San Joaquin Valley Groundwater Basin
Tulare Lake Subbasin

- Groundwater Subbasin Number: 5-22.12
- County: Kings
- Surface Area: 524,000 acres (818 square miles)

Basin Boundaries and Hydrology

The San Joaquin Valley is surrounded on the west by the Coast Ranges, on the south by the San Emigdio and Tehachapi Mountains, on the east by the Sierra Nevada and on the north by the Sacramento-San Joaquin Delta and Sacramento Valley. The northern portion of the San Joaquin Valley drains toward the Delta by the San Joaquin River and its tributaries, the Fresno, Merced, Tuolumne, and Stanislaus Rivers. The southern portion of the valley is internally drained by the Kings, Kaweah, Tule, and Kern Rivers that flow into the Tulare drainage basin including the beds of the former Tulare, Buena Vista, and Kern Lakes.

The Tulare Lake Subbasin is bounded on the south by the Kings-Kern county line, on the west by the California Aqueduct, the eastern boundary of Westside Groundwater Subbasin, and Tertiary marine sediments of the Kettleman Hills. It is bounded on the north by the southern boundary of the Kings Groundwater Subbasin, and on the east by the westerly boundaries of the Kaweah and Tule Groundwater Subbasins. The southern half of the Tulare Lake Subbasin consists of lands in the former Tulare Lake bed in Kings County. Average annual precipitation is seven inches throughout most of the subbasin and nine inches at the northern margin.

Hydrogeologic Information

The San Joaquin Valley represents the southern portion of the Great Central Valley of California. The San Joaquin Valley is a structural trough up to 200 miles long and 70 miles wide. It is filled with up to 32,000 feet of marine and continental sediments deposited during periodic inundation by the Pacific Ocean and by erosion of the surrounding mountains, respectively. Continental deposits shed from the surrounding mountains form an alluvial wedge that thickens from the valley margins toward the axis of the structural trough. This depositional axis is below to slightly west of the series of rivers, lakes, sloughs, and marshes, which mark the current and historic axis of surface drainage in the San Joaquin Valley.

Water Bearing Formations

Sediments comprising the Tulare Lake subbasin include younger and older alluvium, flood-basin deposits, lacustrine and marsh deposits and continental deposits. Younger alluvium consists of a heterogeneous complex of interstratified discontinuous beds of unsorted to fairly well sorted clay, silt, sand, and gravel. This unit is very permeable but largely above the water table. Older alluvium consists of poorly sorted lenticular deposits of clay, silt, sand, and gravel, which may be loosely consolidated to cemented. Older alluvium is moderately to highly permeable, and yields large quantities of water to wells. The unit is a major aquifer in the subbasin (Hilton and others 1963). Flood basin deposits are relatively impermeable silt and clay with some moderately to poorly permeable sand layers. This unit is not an important source of ground water, but locally, may yield sufficient supplies for domestic and stock use. Lacustrine and marsh deposits are reduced deposits of silt, clay, and fine sand. In the subsurface, lacustrine clay interfingers as tongues with continental and alluvial deposits. The lacustrine and marsh deposits include the Corcoran Clay which underlies the subbasin at depths ranging between about 300 and 900 feet (DWR 1981). Continental deposits consist of poorly sorted lenticular deposits of clay, silt, sand, and gravel. These deposits are moderately to poorly permeable and yield low to large quantities of water to wells.

Land subsidence of one to four feet due to deep compaction of fine-grained units has occurred in the subbasin (Ireland and others 1984). The estimated average specific yield is 8.5 percent (based on DWR San Joaquin District internal data and Davis 1959).

Restrictive Structures

Groundwater flow is generally southwestward, toward the Tulare lakebed (DWR 2000). Based on current and historical groundwater elevation maps, horizontal groundwater barriers do not appear to exist in the subbasin.

Recharge Areas

Groundwater recharge is primarily from stream recharge and from deep percolation of applied irrigation water (Croft and Gordon 1968, DWR 1995).

Groundwater Level Trends

Changes in groundwater levels are based on annual water level measurements by DWR and cooperators. Water level changes were evaluated by quarter township and computed through a custom DWR computer program using geostatistics (kriging). On average, the subbasin water level has declined nearly 17 feet from 1970 through 2000. The period from 1970 through 1978 showed moderate declines with many fluctuations, totaling about 12 feet. The ten-year period from 1978 to 1988 saw more fluctuations and a general increase of about 24 feet, bringing water levels up to 12 feet above the 1970 water levels. 1988 through 1993 showed steep declines, bottoming out in 1993 at 23 feet below 1970 water levels. Water levels rose from 1993 to 1999 to about 10 feet below the 1970 level. From 1999 to 2000, water levels dropped another 7 feet, bringing the water levels to about 17 feet below 1970 water levels. Fluctuations in water levels have been most exaggerated in the Lakebed area of the subbasin. This area has the steepest decreases in water levels as well as some of the strongest increases in water levels.

Groundwater Storage

Estimations of the total storage capacity of the subbasin and the amount of water in storage as of 1995 were calculated using an estimated specific yield of 8.5 percent and water levels collected by DWR and cooperators. According to these calculations, the total storage capacity of this subbasin is estimated to be 17,100,000 af to a depth of 300 feet and 82,500,000 af to the base of fresh groundwater. These same calculations give an estimate of 12,100,000 af of groundwater to a depth of 300 feet stored in this subbasin as of 1995 (DWR 1995). According to published literature, the amount of stored groundwater in this subbasin as of 1961 is 37,000,000 af to a depth of ≤ 1000 feet (Williamson 1989).

Groundwater Budget (Type B)

Although a detailed budget was not available for this subbasin, an estimate of groundwater demand was calculated based on the 1990 normalized year and data on land and water use. A subsequent analysis was done by a DWR water budget spreadsheet to estimate overall applied water demands, agricultural groundwater pumpage, urban pumping demand and other extraction data.

Natural recharge is estimated to be 89,200 af. Artificial recharge and subsurface inflow are not determined. There is 195,000 af of applied water recharge into this subbasin. Annual urban and agricultural extractions are 24,000 af and 648,000 af, respectively. Other extractions and subsurface inflow are not determined.

Groundwater Quality

Characterization. The water in this groundwater subbasin is generally a calcium bicarbonate type in the northern portion. This trends towards sodium bicarbonate as it approaches the Tulare Lakebed (Croft and Gordon 1968). TDS values typically range from 200 to 600 mg/L. TDS values of shallow groundwater in drainage problem areas are as high as 40,000 mg/L (Beard and others 1994, Fujii and Swain 1995). The Department of Health Services, which monitors Title 22 water quality standards, reports TDS values in 36 wells ranging from 150 to 820 mg/L, with an average value of 342 mg/L. The city of Hanford reports EC values in 14 wells ranging from 210 to 820 µmhos/cm, with an average value of 554 µmhos/cm (Carr 2001).

Impairments. There are areas of shallow, saline groundwater in the southern portion of the subbasin and localized areas of high arsenic. The city of Hanford reports odors caused by the presence of hydrogen sulfide (Carr 2001).

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	39	11
Radiological	39	7
Nitrates	38	0
Pesticides	40	2
VOCs and SVOCs	39	2
Inorganics – Secondary	39	10

[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 Characteristics

	Well yields (gal/min)	
Municipal/Irrigation	Range: 20 – 3,000	Average: 300 – 1,000
	Total depths (ft)	
Domestic		
Municipal/Irrigation	Range: 150 – 2,000	

Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR (incl. Cooperators)	Groundwater levels	241 Semi-annually
Department of Health Services (incl. Cooperators)	Title 22 water quality	86 Varies

Basin Management

Groundwater management:	Kings River Conservation District-Area "C" adopted a groundwater management plan in August, 1998. Tulare Lake Reclamation District adopted a plan in 1996.
Water agencies	
Public	Tulare Lake Subbasin Water Storage District, Dudley Ridge W.D., Salyer W.D., Kings County W.D., Stratford I.D., Empire West Side I.D., Corcoran I.D., Melga W.D., Angiola W.D., Hacienda I.D.
Private	California Water Service

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Errata

Updated groundwater management information and added hotlinks to applicable websites. (1/20/06)