Upper Mojave River Valley Groundwater Basin

- Groundwater Basin Number: 6-42
- County: San Bernardino
- Surface Area: 413,000 acres (645 square miles)

Basin Boundaries and Hydrology

The Upper Mojave River Valley Groundwater Basin underlies an elongate north-south valley, with the Mojave River flowing (occasionally) through the valley from the San Bernardino Mountains on the south, northward into the Middle Mojave River Valley Groundwater Basin at the town of Helendale. The groundwater basin is bounded on the north by a roughly east-west line from basement rock outcrops near Helendale to those in the Shadow Mountains. The southern boundary is the contact between Quaternary sedimentary deposits and unconsolidated basement rocks of the San Bernardino Mountains. The basin is bounded on the southeast by the Helendale fault and on the east by basement exposures of the mountains surrounding Apple Valley. In the west, the boundary is marked by a surface drainage divide between this basin and El Mirage Valley Basin, and a contact between alluvium and basement rocks that form the Shadow Mountains. Average precipitation varies across the basin from 5 to 36 inches with the average for the basin near 12 inches (USDA 1999).

Hydrogeologic Information

Water Bearing Formations

The two primary water-bearing units within the Mojave River Valley Basin system consist of regional Pliocene and younger alluvial fan deposits (fan unit) and of overlying Pleistocene and younger river channel and floodplain deposits, which have been called the floodplain unit (DWR 1967), or the floodplain aquifer (Lines 1996; Stamos and others 2001). Other potential, but not regionally significant, water-bearing units include older alluvium, old fan deposits, old lake and lakeshore deposits, and dune sand deposits (DWR 1967). Water-bearing deposits in this basin are predominantly unconfined, though some perched water appears near Adelanto. Well yields typically range from 100 to 2000 gpm (Hardt 1969; Lines 1996; Stamos and others 2001) with an average of about 630 gpm for all units (BEE 1994).

Pleistocene and Younger Floodplain Unit. The floodplain unit is the more productive and extensively studied of the two units and extends 50 to 200 feet deep in this basin, but is restricted to within about 1 mile of the active Mojave River channel (Stamos and others 2001). The average thickness is estimated to be about 150 feet through this basin. Specific yield for this unit ranges from 23 to 39 percent (Lines 1996) and the average specific yield for this unit is about 27 percent in this basin (DWR 1967; Lines 1996).

Pliocene and Younger Fan Unit. The regional fan unit is composed of late Tertiary and younger unconsolidated to partially consolidated alluvial fan deposits up to 1,000 feet thick (Stamos and Predmore 1995; Lines 1996). The permeability of these deposits decreases with depth (Stamos and others 2001). Estimated average effective thickness in the Upper Mojave River

Valley Groundwater Basin is about 300 feet thick (DWR 1967). Available information is indicates that specific yields and well yields are generally less for the fan unit compared to the floodplain unit, but suggest generally higher well yields for younger fan deposits and lower well yields for older fan deposits (DWR 1967). The specific yields for this unit range from 4 percent to 25 percent with an estimated average of 10 percent (DWR 1967).

Restrictive Structures

This groundwater basin is bounded on the northeast by the Helendale fault zone which forms a barrier to groundwater flow in the regional fan unit, but does not appear to be a barrier to groundwater flow in the floodplain unit (Stamos and Predmore 1995; Stamos and others 2001). The fault zone causes an eastward lowering of the water table across the southeastern boundary into the Lucerne Valley Basin in the fan unit deposits (Stamos and Predmore 1995; Lines 1996). Stamos and others (2001) also interpret unexposed faults acting as barriers to cause steep groundwater gradients between Victorville and Adelanto.

In the southern portion of the basin, bedrock constriction causes water to rise to the surface of the Mojave River at the Upper and Lower Narrows (Lines 1996; Stamos and others 2001). Historically, such locations have been used for camping and watering spots, such as Lane's Crossing just north of the Lower Narrows (Lines 1996).

Recharge Areas

Natural recharge of the basin is from direct precipitation, ephemeral stream flow, infrequent surface flow of the Mojave River, and underflow of the Mojave River into the basin from the southwest (Eccles 1981; Stamos and Predmore 1995; Lines 1996). Treated wastewater effluent, septic tank effluent, effluent from two fish hatchery operations, and irrigation waters are allowed to percolate into the ground and recharge the groundwater system (Eccles 1981; Lines 1996). A large, but sporadic contribution to recharge occurs when the Mojave River is flowing, with 40 feet of rise in the water table observed during 1969 and 16 to 48 feet of rise observed in 1993 (Hardt 1969; Robson 1974; Lines 1996). The general groundwater flow is toward the active channel of the Mojave River and then it follows the course of the river through the valley (Stamos and Predmore 1995; Lines 1996). The Helendale fault forms a barrier to groundwater flow in the southeast corner of the basin. This barrier causes groundwater to flow northwestward under a surface drainage divide into the Mojave River drainage instead of northeastward into Lucerne Lake (dry) in the Lucerne Valley Basin.

Groundwater Level Trends

Groundwater levels in wells in the floodplain unit near the Mojave River tend to vary in concert with rainfall and runoff rates, whereas groundwater levels in the fan unit do not show significant changes due to local rainfall (MWA 1999). The general trend in this basin is for declining groundwater levels, particularly in the fan unit. Three of the ten highest precipitation years over a 60-year base period occurred during 1991 through 1999 (MWA 1999). Infiltration of the runoff from this relatively abundant precipitation has produced an increase in groundwater level (and groundwater storage) in the floodplain unit near the Mojave River (MWA 1999). A hydrograph for a well near Adelanto shows a gentle decline of about 25 feet during 1955 through 1985 and a faster decline of about 35 feet since about 1985. Another well near Victorville in the fan unit shows a range of about 30 feet in water level over the last 20 years, with a decrease in water level of about 10 feet (MWA 1999).

Groundwater Storage

Groundwater Storage Capacity. Published total storage capacity for the Upper Mojave River Valley Groundwater Basin varies. The boundaries of the Upper Mojave River Valley Groundwater Basin of this report correspond closely to the Upper Mojave River Basin and Fifteen Mile storage units discussed by DWR (1967). DWR (1967) calculated the total storage capacity for these storage units using the base of water-bearing materials, an average of about 300 feet. The total storage for the Upper Mojave River Basin and Fifteen Mile storage units is 27,839,000 af (DWR 1967). The Upper Mojave River Valley Groundwater Basin also roughly underlies the Alto subarea and about one-third of the Este subarea under the administration of the Mojave Water Agency (MWA 1999). The MWA uses an economic pumping depth of 100 feet as a limit for effective basin depth, and calculates a total effective storage capacity of 2,086,000 af for the Alto subarea and 530,000 af for the Este subarea (BEE, 1994). Using an overlying area of about 413,000 acres, an average thickness of about 300 feet, and an average specific yield of about 10.5 percent indicates a total storage capacity of about 13,000,000 af.

Groundwater in Storage. MWA (1999) calculated the available stored groundwater underlying the Alto subarea at the end of 1998 was 960,000 af and the available storage space was 1,126,000 af. MWA (1999) calculated the available stored groundwater in the Este subarea at the end of 1998 was 420,000 af and the available storage space was 110,000 af. The basin is considered to be effectively full when 1930 water level elevations are reached (BEE, 1994). Assuming an overlying area of about 413,000 acres, a saturated thickness of about 250 feet, and a specific yield of 10.5 percent indicates about 10,800,000 af of stored groundwater at the end of 1998. This amount indicates that about 2,200,000 af of additional storage space was available.

Groundwater Budget (Type A)

Not enough data exist to compile a detailed groundwater budget for the basin. However, MWA monitors groundwater extraction and reports extractions of 58,300 af for urban uses, 7,800 af for agriculture, and 11,900 af for industrial and recreational uses in the 1997-1998 water year (MWA 1999). In addition to the extraction data, several other components of the water budget have been reported. For the 1997-1998 water year, MWA (1999) estimated natural recharge at 105,000 af, artificial recharge at 16,350 af, and applied water recharge at 3,900 af. Subsurface inflow and outflow averages are estimated by DWR (1967) at 950 af inflow and 2,000 af outflow. Bookman-Edmonston Engineering (1994) set the average inflow at about 1,000 af and the average outflow at 2,000 af. Stamos and others (2001) an estimate that 5,000 to 6,000 afy flows through the floodplain unit into the Middle Mojave River Valley Groundwater Basin near the Helendale fault.

Groundwater Quality

Characterization. Calcium bicarbonate character waters are found near the San Bernardino Mountains and near the Mojave River channel. Sodium bicarbonate waters are found near Victorville. Sodium bicarbonate-sulfate waters are found near Adelanto. Sodium-calcium sulfate waters occur west of Victorville. Sodium chloride waters are found in Apple Valley. Small areas of calcium-sodium sulfate and calcium-sodium bicarbonate also occur in this basin (DWR 1967). Total dissolved solids content typically is less than 500 mg/L (BEE 1994), but concentrations up to 1,105 mg/L were found near Apple Valley (DWR 1967). Electrical Conductivity readings range as high as 1,529 µmhos, with lower values of 650 µmhos found near Apple Valley, and 550 µmhos found near Adelanto (DWR 1967).

Impairments. High nitrate concentrations occur in the southern portion of the basin and high iron and manganese concentrations are found near Oro Grande. Groundwater has been contaminated with trichloroethane (TCE) at the former George Air Force Base, now a federal Superfund site (BEE 1994). Leaking underground storage tanks in and around Victorville have introduced fuel additives benzene, toluene, ethlybenzene, xylene, and methyl tertiary butyl ether (MTBE) into groundwater (BEE 1994; MWA 1999).

Water Quality in Public Supply Wells

Constituent Group[1]	Number of wells sampled[2]	Number of wells with a concentration above an MCL[3]
Inorganics – Primary	122	9
Radiological	115	2
Nitrates	125	2
Pesticides	117	0
VOCs and SVOCs	120	0
Inorganics – Secondary	122	11

[1] A description of each member in the constituent groups and a generalized discussion of the relevance of these groups are included in *California's Groundwater – Bulletin 118* by DWR (2003).
[2] Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.
[3] Each well reported with a concentration above an MCL was confirmed with a second detection above an MCL. This information is intended as an indicator of the types of activities that cause contamination in a given basin. It represents the water quality at the sample location. It does not indicate the water quality delivered to the consumer. More detailed drinking water quality information can be obtained from the local water purveyor and its annual Consumer Confidence Report.

Well Production Characteristics

	Well yields (gal/min)	
Municipal/Irrigation	Range: to 5,500 gal/min	Average: 1,030 gal/min Median: 980 (130 Well Completion Reports)
	100-2,000 gal/min for floodplain unit (Hardt 1969; Lines 1996)	Average = 630 gal/min for all units (BEE 1994)
	Total depths (ft)	
Domestic	Range: 22-1,140 ft	Average: 250 ft Median: 210 ft (1,188 Well Completion Reports)
Municipal/Irrigation	Range: 50-1,970 ft	Average: 360ft Median: 300 ft (326 Well Completion Reports)

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
US Geological Survey	Water level	120/ Annually
US Geological Survey	Water Quality	22/ Annually
Department of Health Services	Title 22 Water Quality	153/ Annually

Basin Management

Groundwater management	The Upper Mojave River Valley Groundwater Basin is a portion of an area adjudicated in 1996 setting the Mojave Water Agency as watermaster. MWA has proposed three basic management strategy alternatives that would reduce and eliminate overdraft in the basin: water conservation, water supply enhancement, and water allocation. These alternatives will likely be implemented together in the final management strategy adopted by MWA (BEE 1994).
Water agencies	
Public	Mojave Water Agency, Victor Valley Water District, Thunderbird County Water District, Juniper Riveria County Water District, Mariana Ranchos County Water District, Hesperia Water District, Baldy Mesa Water District, County Service Area Number 64, Apple Valley Heights County Water District, Apple Valley Foothill County Water District
Private	Apple Valley Ranchos Water Company, Southern California Water Company, Rancheritos Mutual Water Company

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Errata

Substantive changes made to the basin description will be noted here.