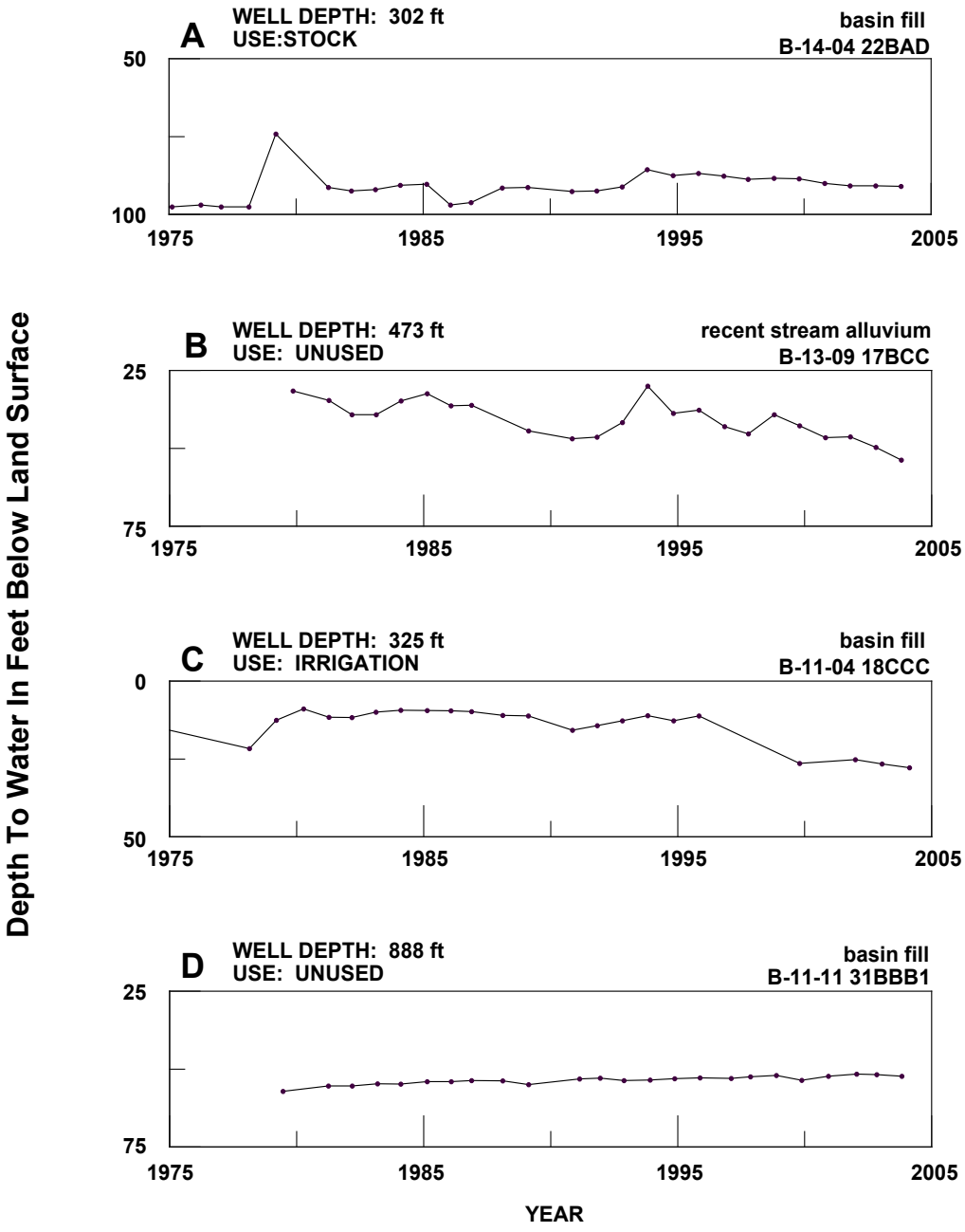
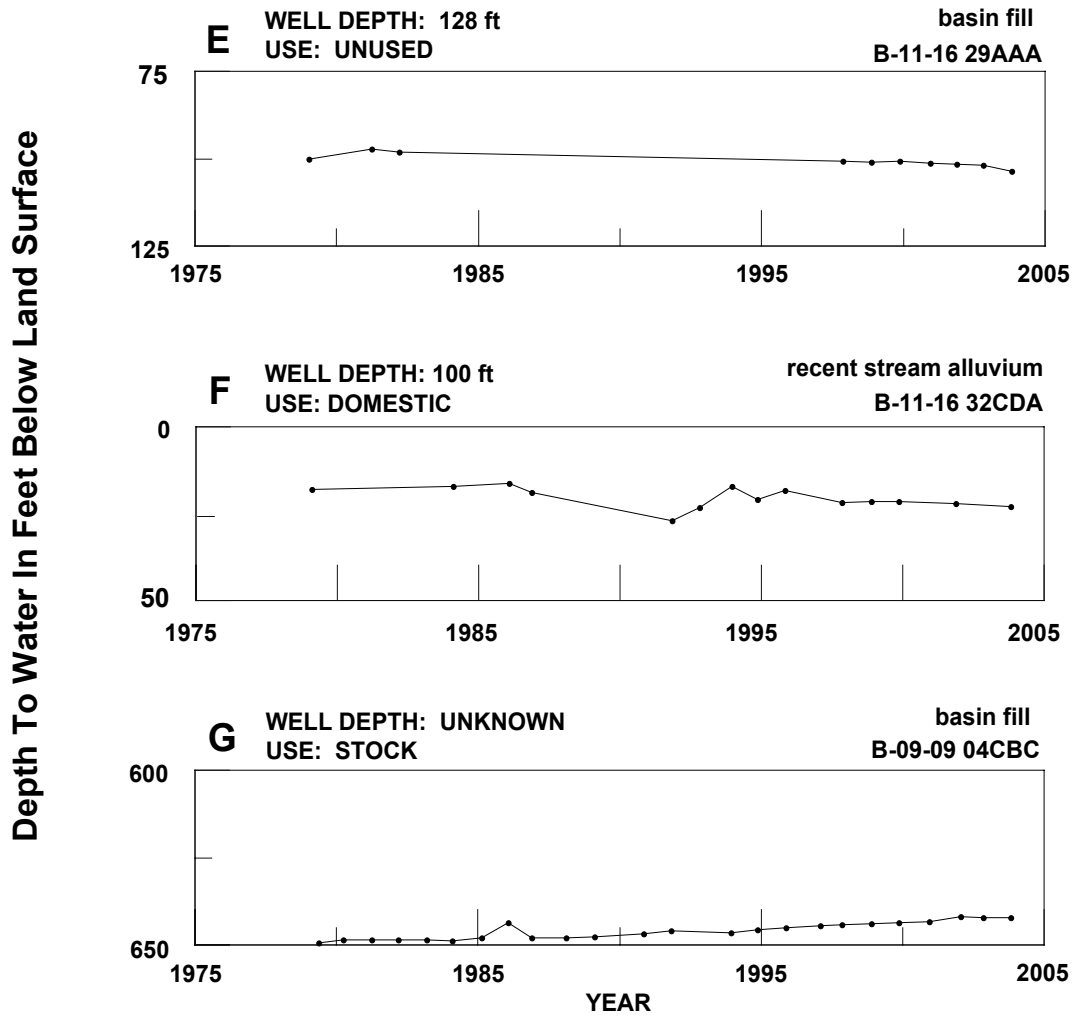


Figure 4.2-7 (Cont)
Bill Williams Basin
Hydrographs Showing Depth to Water in Selected Wells



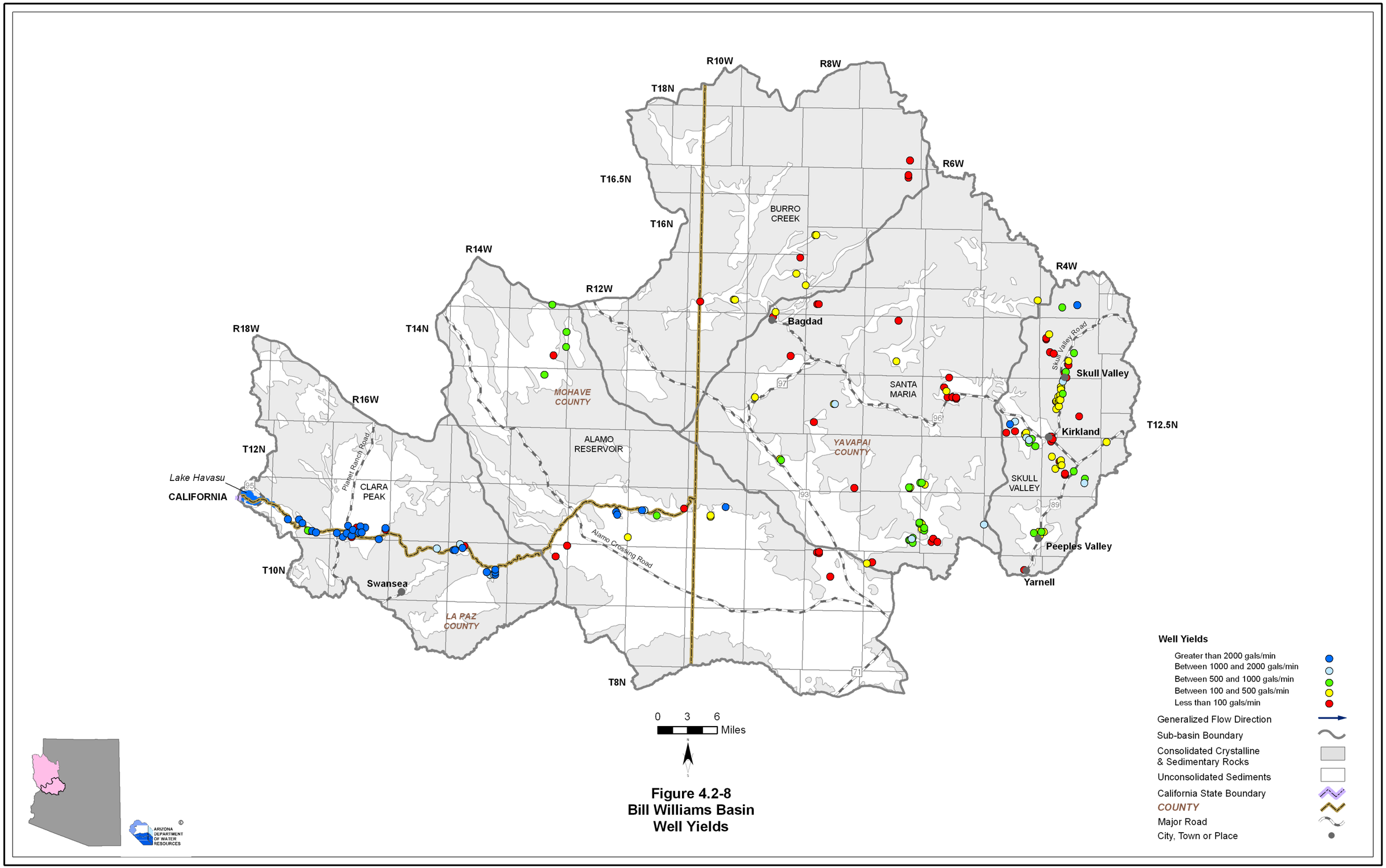


Figure 4.2-8
Bill Williams Basin
Well Yields

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 Basin[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	
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

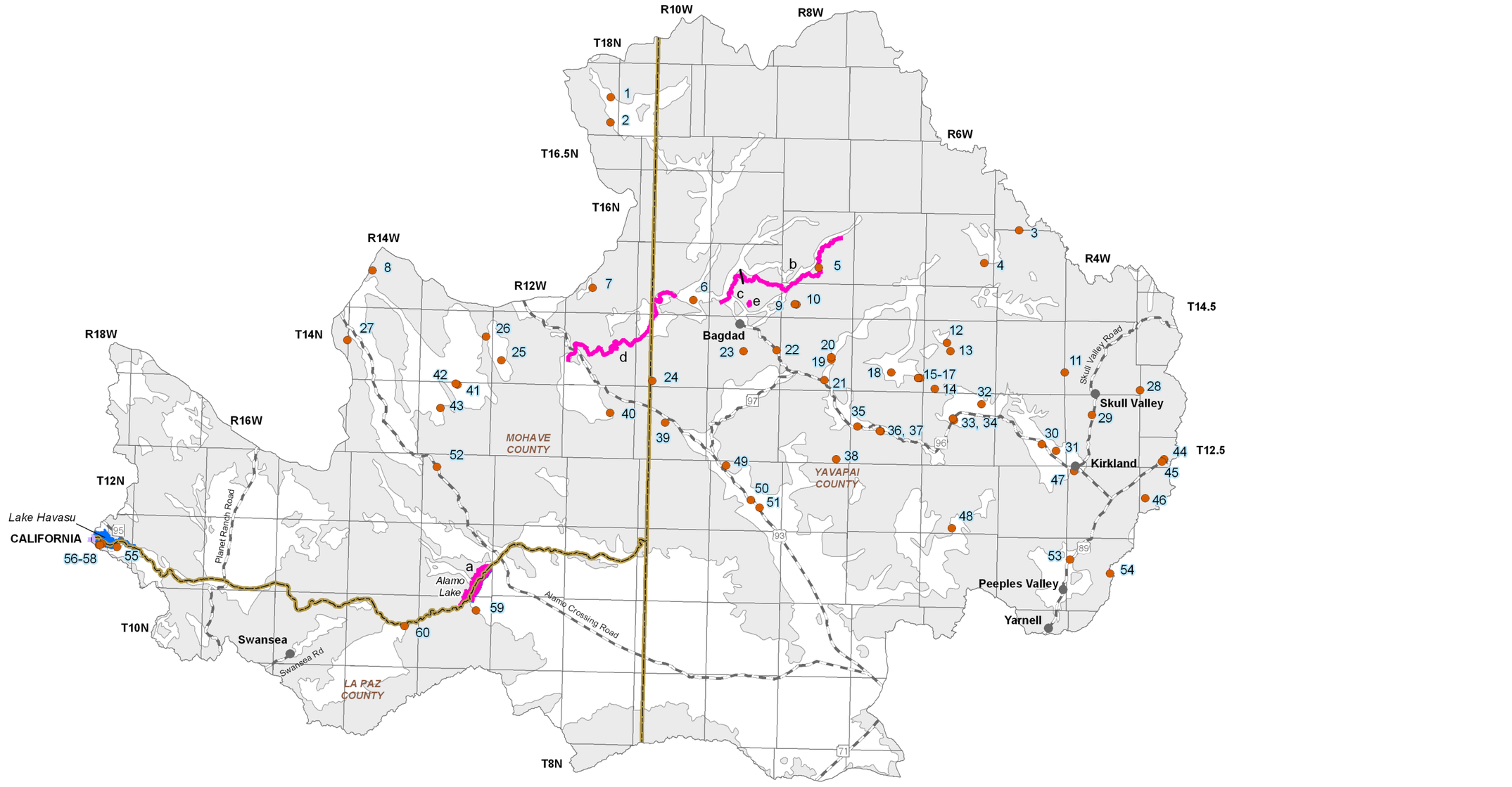


Figure 4.2-9
Bill Williams Basin
Water Quality Conditions

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 Peeples 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 Peeples 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. T
- 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 Basin[1]

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[2]			
		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										
1974										
1975										
1976				18,000			800			
1977										
1978										
1979										
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.

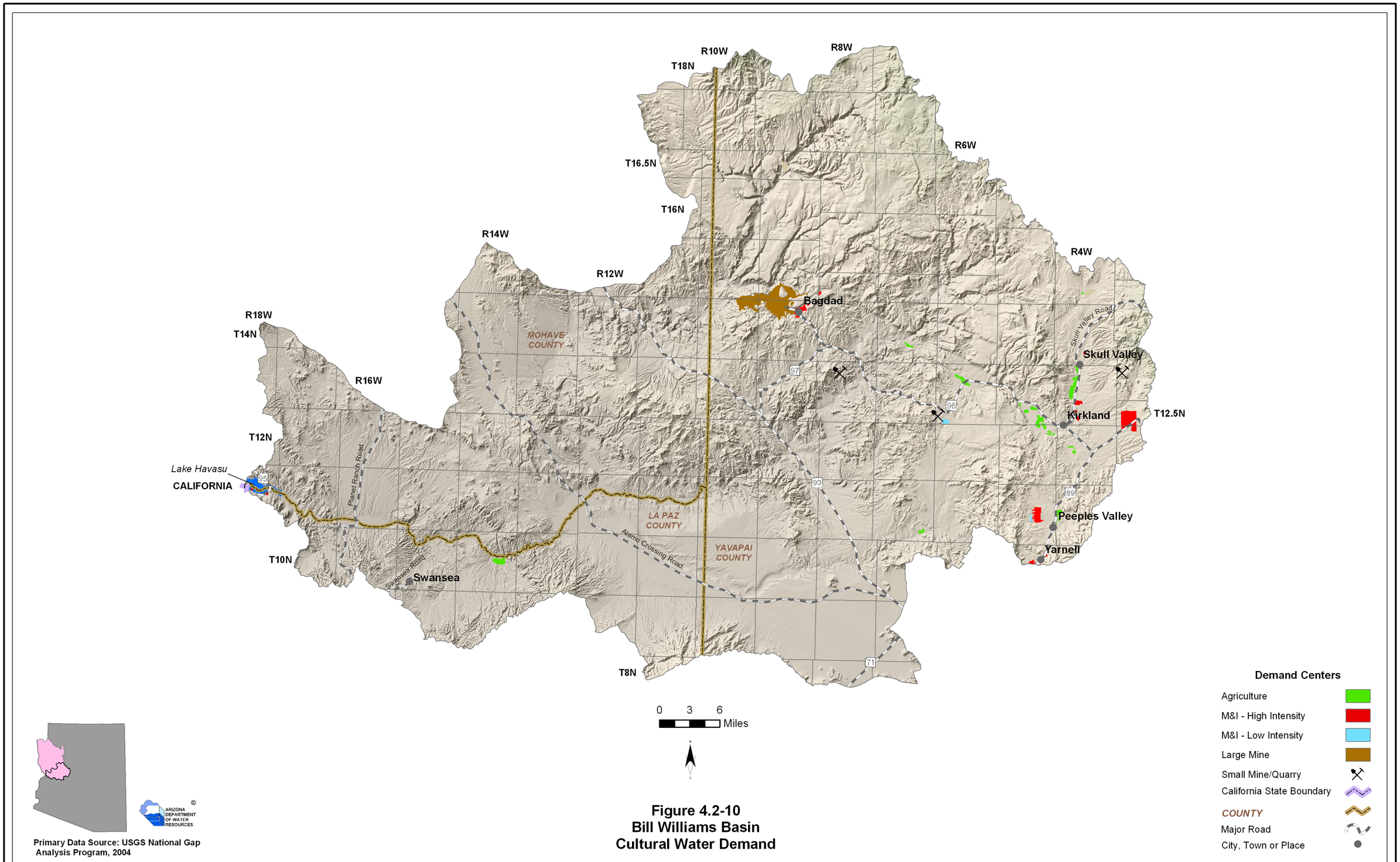


Figure 4.2-10
Bill Williams Basin
Cultural Water Demand

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 Basin[1]

Map Key	Subdivision Name	County	Location			No. of Lots	ADWR File No.[2]	ADWR Adequacy Determination	Reason(s) for Inadequacy Determination[3]	Date of Determination	Water Provider at the Time of Application
			Township	Range	Section						
1	Highland Pines	Yavapai	14 North	3 West	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:

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

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

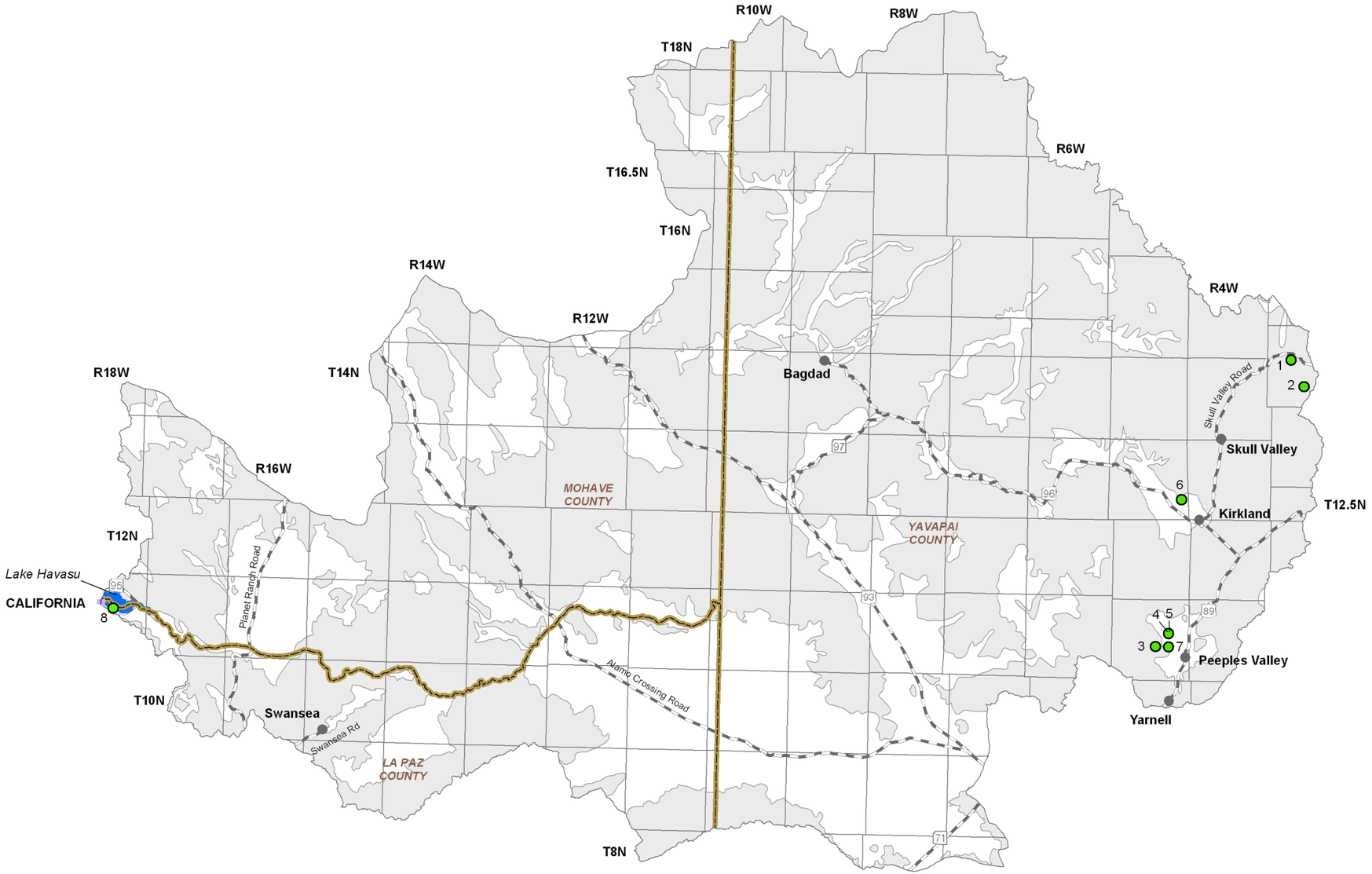


Figure 4.2-11
Bill Williams Basin
Adequacy Determinations

Bill Williams Basin
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