Indian Wells Valley Groundwater Basin

- Groundwater Basin Number: 6-54
- County: Inyo, Kern, and San Bernardino
- Surface Area: 382,000 acres (597 square miles)

Basin Boundaries and Hydrology

Indian Wells Valley Groundwater Basin is located east of the southern Sierra Nevada Range. Average annual precipitation in the valley is about 4 to 6 inches. Surface elevation in the central Indian Wells Valley ranges from 2,150 to 2,400 feet above sea level. The basin is a closed, internally drained basin bounded by outcrop of igneous and metamorphic basement rock complexes. The Sierra Nevada Range bounds the basin on the west, the Coso Range on the north, the Argus Range on the east, and the El Paso Mountains on the south. China Lake, a perennial lake, is situated in the central northeastern valley and is the primary natural groundwater discharge point.

Hydrogeologic Information

Water Bearing Formations

Pleistocene to Holocene age lakebed, stream and alluvial fan deposits comprise the primary water-bearing formations. These unconsolidated deposits make up an upper aquifer and a lower aquifer. The lower aquifer is the primary producer for this basin (Berenbrock and Martin, 1991).

The upper aquifer underlies a portion west of China Lake towards the center of the Valley and an area southward into the community of China Lake (Kunkel and Chase 1969). The base of this aquifer is not well defined, the aquifer does not yield water freely to wells, and consists of poor quality water (Berenbrock and Martin, 1991).

The lower aquifer is much larger, with a saturated thickness of up to 1000 feet in the central part of the valley (Kunkel and Chase, 1969). The lower aquifer is considered unconfined except in the eastern part of the valley where the aquifer is confined by silt and clay lenses, lake deposits, and playa deposits. Specific yields used for calculating storage capacity have ranged from 10 to 20 percent but may be somewhat lower (Bean 1989). Well yields in the lower aquifer are more than 1,000 gallons per minute (gpm) and some wells consistently yield more than 2,000 gpm. The lower aquifer is the primary basin aquifer because it has much better water quality than the upper aquifer (Berenbrock, 1987).

Restrictive Structures

Indian Wells Valley is a structural depression and the sedimentary deposits within the basin have been deformed due to regional faulting. Northwest-trending faults border the Sierra Nevada Range to the west. Northwest-trending faults are also present in the central valley while smaller northeast trending faults are noted in the eastern part of the valley. Geologic, geophysical, and hydrologic data indicate the existence of several more faults within the valley but these faults have been obscured or concealed by alluvial deposition. All these faults could act as barriers to groundwater flow (Warner, 1975).

Groundwater Level Trends

Groundwater levels in the basin have been declining since 1945 (Mallory 1979). Mallory (1979) used a groundwater model to estimate future water levels and noted that projected increased groundwater use will continue to cause water levels to decline in the basin.

Groundwater flow under natural conditions was from the lower aquifer to the upper aquifer and flowed through the lower aquifer from the areas of recharge along the southwest, west, north, and northeast edges of the valley toward China Lake playa. However, human activities in the valley including pumping and sewage effluent recharge have altered natural flow (Warner 1975).

Groundwater Storage

Groundwater Storage Capacity. DWR (1975) reports storage capacity for the basin to be 5,120,000 af. Dutcher and Moyle (1973) calculated storage capacity for the basin to be 2,200,000 af using the 1921 water levels as a steady state limit and 200 feet below this level as the economically feasible limit to extract groundwater.

Groundwater in Storage. Bean (1989) reported storage has declined by about 150,000 af between the years 1921 and 1985 based on water level studies by the USGS. Then in 1985 groundwater in storage would be about 2,050,000 af. This shows the basin was in overdraft at this time and that the amount of current storage is probably less than the 1985 amount.

Groundwater Budget (Type A)

Bean (1989) using multiple data sources and 1985 hydrologic data estimated the basic hydrologic balance as 15,100 af of recharge minus 31,000 af of groundwater discharge. This budget shows that in 1985 the basin lost 15,900 af of groundwater.

Groundwater Quality

Characterization. There are many types of groundwater quality in Indian Wells Valley and vicinity. TDS for these waters range from less than 600 mg/L to more than 1,000 mg/L (Bean 1989). Thirty three Title 22 wells sampled by DHS have TDS concentrations ranging from 192 to 950 mg/L with an average concentration of 390 mg/L.

Whelan and Baskin (1987) describe eight major types that occur in the area. These major types are as follows:
1) alpine waters, characteristically calcium-sodium-magnesium-bicarbonate. These are characteristic of the Sierra Nevada.
2) sodium-chloride waters, characteristic of China Lake, southeastern parts of the City of Ridgecrest, and the Coso Geothermal Area.
3) sodium-carbonate waters, principally occurring in the southwestern part of Indian Wells Valley.

4) sodium-bicarbonate waters, occurs in an extensive horseshoe-shaped area in the north and southwestern parts of the basin.
5) sodium-bicarbonate-chloride waters, east of the horseshoe area and may represent mixing of easterly moving groundwater with the groundwater of the China Lake Playa.
6) sulfate waters from geothermal areas, mineralized areas, and sewage pond seepage.
7) calcium-(sodium-magnesium)-bicarbonate-chloride-sulfate waters, these water probably represent a mixture of Alpine and Coso geothermal waters.
8) "waters of the well fields. Usually sodium-calcium, but sometimes calcium-sodium-bicarbonate-chloride waters. These water could represent Alpine waters concentrated by evapotranspiration mixed with sodium chloride geothermal leakage" (Bean 1989).

Impairments. As a result of pumping, a regional cone of depression has formed approximately three miles northwest of the City of Ridgecrest (Berenbrock 1987). Hydraulic heads have changed in the shallow aquifer, due to effluent recharge, causing it to leak into the deep aquifer and migrate towards the cone of depression (Bean 1989). This leakage is of concern because of the shallow aquifer's historically poor water quality.

Water quality in areas of geothermal waters may be poor with high levels of chloride and in many cases, high boron and arsenic (Dutcher and Moyle 1973).

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	47	3
Radiological	46	2
Nitrates	58	1
Pesticides	47	0
VOCs and SVOCs	49	0
Inorganics – Secondary	47	15

[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	To 3,800 gal/min	Average: 815 gal/Min (DWR 1975)
	Total depths (ft)	
Domestic		
Municipal/Irrigation		

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
Department of Health Services	Title 22	63

Basin Management

Groundwater management:	Indian Wells Valley Cooperative Groundwater Management Group
Water agencies	
Public	Indian Wells Water District, Inyokern Community Services District, Inyokern Airport District, Kern County Water Agency, City of Ridgecrest.
Private	

Selected Bibliography

Bean, Robert, T. 1989. *Hydrogeologic Conditions in Indian Wells Valley and Vicinity*. Prepared for California Department of Water Resources. Contract No. DWR B- 56783. 51 p.

Berenbrock, Charles. 1987. *Ground-water data for Indian Wells Valley, Kern, Inyo, and San Bernardino Counties, California, 1977-1984*. U. S. Geological Survey Open-File Report 86-315.

Berenbrock, Charles, and Martin, Peter. 1991. *The ground-water flow system in Indian Wells Valley, Kern, Inyo, and San Bernardino Counties, California*. U. S. Geological Survey Water-Resources Investigations Report 89-4191.

California Department of Water Resources (DWR). 1975. *California's Ground Water*. Bulletin 118. 135p.

Dutcher, L.C., and W.R. Moyle, Jr. 1973. *Geologic and Hydrologic Features of Indian Wells Valley, California*. U.S. Geological Survey Water-Supply Paper 2007. 30 p.

Kunkel, Fred, and Chase, G.H. 1969. *Geology and ground water in Indian Wells Valley ,California*. U.S. Geological Survey Open-File Report. 84 p.

Mallory, M.J. 1979. *Water-Level Prediction for Indian Wells Valley Groundwater Basin, California, 1978*. U.S. Geological Survey Open-File Report 79-254. 28 p.

Warner, J. W. 1975. *Ground-water quality in Indian Wells Valley, California*. U. S. Geological Survey Water-Resources Investigations Report 8-75. 59 p.

Whelan, J.A., and Baskin, R. 1987. *A Water Geochemistry Study of Indian Wells Valley, Inyo and Kern Counties, California*.

Additional References

Austin, W. H. 1987. Preliminary report on suggested seismic studies and deep water well tests. Duplicated report.

Bloyd, R.M., Jr., and Robson, S.G. 1971. Mathematical ground-water model of Indian Wells Valley, California. U.S. Geological Survey Open-File Report. 36 p.

California Department of Water Resources (DWR). 1964. Ground Water Occurrence and Quality Lahontan Region. p.135-138.

United States Bureau of Reclamation, Lower Colorado Region. 1993. Indian Wells Valley Groundwater Project. Volume II, Technical Report.

Young, A.A., and Blaney, H.F. 1942. Use of water by native vegetation. California Division of Water Resources Bulletin 50. 160 p.

Errata

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