

## **San Joaquin Valley Groundwater Basin**

### **Merced Subbasin**

- Groundwater Subbasin Number: 5-22.04
- County: Merced
- Surface Area: 491,000 acres (767 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 Merced subbasin includes lands south of the Merced River between the San Joaquin River on the west and the crystalline basement rock of the Sierra Nevada foothills on the east. The subbasin boundary on the south stretches westerly along the Madera-Merced County line (Chowchilla River) and then between the boundary of the Le Grand-Athlone Water District and the Chowchilla Water District. The boundary continues west along the northern boundaries of Chowchilla Water District and El Nido Irrigation District. The southern boundary then follows the western boundary of El Nido I.D. south to the northern boundary of the Sierra Water District, which is followed westerly to the San Joaquin River. Average annual precipitation is 11 to 13 inches, increasing eastward.

### **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***

Geologic units in the Merced Subbasin consist of consolidated rocks and unconsolidated deposits. The consolidated rocks include the Ione Formation, the Valley Springs Formation, and the Mehrten Formation. In the eastern part of the area, the consolidated rocks generally yield small quantities of water to wells except for the Mehrten Formation, which is an important aquifer.

The unconsolidated deposits were laid down during the Pliocene to present. From oldest to youngest, these deposits include continental deposits, lacustrine and marsh deposits, older alluvium, younger alluvium, and flood-basin deposits. The continental deposits and older alluvium are the main water-yielding units in the unconsolidated deposits. The lacustrine and marsh deposits (which include the Corcoran, or "E-" Clay), and the flood-basin deposits yield little water to wells, and the younger alluvium in most places probably yields only moderate quantities of water to wells (Page 1973.)

There are three ground water bodies in the area: an unconfined water body, a confined water body, and the water body in consolidated rocks. The unconfined water body occurs in the unconsolidated deposits above and east of the Corcoran Clay, which underlies the western half of the subbasin at depths ranging between about 50 and 200 feet (DWR 1981), except in the western and southern parts of the area where clay lenses occur and semi-confined conditions exist. The confined water body occurs in the unconsolidated deposits below the Corcoran Clay and extends downward to the base of fresh water. The water body in consolidated rocks occurs under both unconfined and confined conditions.

The estimated average specific yield of this subbasin is 9.0 percent (based on DWR, San Joaquin District internal data and that of Davis 1959).

### ***Restrictive Structures***

Groundwater flow is primarily to the southwest, following the regional dip of basement rock and sedimentary units. DWR (2000) data show two groundwater depressions south and southeast of the city of Merced during 1999.

### ***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 30 feet from 1970 through 2000. The period from 1970 through 1978 showed steep declines totaling about 15 feet. The ten-year period from 1978 to 1988 saw stabilization and a rebound of about 10 feet. 1988 through 1995 again showed steep declines, bottoming out in 1996 with water levels rising from 1996 to 2000. Water level declines have been more severe in the eastern portion of the subbasin

### ***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 9.0 percent and water levels collected by DWR and cooperators. According to these calculations, the total storage capacity of this subbasin is estimated to be 21,100,000 af to a depth of 300 feet and 47,600,000 af to the base of fresh groundwater. These same calculations give an estimate of 15,700,000 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  $\leq 1000$  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 into the subbasin is estimated to be 47,000 af. Values for artificial recharge and subsurface inflow are not determined. There is approximately 243,000 af of applied water recharge into the subbasin. Annual urban and agricultural extractions are 54,000 af and 492,000 af, respectively. Other extractions equal approximately 9,000 af. Subsurface inflow values are not determined.

### **Groundwater Quality**

**Characterization.** The groundwater in this subbasin is characterized by calcium-magnesium bicarbonate at the basin interior, sodium bicarbonate to the west, and calcium-sodium bicarbonate to the south. Small areas of sodium chloride and calcium-sodium chloride waters exist at the southwest corner of the basin (Page 1973). TDS values range from 100 to 3,600 mg/L, with a typical range of 200 to 400 mg/L. The Department of Health Services, which monitors Title 22 water quality standards, reports TDS values in 46 wells ranging from 150 to 424 mg/L, with an average value of 231 mg/L. For 10 wells, EC values range from 260 to 410  $\mu\text{mhos/cm}$ , with an average value of 291  $\mu\text{mhos/cm}$ .

**Impairments.** There are localized areas of high hardness, iron, nitrate, and chloride in this subbasin.

### **Water Quality in Public Supply Wells**

Constituent Group <sup>1</sup>	Number of wells sampled <sup>2</sup>	Number of wells with a concentration above an MCL <sup>3</sup>
Inorganics – Primary	65	0
Radiological	58	1
Nitrates	64	2
Pesticides	62	8
VOCs and SVOCs	59	1
Inorganics – Secondary	65	8

<sup>1</sup> 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).

<sup>2</sup> Represents distinct number of wells sampled as required under DHS Title 22 program from 1994 through 2000.

<sup>3</sup> 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: 100 – 4,450	Average: 1,500 – 1,900
Total depths (ft)		
Domestic		
Municipal/Irrigation	Range: 100 - 800	

## Active Monitoring Data

Agency	Parameter	Number of wells /measurement frequency
DWR (incl. Cooperators)	Groundwater levels	378 Semi-annually
Department of Health Services (including Cooperators)	Title 22 water quality	142 Varies

## Basin Management

Groundwater management:	None
Water agencies	
Public	Merced I.D., Merquin County Water District, Turner Island Water District, Le Grand-Athlone W.D., Plainsburg I.D., Stevinson W.D.
Private	Not Determined

## References Cited

- California Department of Water Resources (DWR), San Joaquin District. Unpublished Land and Water Use Data.
- \_\_\_\_\_. Well completion report files.
- \_\_\_\_\_. 1995. Internal computer spreadsheet for 1990 normal computation of net water demand used in preparation of DWR Bulletin 160-93.
- \_\_\_\_\_. 1981. *Depth to Top of Corcoran Clay*. 1:253,440 scale map.
- \_\_\_\_\_. 2000. *Spring 1999, Lines of Equal Elevation of Water in Wells, Unconfined Aquifer*. 1:253,440 scale map sheet.
- Davis, GH, Green, JH, Olmstead, SH, and Brown, DW. 1959a. *Ground Water Conditions and Storage Capacity in the San Joaquin Valley, California*; US Geological Survey Water Supply Paper No. 1469, 287p.
- Page, RW, and Balding, GO. 1973. *Geology and Quality of Water in the Modesto-Merced Area, San Joaquin Valley, California, with a Brief Section of Hydrology*. USGS Water-Resources Investigations 6-73, 85p.

Williamson, Alex K, Prudic, David E, and Swain, Lindsay A. 1989. *Groundwater flow in the Central Valley, California*. US Geological Survey Professional Paper 1401-D. 127 p.

## Additional References

Balding, GO, and Page, RW. 1971. *Data for Wells in the Modesto-Merced Area San Joaquin Valley, California*. U.S. Geological Survey Open-File Report.

California Department of Water Resources. 1980. Bulletin 118-80. *Ground Water Subbasins in California*.

\_\_\_\_\_. 1994. Bulletin 160-93. *California Water Plan Update, Vol. 1*.

Davis, SN and Hall, FR. 1959b. *Water Quality of Eastern Stanislaus and North Merced Counties, California*; Stanford Univ. Pubs., Geol. Sci., v. 6, no. 1. 112 p.

## Errata

Changes made to the basin description will be noted here.