# Redding Groundwater Basin, Bowman Subbasin

- Groundwater Basin Number: 5-6.01
- County: Tehama
- Surface Area: 85,330 acres (133 square miles)

## Basin Boundaries and Hydrology

The Bowman Subbasin comprises the portion of the Redding Groundwater Basin bounded on the west by the Coast Ranges; on the north by Salt, Dry, and Cottonwood Creeks; on the east by the Sacramento River and on the south by the Red Bluff Arch. The Red Bluff Arch is defined as the hydrologic divide between the drainages of Cottonwood Creek and Hooker Creek to the north and the drainages of Blue Tent Creek, Dibble Creek, and Reeds Creek to the south.

The South Fork of Cottonwood Creek drains the western half of the subbasin and Hooker Creek drains the central portion. The eastern extents of the subbasin has many small drainages tributary to the Sacramento River. Annual precipitation ranges from 23- to 27-inches.

## Hydrogeologic Information

### *Water-Bearing Formations*

The Bowman Subbasin aquifer system consists of continental deposits of late Tertiary to Quaternary age. The Quaternary deposits include Holocene alluvium and Pleistocene Modesto and Riverbank formations. The Tertiary deposits include Pliocene Tehama and Tuscan formations. The following descriptions are from Helley and Harwood (1985) unless otherwise noted.

**Holocene Alluvium.** The alluvium consists of unconsolidated gravel, sand, silt and clay from stream channel and floodplain deposits. These deposits are found along stream and river channels. The thickness ranges up to 30 feet. This unit represents the perched water table and the upper part of the unconfined zone of the aquifer. Although the alluvium is moderately permeable, it is not a significant contributor to groundwater usage.

**Pleistocene Modesto and Riverbank Formations.** The Modesto and Riverbank formations consist of poorly consolidated gravel with some sand and silt deposited during the Pleistocene time. They are usually found as terrace deposits near the surface along the Sacramento River and its tributaries. Modesto Formation deposits are observed along parts of Cottonwood Creek and Hooker Creek and along the Sacramento River. Riverbank Formation deposits are observed along all major creeks. The thickness ranges up to 50 feet. These deposits are moderately to highly permeable and yield limited domestic water supplies.

**Pliocene Tehama Formation.** The Tehama Formation consists of locally cemented silts, sand, gravel, and clay of fluviatile origin derived from the Klamath Mountains and Coast Ranges and is the principal water-bearing formation in the subbasin. The formation is exposed over approximately 80 percent of the subbasin surface area. The thickness varies from 4,000 feet to

the north to approximately 3,800 feet to the south along Interstate Highway 5. The thickness of the deposit thins to the west from Cottonwood and reaches a thickness of 2,500 feet at the Sacramento River (DWR 1964). The permeability of the formation is moderate to high with yields of 100- to 1,000-gpm.

**Pliocene Tuscan Formation.** The Tuscan Formation is found interfingered with the Tehama Formation south of Cottonwood Creek. The overlapping thickness may reach up to 2,500 feet towards the Red Bluff Arch. The Tuscan Formation is the principal water-bearing formation at the eastern extents of the subbasin. The formation consists of volcanic gravel and tuff-breccia, fine- to coarse-grained volcanic sandstone, conglomerate, tuff, tuffaceous silt and clay predominantly derived from andesitic and basaltic source rocks. The formation is described as four separate but lithologically similar units, Units A through D (with Unit A being the oldest), which in some areas are separated by layers of thin tuff or ash units.

Unit A is the oldest water-bearing unit of the formation and is characterized by the presence of metamorphic clasts within interbedded lahars, volcanic conglomerate, volcanic sandstone and siltstone. Unit B is composed of a fairly equal distribution of lahars, tuffaceous sandstone, and conglomerate. Coarse cobble to boulder conglomerate predominates the deposit in the eastern and northern parts of mapped unit. Unit C consists of several massive mudflow or lahar deposits with some interbedded volcanic conglomerate and sandstone. Unit D consists of fragmental deposits characterized by large monolithologic masses of andesite, pumice, and fragments of black obsidian in a mudstone matrix. The unit has limited areal extents and may not occur within the Redding Basin.

Permeability is moderate to high with yields of 100- to 1,000-gpm except for beds of tuff-breccia which are essentially impermeable.

### *Restrictive Structures*

The Red Bluff Arch is an anticlinal structure that forms the hydrogeologic boundary between the Redding and Sacramento Valley groundwater basins.

### *Recharge Areas*

Recharge to the principal aquifer is mostly by infiltration of streamflows at the margins of the subbasin. Infiltration of applied water and streamflows, and direct infiltration of precipitation are the main sources of recharge into the alluvium (Pierce 1983).

### *Groundwater Level Trends*

Review of the hydrographs for long-term comparison of spring-spring groundwater levels indicates a slight decline in groundwater levels associated with the 1976-77 and 1987-94 droughts, followed by a recovery to pre-drought conditions of the early 1970's and 1980's. Some wells increased in levels beyond the pre-drought conditions of the 1970's during the wet season of the early 1980's. Generally, the seasonal fluctuation is approximately 5-feet for normal and dry years. Overall, there does not appear to be any increasing or decreasing trends in groundwater levels.

### *Groundwater Storage*

**Groundwater Storage Capacity.** The storage capacity for the entire Redding Basin is estimated to be 5.5 million acre-feet for 200 feet of saturated thickness over an area of approximately 510 square miles (Pierce 1983). Specific yield data for the Bowman Subbasin aquifer system is not available to estimate storage capacity at the subbasin level.

### *Groundwater Budget (Type B)*

Estimates of groundwater extraction are based on surveys conducted by the California Department of Water Resources during 1994 and 1995. Surveys included land use and sources of water. Estimates of groundwater extraction for agricultural and municipal/industrial uses are 350 and 9 acre-feet respectively. Deep percolation of applied water is estimated to be 1,500 acre-feet.

### *Groundwater Quality*

**Characterization.** Groundwater in the subbasin is characterized as magnesium-calcium bicarbonate and calcium-magnesium bicarbonate type waters. Total dissolved solids concentrations range from 70- to 247-mg/L (DWR unpublished data).

**Impairments.** Groundwater impairments include localized high boron concentrations.

## 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 | 6 | 0 |
| Radiological | 5 | 0 |
| Nitrates | 6 | 0 |
| Pesticides | 5 | 0 |
| VOCs and SVOCs | 5 | 0 |
| Inorganics – Secondary | 6 | 1 |

[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)** | |
| Irrigation | Range: 65 – 2000 | Average: 589 (4 Well Completion Reports) |
| | **Total depths (ft)** | |
| Domestic | Range: 60 – 700 | Average: 257 (804 Well Completion Reports) |
| Irrigation | Range: 112 – 600 | Average: 312 ( 27 Well Completion Reports) |

## Active Monitoring Data

| Agency | Parameter | Number of wells /measurement frequency |
|---|---|---|
| DWR | Groundwater levels | 8 wells semi-annually |
| Department of Health Services | Miscellaneous Water Quality | 13 |

## Basin Management

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|---|---|
| Groundwater management: | Tehama County adopted a groundwater management ordinance in 1994.<br>Tehama County adopted a countywide AB3030 plan in 1996. |
| Water agencies | |
| Public | Tehama County Flood Control and Water Conservation District<br>Anderson-Cottonwood ID, and Rio Alto WD. |
| Private | |

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## Errata

Changes made to the basin description will be noted here.