Death Valley Groundwater Basin

- Groundwater Basin Number: 6-18
- County: Inyo, San Bernardino
- Surface Area: 921,000 acres (1440 square miles)

Basin Boundaries and Hydrology

Death Valley Groundwater Basin underlies a northwest-trending valley in eastern Inyo and northern San Bernardino Counties. Elevation of the valley floor ranges from 282 feet below mean sea level at Badwater to about 4,000 feet above mean sea level at the north end of the valley. The basin is bordered by consolidated rocks of the Grapevine, Funeral, Black, and Ibex Mountains of the Amargosa Range on the east, the Panamint Range, which includes the Owlshead and Cottonwood Mountains, on the west, the Avawatz Mountains on the south, and the Last Chance Range on the northwest. The California-Nevada state line is the northeast boundary, however, the physical basin extends into Nevada. The bordering mountains range in elevation from about 5,000 to 11,049 feet at Telescope Peak in the Panamint Range. There is a 200 square mile salt incrusted playa lake in the southern part of the valley. Because the valley lies within a National Park, private development and commercial land use is limited (DWR 1964; Hunt and others 1966; Miller 1977).

Average annual precipitation ranges from about 1 to 4 inches in the central and southern parts of the valley and increases in the northern valley to about 4 to 8 inches. Surface runoff, derived from occasional rainstorms and flash floods in the surrounding mountains, drains towards the central axis of the valley and flows towards Badwater by way of Salt Creek from the north, and the Amargosa River from the south (Jennings 1958; Jennings and others 1962).

Hydrogeologic Information

Water Bearing Formations

The primary water-bearing materials used as a source of potable water are the unconsolidated, coarse- to fine-grained older and younger Quaternary alluvial deposits found at the base of the mountains and along stream channels. Although Quaternary lucustrine deposits that underlie much of the valley's floor and playa lake are also water-bearing, the quality of the water is excessively saline with high TDS content. In the vicinity of Furnace Creek Ranch, the Funeral Formation, a moderately consolidated Pliocene to Pleistocene age fanglomerate, is water-bearing near its base and is tapped by wells there as a source of water (DWR 1964; Hunt and others 1966; Miller 1977).

Among the consolidated rocks bordering the basin, the carbonate rocks of Precambrian and Paleozoic age are important because they are, in addition to faulted and folded, highly fractured and fissured and may permit groundwater originating outside the basin to enter along faults or through solution openings. Moreover, these rocks may form a regional inter-basin flow system in which groundwater is transported into the basin from areas to the north and east in the Sarcobatus Flat and Amargosa Desert regions of Nevada. Many of the larger warm springs that issue along the eastern perimeter of the valley, including Saratoga, Cow, Travertine, Texas, Nerveres, and Grapevine Springs, are believed to derive their flow from sources outside of the basin (Hunt and others 1966; Miller 1977).

Restrictive Structures

The northwest-trending Death Valley-Furnace Creek fault zone is a barrier to the movement of groundwater along the eastern perimeter of the valley, where numerous large and small springs occur. Uplifted beds of the Funeral Formation in the Salt Creek Hills impede the southerly flow of groundwater, causing it to rise to the surface and pond at Mesquite Flat located in the northern part of the valley. Similarly, the northerly flow of groundwater is impounded behind uplifted Tertiary beds of the Confidence Hills, where the Amargosa River intersects them in the southern portion of the valley. The movement of groundwater is also impeded at the base of alluvial fans where springs and seeps occur above the contact between coarse-grained alluvium and fine-grained lucustrine deposits (DWR 1964; Hunt and others 1966; Miller 1977).

Recharge and Discharge Areas

Recharge to the basin is derived from the percolation of storm runoff through alluvial fan deposits at the base of the surrounding mountains, and from subsurface inflow originating from the Amargosa River drainage system that may include inflow derived from the Mojave River drainage system on the south. The Pahrump Valley on the southeast and the Sarcobatus Flat and Amargosa Desert on the north and east contribute additional recharge. From the west, some inflow may be obtained from Windgate Valley in the Owlshead Mountains. Groundwater moves towards the valley floor and ultimately beneath the playa lake at Badwater where discharge occurs through evaporation (DWR 1964; Hunt and others 1966; Miller 1977)

Groundwater Level Trends

Although the historical record is sparse, water levels in wells and discharge from springs are not believed to have appreciably changed. This suggests that, for the period of record, overall recharge has equaled discharge in the basin.

In the southern-most part of the basin, in the vicinity of Saratoga Spring, groundwater levels have remained largely unchanged or have declined slightly. Records show that water levels fell by 0.2 feet from 1968 through 1972 at one location near the Amargosa River, but rose by 0.6 feet over roughly the same period northeast of Saratoga Spring. Discharge from Saratoga Spring has historically been between 76 and 80 gallons per minute (Miller 1977).

Water levels at Badwater, beneath the southeast part of the valley, rose by about 1.5 feet between August 1997 and October 2001.

Beneath the southwest side of the valley at the base of the Panamint Range, records indicate water levels in wells and developed springs declined slightly from 1998 through 2001 by about 1.5 to 2.0 feet. Depth to water, however, remained shallow at 4 to 6 feet below the surface.

Beneath the eastern part of the valley at Travertine Point, water levels declined by about 4.0 feet from May of 1990 through March of 2002. Depth to water at this location fluctuated between 598 and 601 feet below the surface. Groundwater levels near Texas Spring declined by about 1.5 feet from 1958 through 1986, and declined by 0.5 feet in the vicinity of Neveras Spring during 1977 through 1986. The combined discharge of Texas and Neveras Springs has historically been about 550 gallons per minute, while Travertine Springs near Furnace Creek Ranch discharges approximately 2,000 gallons per minute (Hunt and others 1966).

Near Stovepipe Wells Hotel, in the north-central part of the valley, groundwater levels rose by about 1.5 feet from 1967 through 1985, but declined at other nearby locations from 0.5 to 2.0 feet during 1973 through 1988. Near Midway Well, north of Stovepipe Wells, water levels declined by 1.7 feet from March 2000 through October 2000, but rose slightly at the northern end of the valley at Grapevine Springs by about 0.02 feet over roughly the same period.

Groundwater Storage

Groundwater Storage Capacity. Total storage capacity is estimated to be about 11,000,000 af (DWR 1975).

Groundwater in Storage. Unknown.

Groundwater Budget (C)

Groundwater budget information is not available.

Groundwater Quality

Characterization. Most of the large warm springs found along the eastern perimeter of the valley, including Cow, Texas, Travertine, and Neveras Springs, issue water of sodium bicarbonate character. Groundwater derived from the base of the Funeral Formation near Furnace Creek Ranch, is also sodium bicarbonate in character, as is the water from Mesquite Springs and Strainingers Spring near Scotty's Castle in the northern part of the valley. In the northern Funeral Mountains, Keane Spring issues water of a sodium-calcium bicarbonate-sulfate character and is of good quality.

In the vicinity of Mesquite Flats in the north central part of the valley, the groundwater character tends to be either sodium chloride or sodium bicarbonate-sulfate, as is the water at Stovepipe Wells.

Along the eastern front of the Panamint Range and in the Emigrant Pass and upper Emigrant Wash areas, groundwater derived from the percolation of runoff is typically calcium-sodium bicarbonate or sodium-calcium bicarbonate in character. Groundwater moving through permeable alluvial deposits becomes increasingly saline as it approaches the valley floor as exemplified by the sodium chloride water at Tule Springs and Gravel Wells at the base of the Panamint Range. Bennett's Well, located in the same general area in contrast, has water of good quality and is sodium-calcium bicarbonate-sulfate in character. Sodium chloride characterizes most of the groundwater beneath the lower valley floor and playa lake.

In the southern part of the valley, groundwater is influenced by sodium sulfate-chloride character flowing in the Amargosa River. Sodium sulfate-chloride also characterizes the water at Saratoga Spring located at the southern end of the valley.

Impairments. In general, much of the available groundwater in the basin is rated marginal to inferior for irrigation and domestic use because of elevated fluoride, boron, chloride, sulfate, and TDS concentrations. Analyses from wells and springs throughout the basin found that fluoride levels exceeded 0.9 mg/L in at least 25 of 37 locations. Levels of fluoride range from 0.10 to 8.6 mg/L with an average concentration of 2.24 mg/L. Boron levels range from 0.1 to 11.2 mg/L with an average concentration of 2.19 mg/L, and 22 of 37 locations exceed 1.0 mg/L. TDS concentration ranges from about 240 to as much as 19,104 mg/L at Saratoga Spring and 23,600 mg/L at Badwater. TDS concentrations exceeding 1,000 mg/L were found in 13 of 37 locations sampled with an average concentration of about 1,940 mg/L.

Elevated concentrations of fluoride and boron impair most of the large warm springs along the eastern perimeter of the valley, including Cow, Texas, Travertine, and Neveras Springs. So to are most wells and springs impaired along the base of the Panamint Range, including Gravel Well, and Tule and Eagle Borax Springs. Bennett's Well in contrast, is suitable for both domestic and irrigation uses. The water is suitable for most beneficial uses at Keane Spring in the northern Funeral Mountains and at Strainingers Spring near Scotty's Castle. Also, groundwater derived from wells and springs near Emigrant Pass and upper Emigrant Wash are largely low in TDS content and suitable for most domestic and irrigation purposes (DWR 1964, 1975; Hunt and others 1966; Miller 1977).

Well Characteristics

	Well yields (gal/min)	
Municipal/Irrigation	Range: Unknown.	Average: Unknown. (DWR 1975)
	Total depths (ft)	
Domestic	Range: -	Average:
Municipal/Irrigation	Range: -	Average:

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
USGS	Groundwater levels	28
	Miscellaneous water quality	
Department of Health Services and cooperators	Title 22 water quality	6

Basin Management

Groundwater management:

Water agencies

Public

Private

References Cited

California Department of Water Resources (DWR). 1964. *Ground Water Occurrence and Quality Lahontan Region.* Bulletin No.106-1. 439 p.

_____. 1975. *California's Ground Water*. Bulletin No. 118. 135 p.

Hunt, C.B. , T.W. Robinson, W.A. Bowles, and A.L. Washburn. 1966. *Hydrologic Basin Death Valley California.* U.S. Geological Survey Professional Paper 494 – B. 137 p.

Jennings, C.W. 1958. *Geologic Map of California: Death Valley Sheet*. Olaf P. Jenkins Edition. California Department of Conservation, Division of Mines and Geology. Scale 1: 250,000.

Jennings, C. W. , J. L. Burnett, B. W. Troxel. 1962. *Geologic Map of California: Trona Sheet*. Olaf P. Jenkins Edition. California Department of Conservation, Division of Mines and Geology. Scale 1: 250,000.

Miller, G.A. 1977. *Appraisal of the Water Resources of Death Valley, California–Nevada*. U.S. Geological Open – File Report 77-728. 68 p.

Errata

Changes made to the basin description will be noted here.