Salinas Valley Groundwater Basin, Upper Valley Aquifer Subbasin

- Groundwater Subbasin Number: 3-4.05
- County: Monterey
- Surface Area: 98,200 acres (153 square miles)

Basin Boundaries and Hydrology

The Salinas Valley Groundwater Basin, Upper Valley Aquifer Subbasin occupies the upper portion of the Salinas Valley and extends from approximately three miles south of Greenfield to about six miles south of the town of San Ardo. The subbasin is bounded to the west by the contact of the Quaternary Paso Robles Formation or Quaternary terrace deposits with middle Miocene marine sedimentary rocks (Monterey Shale) of the Sierra de Salinas. To the east, the boundary is the contact of the Paso Robles Formation or of the Quaternary terrace deposits or alluvium with the Early to Middle Pliocene Pancho Rico Formation of the Gabilan Range. The northern boundary is shared with the Salinas Valley – Forebay Aquifer subbasin and generally represents the southern limit of confining conditions above the 400-Foot Aquifer (MW 1994). This boundary also represents a constriction of the Valley floor caused by encroachment from the west by the composite alluvial fan of Arroyo Seco and Monroe Creek. The southern boundary is the Sargent Creek drainage and its projection across the valley and is shared with the Salinas Valley – Paso Robles Area subbasin. The narrow constriction of the Salinas Valley at this location generally separates the upper and lower Salinas River drainage basins.

Intermittent streams such as Pine and Pancho Rico Creeks and perennial San Lorenzo Creek drain the western slopes of the Gabilan Range and flow westward across the subbasin toward the Salinas River. The subbasin boundaries are generally correlative with those of the Upper Valley Subarea of the Monterey County Water Resources Agency (MCWRA). Average annual precipitation is approximately 11 inches at the valley floor to 15 inches at the eastern and western margin of the subbasin.

Hydrogeologic Information

Water Bearing Formations

The Salinas Valley is surrounded by the Gabilan Range on the east, by the Sierra de Salinas and Santa Lucia Range on the west, and is drained by the Salinas River, which empties into Monterey Bay on the north. The King City (Rinconda-Reliz) Fault (Durbin 1978) generally follows the western margin of the valley from King City in the south to Monterey Bay in the north. Valley-side down, normal movement along the fault allowed the deposition of an asymmetric, westward thickening alluvial wedge. The Salinas Valley has been filled with 10,000 to 15,000 feet of Tertiary and Quaternary marine and terrestrial sediments that include up to 2,000 feet of saturated alluvium (Showalter 1984). Above the generally non-water bearing and consolidated granitic basement, Miocene age Monterey and Pliocene age Purisima Formations are water-bearing strata within the Plio-Pleistocene age Paso Robles Formation and within Pleistocene to Holocene alluvium. Along the eastern margin of the Upper Valley Aquifer subbasin, the Pancho Rico

Formation is the equivalent of the Purisima Formation. The depth to the base of fresh water ranges from about 1,000 feet at the northern subbasin valley margin to 200 feet at the southern margin (Durbin 1978) with a sharp rise from about 800 to 300 feet at the center of the subbasin.

The primary aquifer of the subbasin is unconfined and is represented by unconsolidated to semi-consolidated and interbedded gravel, sand, and silt of the Paso Robles Formation, alluvial fan and river deposits. Deposits west of the Salinas River tend to be coarser grained than those to the east. Well yields up to 4,000 gallons per minute are present in both the Paso Robles Formation and river deposits (Yates 1988). These deposits represent the lateral equivalents of the 180-Foot and 400-Foot Aquifer units of the lower Salinas Valley. However, no aquitards comparable to those separating aquifers in the lower Salinas Valley exist in the sedimentary sequence of the subbasin. The Deep Aquifer of the lower Valley has no equivalent in the subbasin due to the southward shallowing of the basement complex.

MW (1994) estimated specific yields for the three main aquifers in the Salinas Valley for their Integrated Ground and Surface Water Model (IGSM). The estimated values for the 180-Foot and 400-Foot Aquifers were 8-16 percent and 6 percent, respectively. Yates (1988) estimated a storage coefficient of 7.8 percent for the northern Subbasin and 15.0 percent for the southern subbasin. MCWRA (2000) lists the specific yield as 10 percent.

Groundwater flow is generally in a down-valley direction. Recharge from San Lorenzo Creek east of King City appeared to create a slight flattening of the water table gradient and locally influenced the flow direction at this location during Fall 1995 (MCWRA 1997).

Groundwater quality issues primarily stem from long-term agricultural production in the Salinas Valley that has contributed to an extensive non-point source nitrate problem. Nitrate concentrations in many wells in the valley exceed drinking water standards (DWR 1971), including in wells throughout the Upper Valley Aquifer subbasin (MCWRA 1997).

Restrictive Structures

The King City Fault, whose large vertical offset allowed a deep wedge of sediments to accumulate in the northern Salinas Valley, does not extend southeastward in the subbasin. Instead, between Greenfield and San Ardo, the groundwater basin occupies the axis of a northwest-plunging synclinal flexure in the basement complex (Durbin 1978). Younger marine deposits (Pancho Rico Formation) and overlying non-marine deposits (Paso Robles Formation) outcrop along both sides of the valley. Overlying these deposits are widespread Quaternary terrace deposits and minor Holocene sand dune deposits present south of King City. Holocene alluvium of the Salinas River drainage and its tributaries complete the sedimentary sequence (Jennings 1959).

Recharge Areas

Subbasin recharge is primarily from percolation through channel deposits of the Salinas River and tributary drainages (DWR 1946a). A lesser volume of recharge results from the percolation of precipitation along valley margins and from applied irrigation water (LHI 1985). Subsurface flow from precipitation recharged through the Pancho Rico Formation east of the Subbasin and minimal subsurface flows from drainage along the Salinas River account for the remainder of recharge.

Groundwater Level Trends

Between 1964 and 1974, the amount of groundwater in storage in this subbasin rose 600 af. This trend continued through 1974 to 1984 and through 1984 to 1994, with increases in the amount of groundwater stored of 9,600 af and 4,500 af, respectively (MW 1998).

Groundwater Storage

As of 1994, the amount of groundwater in storage is approximately 2,460,000 af (MW 1998). The total calculated storage capacity of the subbasin is estimated to be 3,100,000 af (DWR 2000).

Groundwater Budget (Type A)

A detailed water budget was determined for 1994 (MW 1998). Natural recharge accounts for approximately 165,000 af of the total basin inflow. Applied water recharge is included in this estimate. Subsurface inflow was estimated to be 7,000 af. Annual urban and agricultural extractions are approximately 153,000 af combined, and there are no other extractions. Subsurface outflow is estimated to be 17,000 af.

Groundwater Quality

Characterization. The groundwater in this subbasin is of a sodium and calcium sulfate type, and sodium chloride groundwaters east of the Salinas river, and west of the river, better quality calcium-magnesium bicarbonate waters dominate (DWR 1969b). TDS values range from 1,200 to 3,700 mg/L (DWR 1969b). The Department of Health Services (2000) reports TDS values of 140 to 990 mg/L, with an average value of 443 mg/L in 168 analyses, and a range of 311 mg/L to 775 mg/L, with an average value of 536 mg/L, in 7 public supply wells. EC values range from 730 to 3,980 µmhos/cm, with an average value of 2,150 µmhos/cm (based on 11 wells, DWR 1969b). DHS (2000) reports EC values ranging from 465 to 1,518 µmhos/cm from 69 analyses.

Impairments. Recharge of poor quality surface water (>2000 µmhos/cm) from drainages along the western slope of the Gabilan Range have created poor quality groundwater along the eastern side of the subbasin. This results in sulfate, boron, TDS, and conductivity exceeding drinking water standards in many areas (DWR 1969b). Of 35 wells sampled during 1995 for nitrate, 23 exceeded the drinking water standard. The average nitrate value was 98 mg/L (MCWRA 1997).

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	12	4
Radiological	11	0

Nitrates	12	6
Pesticides	13	0
VOCs and SOCs	13	0
Inorganics – Secondary	12	0

[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		
	Total depths (ft)	
Domestic		
Municipal/Irrigation	Range: 93 - 600	Average: 235 (16 Well Completion Reports)

Active Monitoring Data

Agency	**Parameter**	**Number of wells /measurement frequency**
MCWRA	Groundwater levels	36 Varies (Geomatrix 2001)
MCWRA	Mineral, nutrient, & minor element.	37 Annually (Geomatrix 2001)
Department of Health Services (incl. Cooperators)	Title 22 water quality	17 Varies

Basin Management

Groundwater management:	MCWRA requires annual extraction reports form all agricultural and municipal well operators, and has researched, developed and/or constructed projects to reduce seawater intrusion, manage nitrate contamination in the groundwater, provide adequate water supplies to meet current and future needs, and to hydrologically balance the groundwater basin in the Salinas Valley.
Water agencies	
Public	Monterey County Water Resources Agency; San Ardo WD; San Lucas WD
Private	California Water Service Co. (CWS)– King City; Little Bear WC

References Cited

California Department of Health Services (DHS). 2000. *California Water Quality Monitoring Database*. Division of Drinking Water and Environmental Management, Sacramento [on CD-ROM].

Department of Public Works, Division of Water Resources (DWR). 1946a. *Bulletin 52. Salinas Basin Investigation*. 230 p.

Department of Water Resources (DWR). 1969b. *Salinas River Basin Special Investigation*. Water Quality Investigations Memorandum Report. Prepared for the Central Coastal Regional Water Quality Control Board. 67 p.

________. 1971. *Nitrates in Ground Waters of the Central Coast Area*. Memorandum Report. San Joaquin District Office. 16 p.

________. 2000. San Joaquin district unpublished calculation using specific yield and area data.

Durbin, TJ, Kapple, GW, and Freckleton, JR. 1978. *Two-Dimensional and Three-Dimensional Digital Flow Models of the Salinas Valley Ground-Water Basin, California*. US Geological Survey. Water Resources Investigations Report 78-113. Prepared in cooperation with the U.S. Army Corps of Engineers. 134 p.

Geomatrix Consultants. 2001. *Evaluation of the Salinas Valley Groundwater Monitoring Network and Proposed Redesign.* Prepared for Monterey County Water Resources Agency.

Jennings, Charles W and Rudolph G Strand (compilers). 1959. Santa Cruz Sheet of *Geologic Map of California*. California Division of Mines and Geology (CDMG). Scale 1:250,000.

Leedshill-Herkenhoff, Inc. (LHI). 1985. *Salinas Valley Seawater Intrusion Study*. Prepared for the Monterey County Flood Control and Water Conservation District.

Monterey County Water Resources Agency (MCWRA). 1997. *Water Resources Data Report, Water Year 1994-1995*. 96 p.

________. 2000. Personal communication with Mr. Gene Taylor, Principal Hydrologist.

Montgomery-Watson Consulting Engineers (MW). 1994. *Salinas River Basin Water Resources Management Plan Task 1.09 Salinas Valley Groundwater Flow and Quality Model Report*. Prepared for Monterey County Water Resources Agency.

________. 1998. *Salinas Valley Historical Benefits Analysis (HBA). Final Report, April 1998.* Prepared for the Monterey County Water Resources Agency.

Showalter, P, Akers, JP, and Swain, LA. 1983. *Design of a Ground Water quality Monitoring Network for the Salinas River Basin, California.* US Geological Survey Water Resources Investigation Report 83-4049. 74 p.

Yates, EB. 1988. *Simulated Effects of Ground-Water Management Alternatives for the Salinas Valley, California*. US Geological Survey. Water Resources Investigations Report 87-4066. Prepared in cooperation with the Monterey County Flood Control and Water Conservation District. 79 p.

Additional References

Boyle Engineering Corporation. 1987. *Salinas Valley Ground Water Model, Alternative Analysis. Final Report*. Prepared for the Monterey County Flood Control and Water Conservation District.

Department of Public Works, Division of Water Resources (DWR). 1946b. *Bulletin 52-B, Salinas Basin Investigation. Summary Report*. 46 p.

Department of Water Resources (DWR). 1969a. *Geology of the Lower Portion, Salinas Valley Ground Water Basin*. Office Report, Central District Office. 18 p.

________. 1980. *Ground Water Basins in California.* Bulletin 118-80.

________. 1988. *1986 Monitoring Program for the Salinas Valley Ground Water Basin*. Report to the State Water Resources Control Board, Task Order 1. Interagency Agreement 4-134-350. 28 p.

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

Greene, HG. 1970. *Geology of Southern Monterey Bay and its Relationship to the Ground-Water Basin and Seawater Intrusion*. US Geological Survey Open File Report. 50 p.

Johnson, MJ. 1983. *Ground Water in North Monterey County, California*. US Geological Survey. Water-Resources Investigations. Report 83-4023.

Jones & Stokes Associates, Inc. 1990. *Salinas Valley Seawater Intrusion Program, Draft Environmental Impact Report/Environmental Impact Statement*. Prepared for the Monterey County Water Resources Agency, the Monterey Regional Water Pollution Control Agency, and the US Bureau of Reclamation.

Monterey County Water Resources Agency (MCWRA). 1996. *Summary Report: 1995 Groundwater Extraction Data and Agricultural Water Conservation Practices*. 8 p.

State Water Resources Board. 1953. *Bulletin No. 5, Santa Cruz-Monterey Counties Investigation.* 230 p.

________. 1955. *Bulletin No. 19, Salinas River Basin Investigation*. 225 p.

State Water Resources Control Board, Regional Water Quality Control Board, Central Coast Region (SWRCB). 1989. *Water Quality Control Plan - Central Coast Basin*.

Errata

Changes made to the basin description will be noted here.