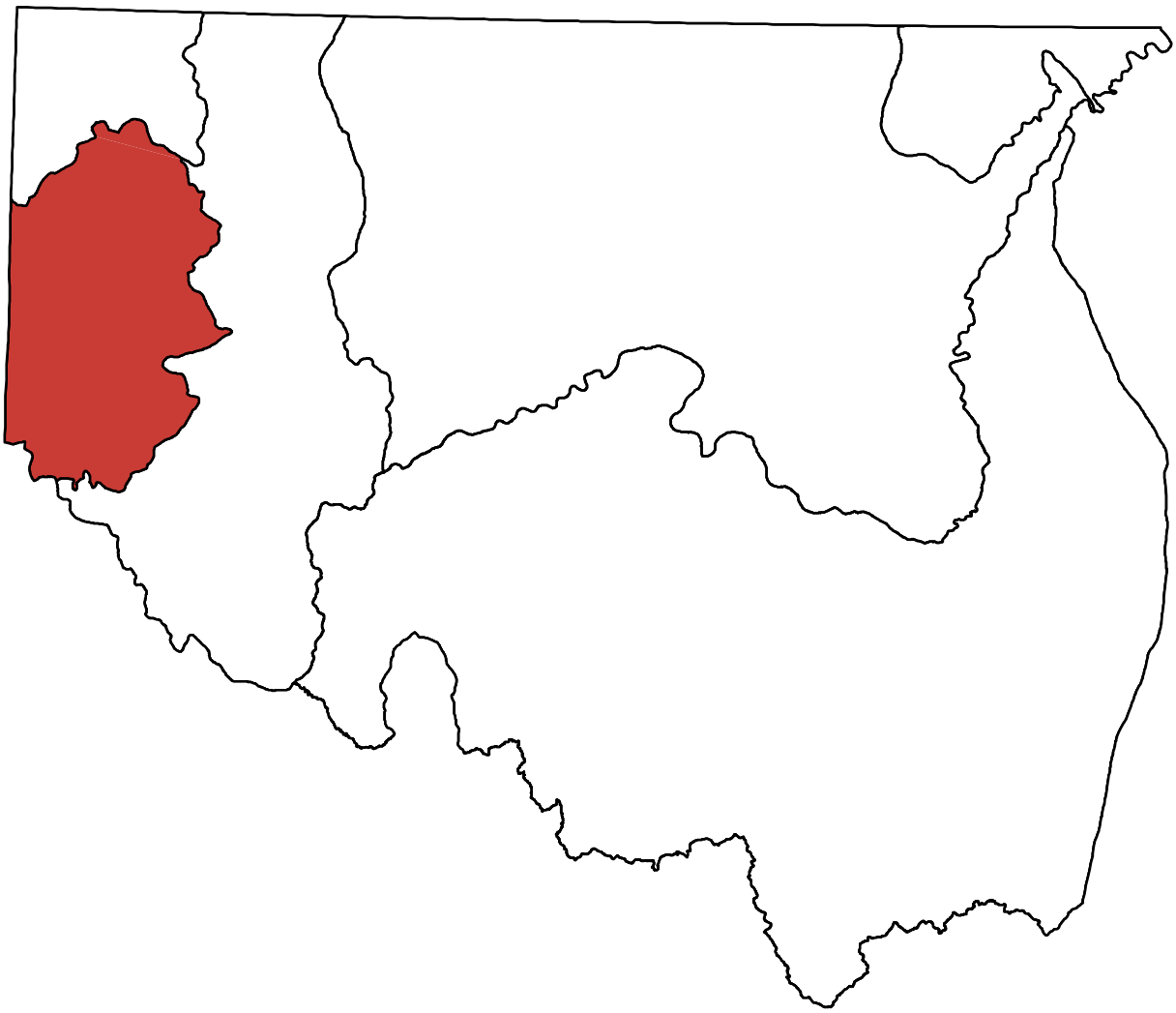
Section 6.2
Grand Wash Basin



6.2.1 Geography of the Grand Wash Basin

The Grand Wash Basin, located in the western part of the planning area is 959 square miles in area. Geographic features and principal communities are shown on Figure 6.2-1. The basin is characterized by cliffs and washes. Vegetation is primarily Mohave desertscrub and Great Basin conifer woodland with small areas of Great Basin desertscrub, interior chaparral and Plains and Great Basin grassland. (See Figure 6.0-11)

- Principal geographic features shown on Figure 6.2-1 are:
    - Lake Mead forming the southwestern basin boundary and the lowest point in the basin at 1,100 feet
    - Grand Wash in the western portion of the basin
    - Grand Wash and Upper Grand Wash Cliffs running north-south through the basin
    - Mud Mountain in the northern portion of the basin
    - The highest point in the basin, Last Chance Knoll in the east central part of the basin at 6,758 feet

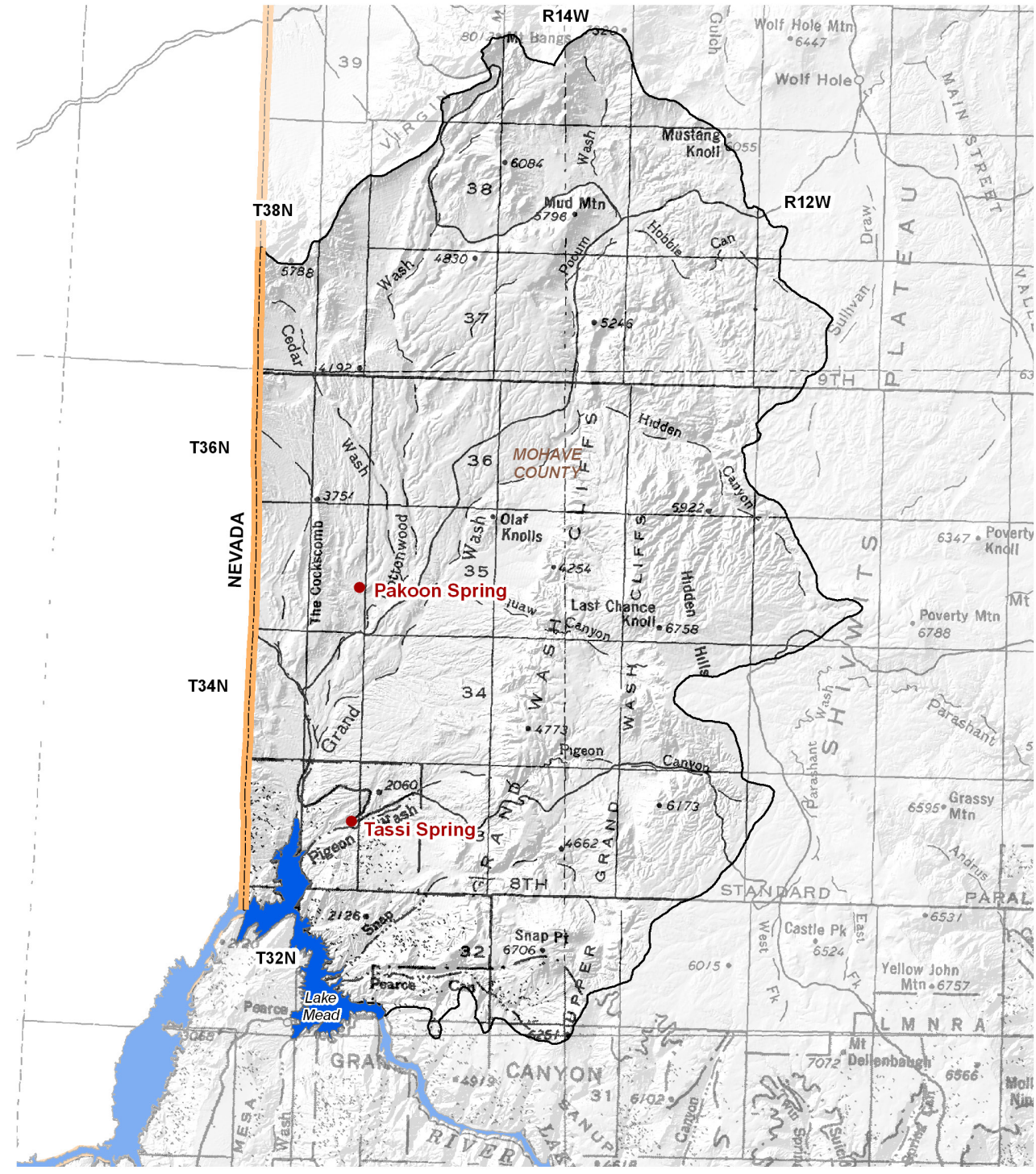


Figure 6.2-1
Grand Wash Basin
Geographic Features

6.2.2 Land Ownership in the Grand Wash Basin

Land ownership, including the percentage of ownership by category, for the Grand Wash Basin is shown in Figure 6.2-2. The principal feature of land ownership in this basin is the large portion of land, 96% of the total basin area, within the Grand Canyon-Parashant National Monument managed by the U.S. Bureau of Land Management and the National Park Service. 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 6.0.4. Land ownership categories are discussed below in the order from largest to smallest percentage in the basin.

U.S. Bureau of Land Management (BLM)

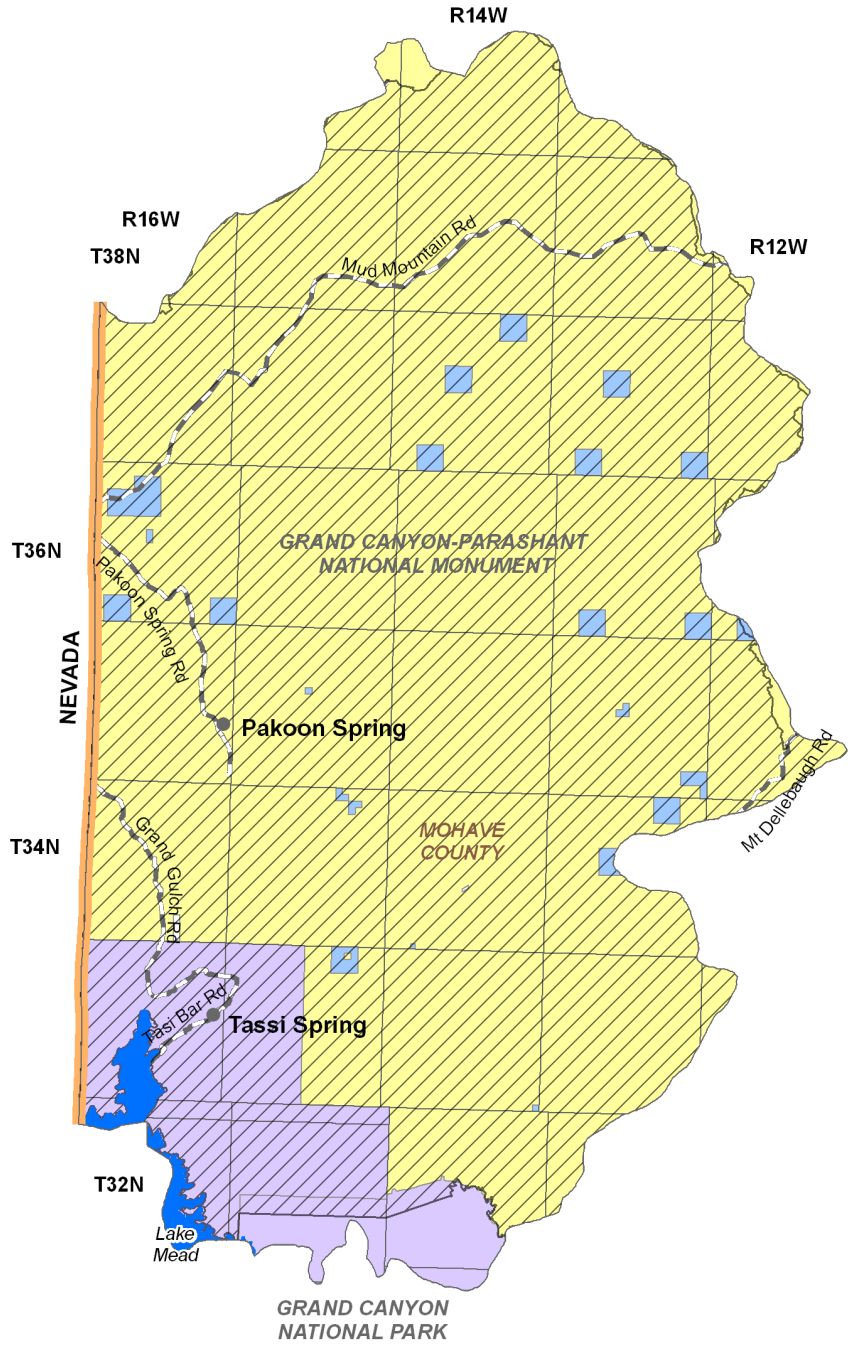
- 86.4% of the land is federally owned and managed by the Arizona Strip Field Office of the Bureau of Land Management.
- Most of the BLM lands in this basin are part of the Grand Canyon-Parashant National Monument, which also includes two wilderness areas, Grand Wash Cliffs (37,030 acres, entire) and Paiute (87,900 acres, portion).
- Land uses include resource conservation, recreation and grazing.

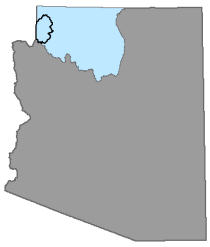
National Park Service (NPS)

- 11.8% of the land is federally owned and managed by the National Park Service as the Grand Canyon-Parashant National Monument and Grand Canyon National Park.
- Land uses include resource conservation and recreation.

State Trust Land

- 1.8% of the land is held in trust for the public schools under the State Trust Land system.
- All state land is interspersed with BLM land and is included within the boundaries of the Grand Canyon-Parashant National Monument.
- Primary land use is grazing.





ARIZONA DEPARTMENT OF WATER RESOURCES ©

Source: ALRIS, 2004
Bureau of Land Management, 1999

0 3 6 Miles

N
S

Figure 6.2-2
Grand Wash Basin
Land Ownership

Land Ownership (Percentage in Basin)

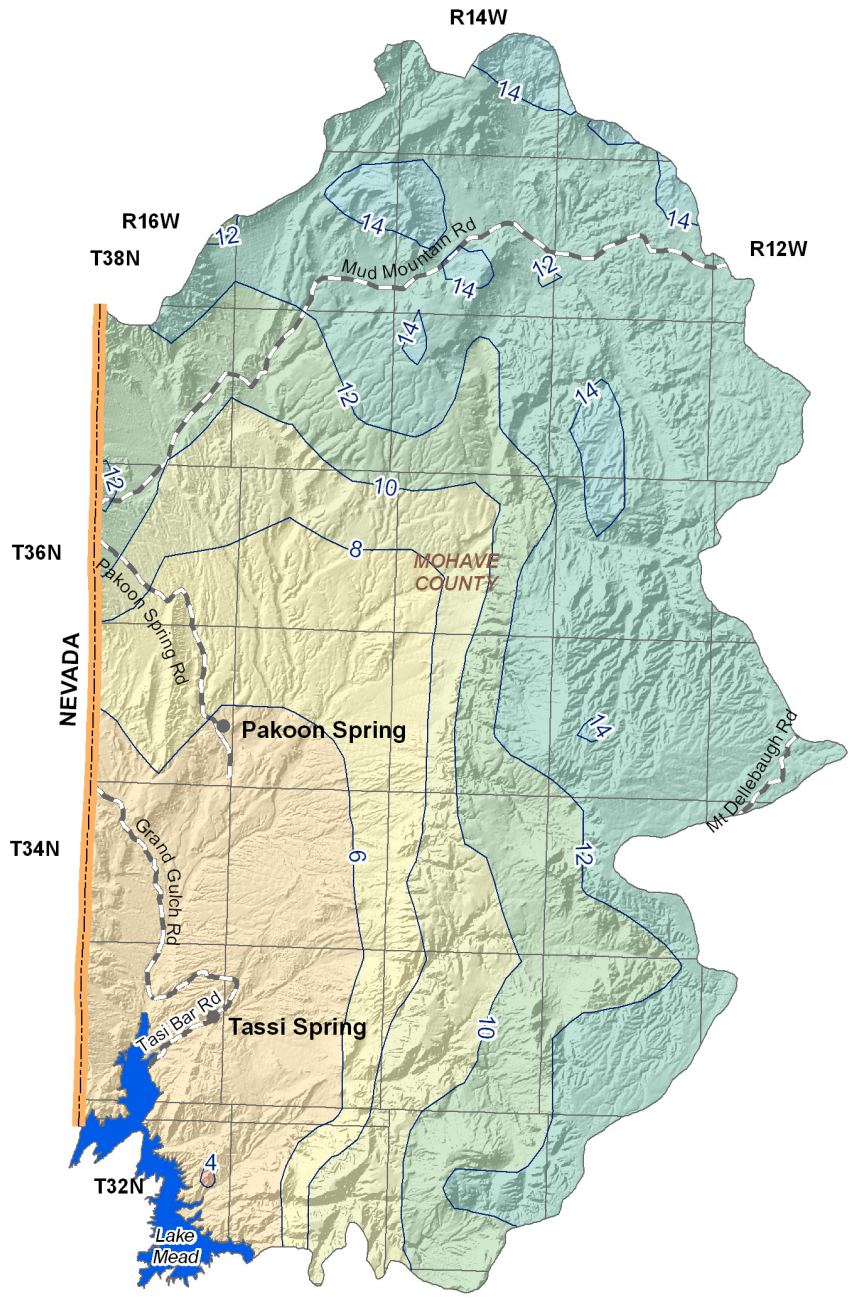
- U.S. Bureau of Land Management (86.4%)
- National Park Service (11.8%)
- State Trust (1.8%)
- National Monument
- Nevada State Boundary
- Major Road
- City, Town or Place

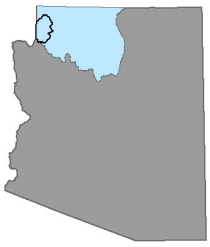
6.2.3 Climate of the Grand Wash Basin

The Grand Wash Basin does not contain NOAA/NWS, Evaporation Pan, AZMET or SNOTEL/ Snowcourse stations. Figure 6.2-3 shows precipitation contour data from the Spatial Climate Analysis Service (SCAS) at Oregon State University. More detailed information on climate in the planning area is found in Section 6.0.3. A description of the climate data sources and methods is found in Volume 1, Appendix A.

SCAS Precipitation Data

- See Figure 6.2-3
- Average annual rainfall is as high as 16 inches in the northern portion of the basin and four inches or less near Lake Mead.





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Precipitation Data Source: Oregon State University, 1998

0 3 6
Miles

N
S

Average Annual Precipitation (1961-1990)
inches per year

- 0-4
- 4-6
- 6-8
- 8-10
- 10-12
- 12-14
- 14-16

Precipitation Contour 12
Nevada State Boundary
Major Road
City, Town or Place

Figure 6.2-3
Grand Wash Basin
Meteorological Stations and Annual Precipitation

6.2.4 Surface Water Conditions in the Grand Wash Basin

There are no streamflow data or flood ALERT equipment in this basin. Reservoir and stockpond data are shown on Table 6.2-1. USGS runoff contours are shown on Figure 6.2-4. Descriptions of stream, reservoir and stockpond data sources and methods are found in Volume 1, Appendix A.

Reservoirs and Stockponds

- Refer to Table 6.2-1
- 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 in the Upper Colorado River Planning Area.
- There are 109 registered stockponds in the basin.

Runoff Contour

- Refer to Figure 6.2-4.
- Average annual runoff is highest, one inch per year, or 53.3 acre-feet per square mile, in the northern portion of the basin near Mud Mountain Road and decreases to 0.1 inches, or 5.33 acre-feet per square mile, in most of the southern portion of the basin.

Table 6.2-1 Reservoirs and Stockponds in the Grand Wash 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

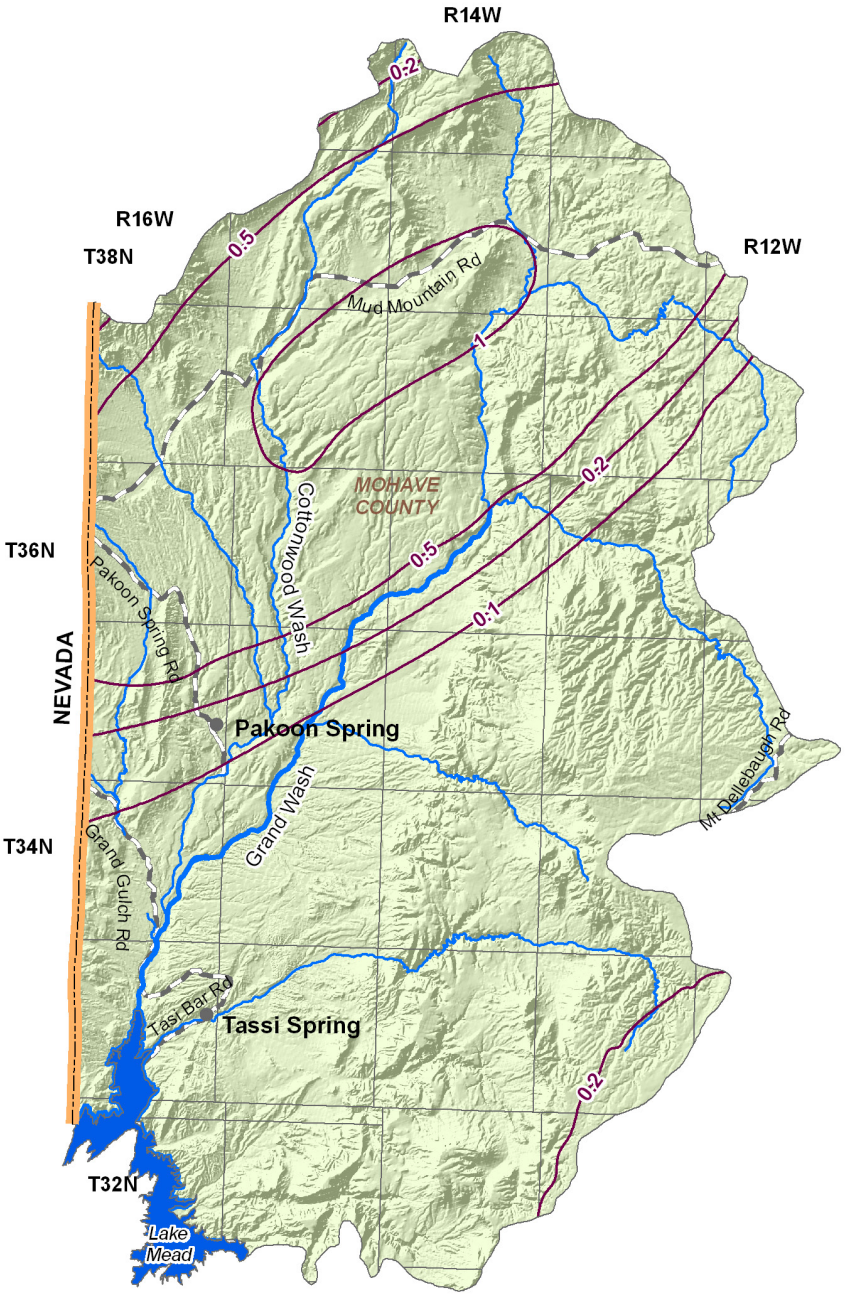
D. Other Small Reservoirs (between 5 and 50 acres surface area)

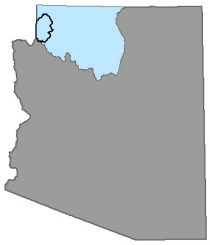
Total number: 0
Total surface area: 0 acres

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

Total number: 109

Notes:
[1]C=flood control; F=fish & wildlife pond; H=hydroelectric; I=irrigation; R=recreation; RR=river regulation; S=water supply
[2] Dam is located in Lake Mohave Basin and lake storage is located in Lake Mohave, Detrital Valley, Hualapai Valley and Meadview Basins.
[3] Includes 2,378,000 acre-feet of dead storage.





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Stream Data Source: ALRIS, 2005

0 3 6 Miles

N

S

Figure 6.2-4
Grand Wash Basin
Surface Water Conditions

USGS Annual Runoff Contour for 1951-1980 (in inches) — 2
Stream Channel (width of line reflects stream order)
Nevada State Boundary
Major Road
City, Town or Place

6.2.5 Perennial/Intermittent Streams and Major Springs in the Grand Wash 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 6.2-2. The locations of major springs and one perennial stream are shown on Figure 6.2-5. Descriptions of data sources and methods for intermittent and perennial reaches and springs are found in Volume 1, Appendix A.

- There are no intermittent streams and the only perennial stream is the Colorado River, which is impounded at Hoover Dam, and forms Lake Mead in this basin.
- 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 75 gpm at Tassi spring.
- Springs with measured discharge of 1 to 10 gpm are not mapped but coordinates are given in Table 6.2-2B. There are nine minor springs in this basin.
- Listed discharge rates may not be indicative of current conditions.
- The total number of springs, regardless of discharge, identified by the USGS varies from 47 to 52, depending on the database reference.

Table 6.2-2 Springs in the Grand Wash Basin

A. Major Springs (10 gpm or greater):

Map Key	Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
		Latitude	Longitude		
1	Tassi	361523	1135728	75	5/9/2000
2	Pakoon	362457	1135726	58	5/11/2000
3	Whiskey	361848	1135851	40	2/6/1980
4	Chill Heal	361301	1135917	25	3/12/1980
5	Unnamed	361817	1135855	20	2/6/1980
6	Unnamed	361314	1135944	13	3/12/1980

B. Minor Springs (1 to 10 gpm):

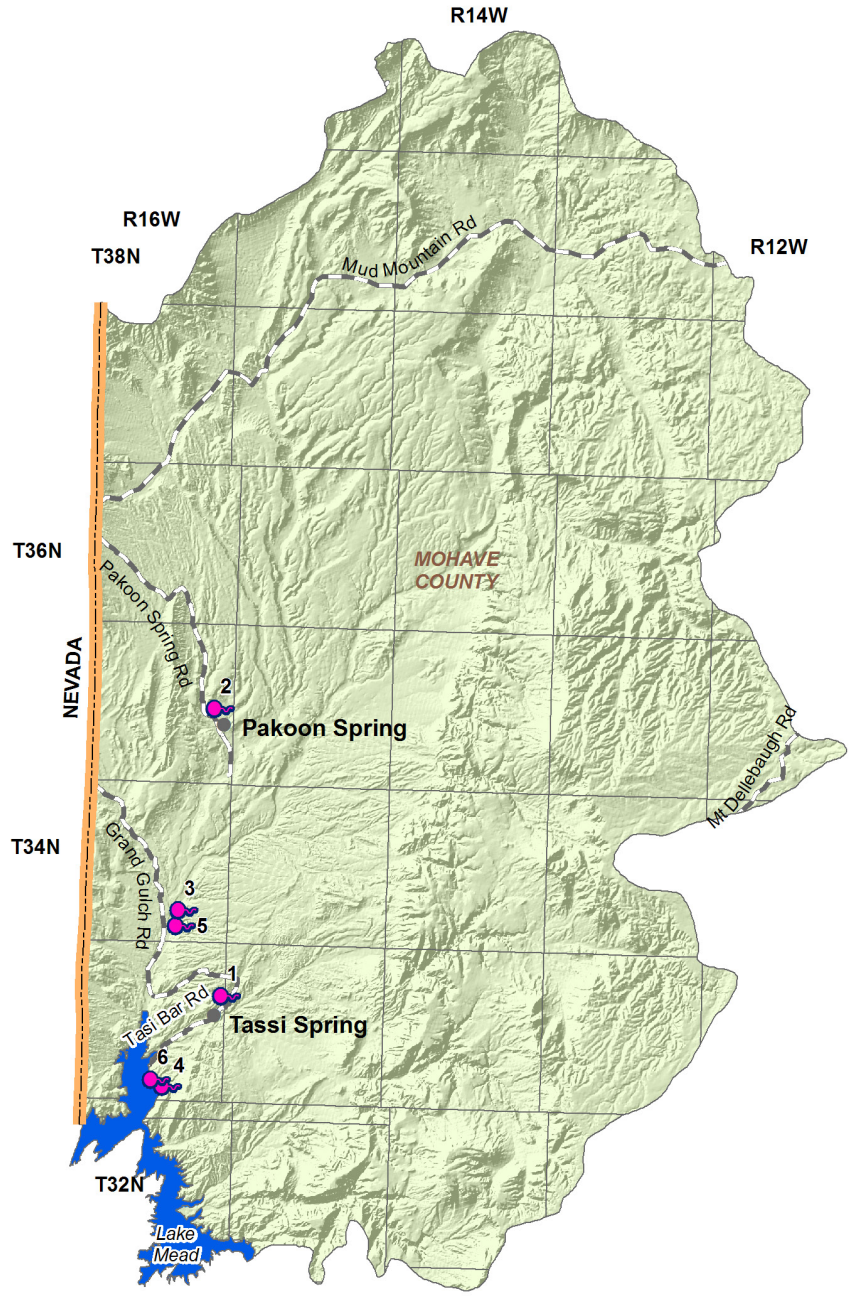
Name	Location		Discharge (in gpm)[1]	Date Discharge Measured
	Latitude	Longitude		
Middle	363205	1140230	9	5/11/2000
Burro	361700	1140013	3	5/9/2000
Unnamed	361752	1135906	4	9/22/1976
Cane -south	363916	1134705	2	5/14/2000
Hidden	362812	1133741	2	5/15/2000
Mud	364145	1134644	2	5/13/2000
Unnamed	361544	1135614	2	3/12/1980
Red Rock	363303	1140124	2	5/12/2000
#106	364100	1134526	2	5/13/2000

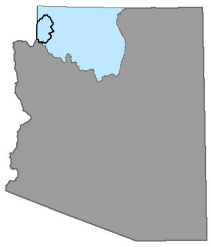
Source: Compilation of databases from ADWR & others

C. Total number of springs, regardless of discharge, identified by USGS (see ALRIS, 2005a and USGS, 2006b): 47 to 52

Notes:

[1] Most recent measurement identified by ADWR





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Stream Data Source: AGFD, 1993 & 1997

0 3 6
Miles

N
S

Figure 6.2-5
Grand Wash Basin
Perennial/Intermittent Streams and Major (>10 gpm) Springs

Springs 1
Perennial Streams
Nevada State Boundary
Major Road
City, Town or Place

6.2.6 Groundwater Conditions of the Grand Wash Basin

Major aquifers, well yields, number of index wells and date of last water-level sweep are shown in Table 6.2-3. Figure 6.2-6 shows water-level change between 1990-1991 and 2003-2004. Figure 6.2-7 contains hydrographs for selected wells shown on Figure 6.2-6. Figure 6.2-8 shows well yield for one well. 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 6.2-3 and Figure 6.2-6.
- Major aquifers in the basin include recent stream alluvium, basin-fill and sedimentary rock (Cottonwood Wash and Muddy Creek formations).
- Most of the basin geology consists of consolidated crystalline and sedimentary rock.
- Data on natural recharge, groundwater in storage and groundwater flow direction is not available for this basin.

Well Yields

- Refer to Table 6.2-3 and Figure 6.2-8.
- As shown on Figure 6.2-8 well yield data are only available for one well, which yields less than 100 gallons per minute (gpm).

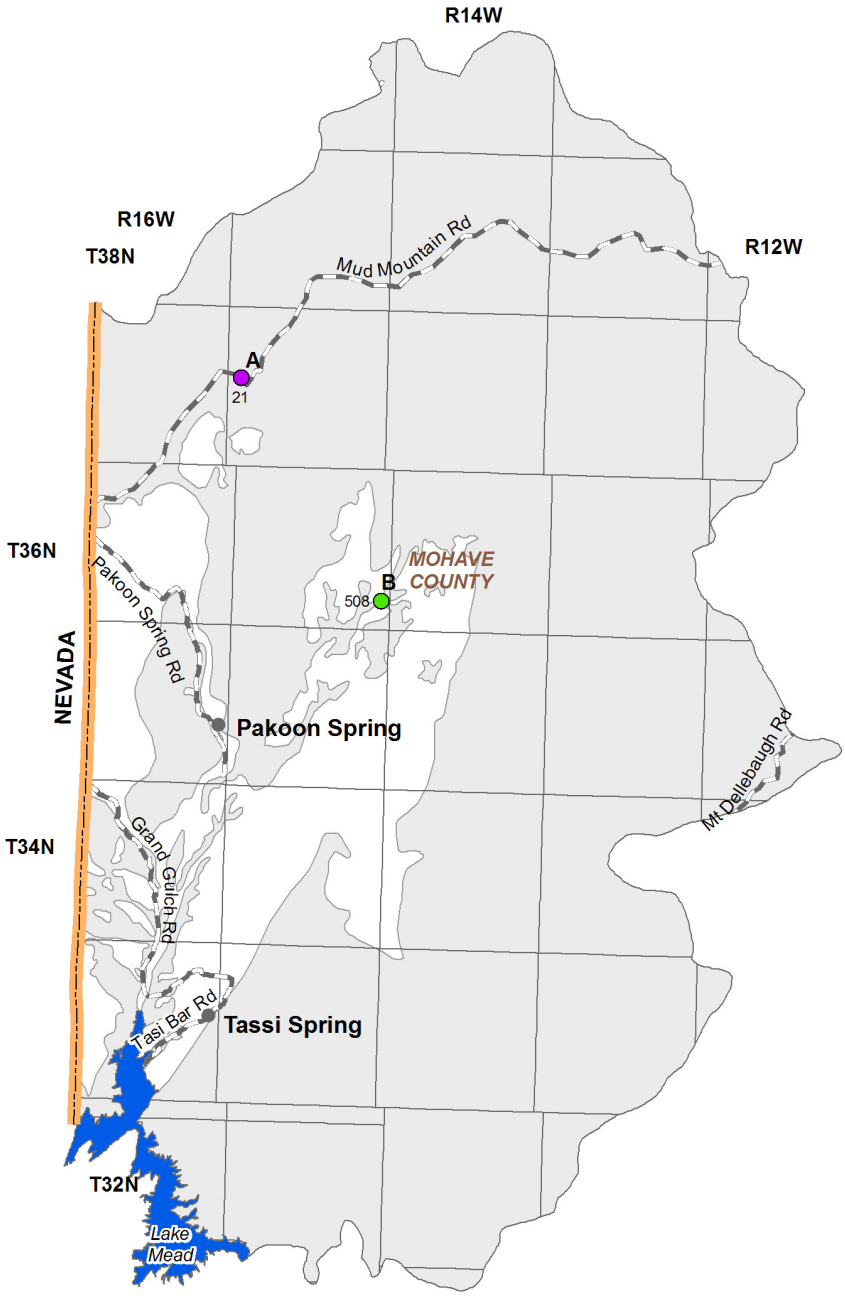
Water Level

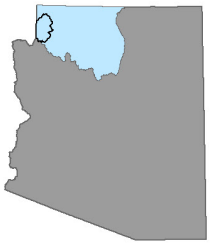
- Refer to Figure 6.2-6. Water levels are shown for wells measured in 2003-2004.
- The Department annually measures two index wells in this basin. Hydrographs for these two wells are shown in Figure 6.2-7.
- The water level in one well was at a depth of 21 feet and rose by more than 30 feet between 1990-1991 and 2003-2004. Water level in the other well is at a depth of 508 feet and was generally stable between 1990-1991 and 2003-2004.

Table 6.2-3 Groundwater Data for the Grand Wash Basin

Basin Area, in square miles:	959	
Major Aquifer(s):	**Name and/or Geologic Units**	
	Recent Stream Alluvium	
	Basin Fill with Interbedded Volcanic Rock	
	Sedimentary Rock (Cottonwood Wash Formation)	
	Sedimentary Rock (Muddy Creek Formation)	
Well Yields, in gal/min:	10 (1 well reported)	Reported on registration forms for large (>10-inch) diameter wells (Wells55)
	300	ADWR (1990)
	Range 0-500	Anning and Duet (1994)
Estimated Natural Recharge, in acre-feet/year:	N/A	
Estimated Water Currently in Storage, in acre-feet:	N/A	
Current Number of Index Wells:	2	
Date of Last Water-level Sweep:	1976 (6 wells measured)	

N/A = Not Available





0 3 6
Miles

N
S

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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 -1 and +1

Greater than +30

Consolidated Crystalline & Sedimentary Rocks

Unconsolidated Sediments

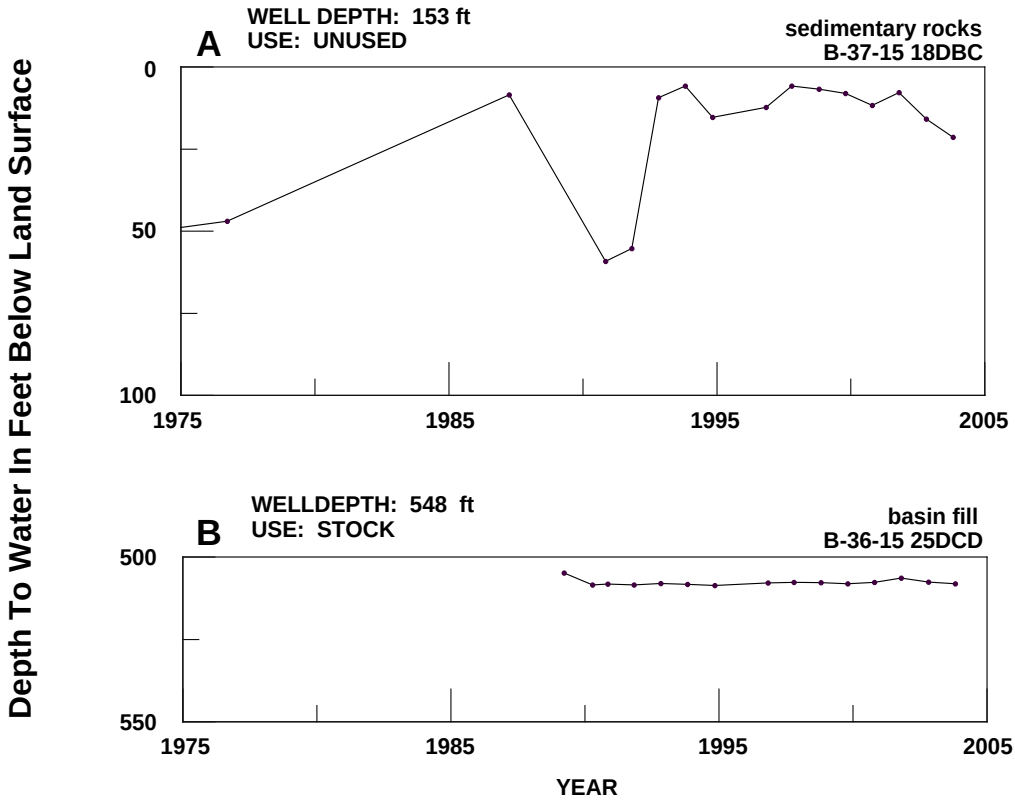
Nevada State Boundary

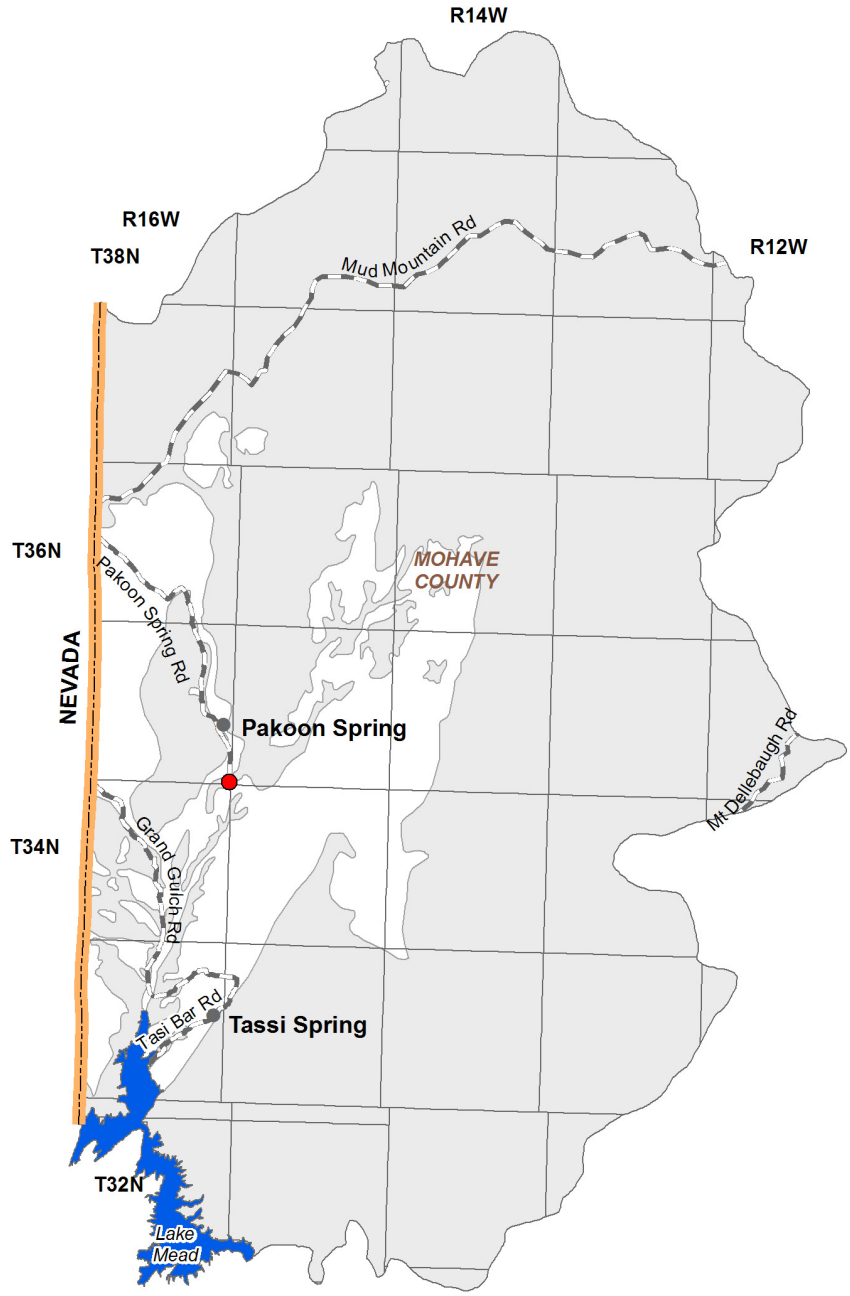
Major Road

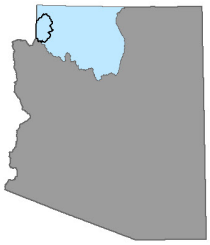
City, Town or Place

Figure 6.2-6
Grand Wash Basin
Groundwater Conditions

Figure 6.2-7
Grand Wash Basin
Hydrographs Showing Depth to Water in Selected Wells







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0 3 6
Miles

N
S

Well Yields
Less than 100 gals/min
Consolidated Crystalline & Sedimentary Rocks
Unconsolidated Sediments
Nevada State Boundary
Major Road
City, Town or Place

Figure 6.2-8
Grand Wash Basin
Well Yields

6.2.7 Water Quality of the Grand Wash Basin

Wells, springs and mine sites with parameter concentrations that have equaled or exceeded drinking water standard(s), including location and parameter(s) are shown in Table 6.2-4A. There are no impaired lakes and streams in this basin. Figure 6.2-9 shows the location of water quality occurrences keyed to Table 6.2-4. 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 6.2-4A.
- All seven springs have parameter concentrations of total dissolved solids that have equaled or exceeded drinking water standards.

Table 6.2-4 Water Quality Exceedences in the Grand Wash Basin[1]

A. Wells, Springs and Mines

Map Key	Site Type	Site Location			Parameter(s) Concentration has Equaled or Exceeded Drinking Water Standard (DWS)[2]
		Township	Range	Section	
1	Spring	38 North	14 West	14	TDS
2	Spring	33 North	15 West	8	TDS
3	Spring	33 North	15 West	9	TDS
4	Spring	33 North	15 West	9	TDS
5	Spring	33 North	15 West	18	TDS
6	Spring	33 North	16 West	3	TDS
7	Spring	33 North	16 West	4	TDS

Source: Compilation of databases from ADWR & others

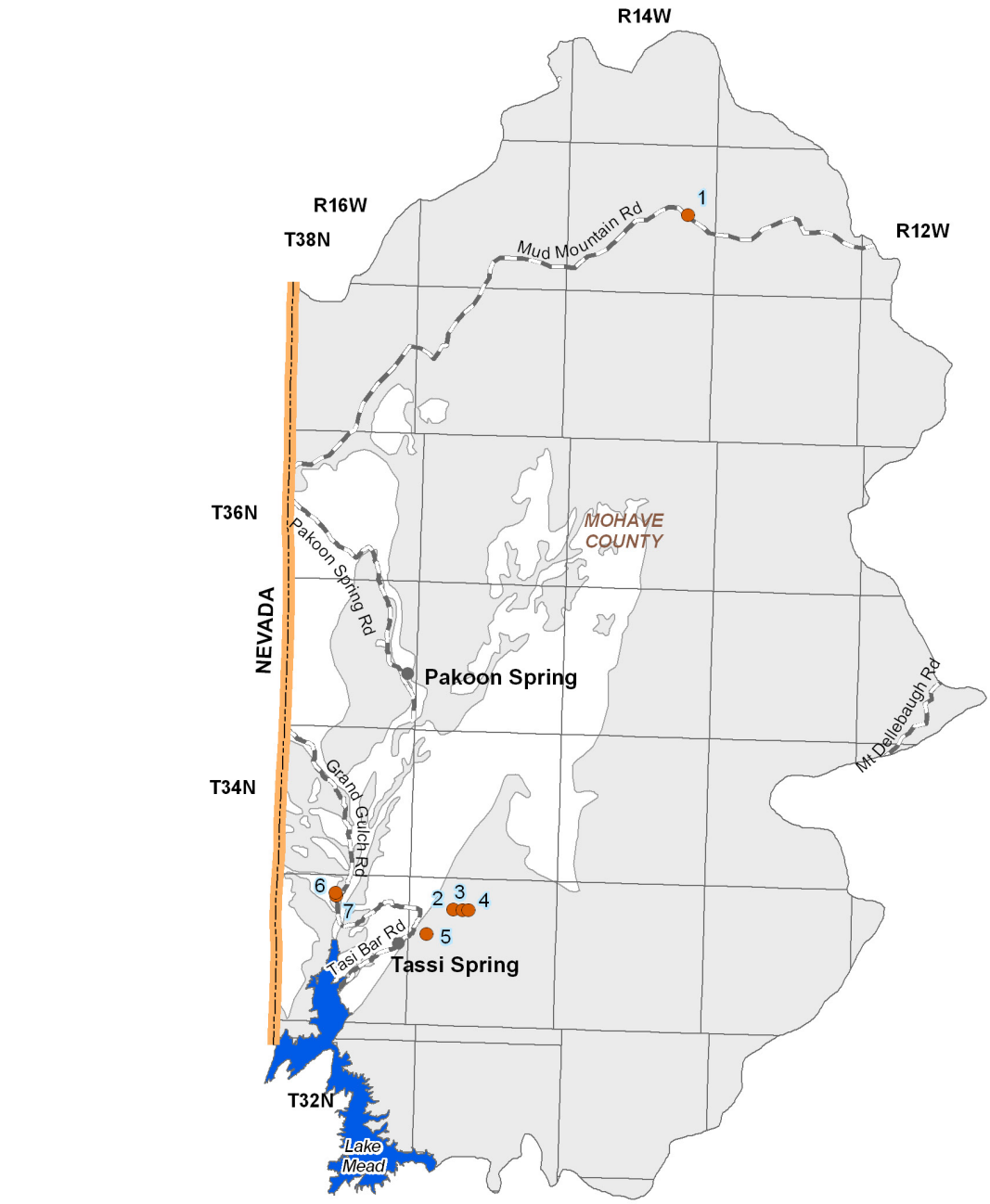
B. Lakes and Streams

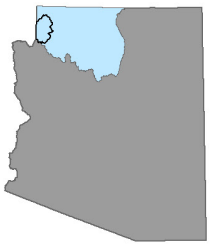
Map Key	Site Type	Site Name	Length of Impaired Stream Reach (in miles)	Area of Impaired Lake (in acres)	Designated Use Standard	Parameter(s) Exceeding Use Standard
None identified by ADWR at this time						

Notes:

[1] Water quality samples collected between 1980 and 2000.

[2] TDS = Total Dissolved Solids





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0 3 6
Miles

N
S

Well, Spring or Mine Site that has Equaled or Exceeded DWS 1
Consolidated Crystalline & Sedimentary Rocks
Unconsolidated Sediments
Nevada State Boundary
Major Road
City, Town or Place

Figure 6.2-9
Grand Wash Basin
Water Quality Conditions

6.2.8 Cultural Water Demand in the Grand Wash 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 6.2-5. There is no recorded effluent generation in this basin. The USGS National Gap Analysis Program, the primary source of cultural demand map data, showed no demand centers for this basin. 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 6.0.7.

Cultural Water Demand

- Refer to Table 6.2-5
- Population in this basin is very small, with 15 residents in 2000.
- There are no recorded surface water uses in this basin. All groundwater use is for municipal demand and has remained relatively constant since 1971.
- As of 2005 there were 11 registered wells with a pumping capacity of less than or equal to 35 gallons per minute (gpm) and one well with a pumping capacity of more than 35 gpm.

Table 6.2-5 Cultural Water Demand in the Grand Wash 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			
		Q ≤ 35 gpm	Q > 35 gpm	Municipal	Industrial	Agricultural	Municipal	Industrial	Agricultural	
1971		3[2]	0[2]	<500			NR			ADWR (1994a)
1972										
1973										
1974										
1975										
1976				<500			NR			
1977										
1978										
1979										
1980	10									
1981	10	5	0	<500			NR			
1982	10									
1983	11									
1984	11									
1985	11									
1986	11	0	1	<500			NR			
1987	11									
1988	12									
1989	12									
1990	12									
1991	12	2	0	<300	NR	NR	NR			USGS (2007)
1992	13									
1993	13									
1994	13									
1995	14									
1996	14	1	0	<300	NR	NR	NR			
1997	14									
1998	14									
1999	15									
2000	15									
2001	15	0	0	<300	NR	NR	NR			
2002	15									
2003	15									
2004	15									
2005	15									
2010	15									
2020	15									
2030	15									
WELL TOTALS:		**11**	**1**							

[1] Does not include evaporation losses from stockponds and reservoirs.
[2] Includes all wells through 1980.
NR - Not reported

6.2.9 Water Adequacy Determinations in the Grand Wash Basin

There are no water adequacy applications on file with the Department as of December 2008 for the Grand Wash Basin. 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.

Grand Wash Basin
References and Supplemental Reading

References

A

Anning, D.W. and N.R. Duet, 1994, Summary of ground-water conditions in Arizona, 1987-90, USGS Open-file Report 94-476.

Arizona Department of Economic Security (DES), 2005, Workforce Informer: Data file, accessed August 2005, http://www.workforce.az.gov. (Cultural Water Demand Table)

Arizona Department of Water Resources (ADWR), 2005a, Groundwater Site Inventory (GWSI): Database, ADWR Hydrology Division. (Groundwater Conditions Table)

_____, 2005b, Registry of surface water rights: ADWR Office of Water Management. (Reservoirs and Stockponds Table)

_____, 2005c, Wells55: Database. (Groundwater Conditions Table)

_____, 2002, Groundwater quality exceedences in rural Arizona from 1975 to 2001: Data file, ADWR Office of Regional Strategic Planning. (Water Quality Map/Table)

_____, 1994a, Arizona Water Resources Assessment, Vol. I, Inventory and Analysis.

_____, 1994b, Arizona Water Resources Assessment, Vol. II, Hydrologic Summary.

_____, 1990, Draft outline of basin profiles for the state water assessment: ADWR Statewide Planning Division, Memorandum to L. Linser, D.W., January, 16, 1990.

Arizona Game & Fish Department (AGFD), 1997 & 1993, Statewide riparian inventory and mapping project: GIS cover.

Arizona Land Resource Information System (ALRIS), 2005a, Springs: GIS cover, accessed January 2006 at http://www.land.state.az.us/alris/index.html.

_____, 2005b, Streams: GIS cover, accessed 2005 at http://www.land.state.az.us /alris/index.html.

_____, 2004, Land ownership: GIS cover, accessed in 2004 at http://www.land.state.az.us /alris/index.html.

B

Bureau of Land Management (BLM), 1999, National Monuments: GIS cover.

G

Gebert, W.A., D.J. Graczyk and W.R. Krug, 1987, Average annual runoff in the United States, 1951-1980: GIS Cover, accessed March 2006 at http://aa179.cr.usgs.gov/metadata/wrdmeta/runoff.htm.

Grand Canyon Wildlands Council, 2002, Arizona Strip Springs, Seeps and Natural Ponds: Inventory, Assessment and Development of Recovery Priorities: AZ Water Protection Fund 99-074. (Spring Map/Table)

O

Oregon State University, Spatial Climate Analysis Service (SCAS), 1998 Average annual precipitation in Arizona for 1961-1990: PRISM GIS cover, accessed in 2006 at www.ocs.orst.edu/prism.

U

United States Geological Survey (USGS), 2008 & 2005, National Water Information System (NWIS) data for Arizona: Accessed October 2008 at http://waterdata.usgs.gov/nwis.

_____, 2007, Water withdrawals for irrigation, municipal, mining, thermoelectric-power, and drainage uses in Arizona outside of the active management areas, 1991-2005: Data file, received November 2007.

_____, 2006a, National Hydrography Dataset: Arizona dataset, accessed at http://nhd.usgs.gov/.

_____, 2006b, Springs and spring discharges: Dataset, received November 2004 and January 2006 from USGS office in Tucson, AZ.

_____, 1981, Geographic digital data for 1:500,000 scale maps: USGS National Mapping Program Data Users Guide.

Supplemental Reading

Andersen, M., 2005, Assessment of water availability in the Lower Colorado River basin: in Conservation and Innovation in Water Management: Proceedings of the 18th annual Arizona Hydrological Society Symposium, Flagstaff, Arizona, September, 2005.

Bales, J.T., and R.L. Laney, 1992, Geohydrologic reconnaissance of Lake Mead National Recreation area: Virgin River, Nevada to Grand Wash Cliffs, Arizona: USGS Water Resources Investigations Report 91-4185, 29 p.

Billingsley, G.H., S.B. Beard, S.S. Priest, J.L. Wellmeyer, D.L. Block, 2004, Geologic Map of the Lower Grand Wash Cliffs and Vicinity, Mohave County, Northwestern Arizona. Miscellaneous Field Studies Map MF-2427

Bureau of Reclamation, 2002, Grand Canyon National Park water supply appraisal study, Coconino, Mohave and Yavapai Counties, Arizona: Grand Canyon National Park report.

Bureau of Land Management, 2005, Draft resource management plan and draft Environmental Impact Statement for Vermillion Cliffs National Monument, and the Grand Canyon Parashant National Monument: BLM Arizona Field Office and NPS joint report, 2005.

Dettiger, M., J. Harrill and D. Schmidt, 1995, Distribution of carbonite rock aquifers and the potential for their development, southern Nevada and adjacent parts of California , Arizona and Utah: USGS Water Resources Investigations Report 91-4146, 100 p.

Enzel, Y., L.L. Ely, P.K. House, V.R. Baker and R.H. Webb, 1993, Paleoflood evidence for a natural upper bound to flood magnitudes in the Colorado River Basin: Water Resources Research, vol. 29, no. 7, p. 2287-2297.

Freilich, Leitner & Carlisle, 2005, Mohave County General Plan: Water Resources Element.

Gauger, R.W., 1997, River-stage data Colorado River, Glen Canyon Dam to upper Lake Mead, Arizona, 1990-1994: USGS Open – File Report 96-626, 20 p.

Hart, R.J., 1999, Water Quality of the Colorado River monitored by the USGS National Stream Quality Accounting Network: in Water Issues and Partnerships for Rural Arizona: Proceedings of the 12 annual symposium of the Arizona Hydrological Society, September 1999, Hon Dah, Arizona.

Hereford, R., G. Webb and S. Graham, 2002, Precipitation history of the Colorado Plateau region, 1990 – 2000: USGS Fact sheet 119-02.

Smith J.D. and S. Wiele, 1991, Flow and sediment transport in the Colorado River between Lake Powell and Lake Mead: USGS report 38 p.