Napa-Sonoma Valley Groundwater Basin, Napa Valley Subbasin

- Groundwater Basin Number: 2-2.01
- County: Napa
- Surface Area: 45,895 acres (72 square miles)

Basin Boundaries and Hydrology

The Napa Valley Subbasin occupies a northwest trending structural depression in the central Coast Ranges, approximately 40 miles northeast of San Francisco. The Subbasin is bounded to the north, east, and west by portions of the Coast Ranges and on the south by San Pablo Bay. The subbasin extends roughly from the city of Napa in the south, to the city of Calistoga in the north, a distance of about 35 miles. Land surface elevations in the central plain of the subbasin range from 400 feet above sea level near Calistoga to approximately sea level south of Napa. The width of the Subbasin ranges between 1 and 4 miles (DWR 1995). The Napa River and several tributaries, the largest of which is Conn Creek, drain the subbasin. Flow in the tributary streams is intermittent, yet flow continues in the Napa River during months of little or no precipitation. Flow during these dry periods is the result of groundwater discharge. The average annual net gain to the Napa River is estimated to be 12,700 acre-feet per year (AFY) (Montgomery 1991). The Napa River is tidally influenced from the city of Napa downstream to its mouth in San Pablo Bay. The annual precipitation ranges from less than 24 inches in the southern portion of the subbasin, to more than 40 inches in the northern portion.

Hydrogeologic Information

Water-Bearing Formations

The primary water-bearing formations include Recent and Pleistocene Alluvium, the Pleistocene Huichica Formation, and the Pliocene Sonoma Volcanics.

Recent Alluvium. The Recent Alluvium consists of interbedded deposits of unconsolidated gravel, sand, silt, and clay. These deposits underlie the flood plains and channels of the Napa River and its tributaries. The recent alluvium is generally less than 30 feet in thickness, but may exceed 120 feet in the tidal marshlands. These deposits are moderately to highly permeable. They freely yield water under unconfined conditions where saturated (Johnson 1977). The thickness of the Recent Alluvium is generally insufficient to yield great volumes of water (Kunkel and Upson 1960).

Pleistocene Alluvium. The Pleistocene Alluvium is composed of lenticular deposits of unconsolidated and poorly sorted clay, silt, sand, and gravel. It has a maximum thickness of more than 500 feet and thins out at the valley margin. The Pleistocene Alluvium generally overlies the Huichica Formation, and in a few areas it overlies the Sonoma Volcanics. It also underlies the recent alluvium. Most of the wells in the Pleistocene Alluvium are less than 200 feet and intersect lenses of clay and gravel or gravel. The water in the Pleistocene alluvium is unconfined to semi-confined. Yields range from nearly nothing to more than 400 gpm. Wells yielding more than

50 gpm are uncommon due to the fine-grained nature of the Pleistocene Alluvium. The large number of wells penetrating this formation makes it one of the principal sources of water in the Napa Valley (Kunkel and Upson 1960).

Pleistocene Huichica Formation. The Huichica Formation is composed of deformed continental beds consisting primarily of yellow silt, with some interbedded lenses of silt and gravel or silt and boulders. The Huichica rests unconformably on the Sonoma Volcanics and underlies the Pleistocene and Younger Alluvium. It is typically poorly sorted, lenticular, and somewhat crossbedded. It is primarily fine grained except at the bottom. The total thickness of this formation is estimated to be at least 900 feet. The permeability of the Huichica Formation is low and well yields are usually insufficient even for domestic purposes (Kunkel and Upson 1960).

Pliocene Sonoma Volcanics. The Sonoma Volcanics constitute a thick highly variable series of continental volcanic rocks, including andesite, basalt, and minor rhyolite flows with interbedded coarse to fine grained pyroclastic tuff and breccia, re-deposited tuff and pumice, and diatomaceous mud, silt, and sand. There is also a distinctive body of rhyolite flows and tuff with some obsidian and perlitic glass. The Sonoma Volcanics is believed to have been formed in the interval between late Miocene and early Pleistocene times. The Sonoma Volcanics is composed of three units, the St. Helena rhyolite member, the Diatomaceous member, and an undifferentiated unit, each several hundred feet thick (Kunkel and Upson 1960): (1) The basal undifferentiated volcanic unit is composed of tuff, pumice, breccia, and agglomerate with interbedded flows of andesite and basalt. Wells within the basal unit derive water principally from the pumice and tuffs. Tuff beds within this are locally confined to semi-confined. Yields for wells within this are moderate, proportional to the thickness of the tuff penetrated below the water table (Kunkel and Upson 1960). Specific capacity ranges from less than 1 (gal/min)/ft to 42 (gal/min)/ft (Johnson 1977). (2) The Diatomaceous member, near the middle of the formation, is composed of fine-grained diatomaceous clay and diatomaceous tuff. The diatomaceous deposits are generally of low yield and typically have specific capacities less than 1 (gal/min)/ft. The water is of poor quality and is reported to have high iron and sulfur concentrations (Johnson 1977). (3) The St. Helena rhyolite member rests unconformably on the other two members of the Sonoma Volcanics. It is composed of banded rhyolitic flows, welded rhyolitic tuff, with some obsidian and perlitic glass. Permeability is very low and few wells are drilled in this member (Kunkel and Upson 1960).

Recharge Areas

Except for connate seawater and brackish water from San Pablo Bay, the source of all natural groundwater recharge in the Napa Valley is from precipitation on the alluvial plain, the adjacent hills, and mountains within the drainage basin of the valley (Kunkel and Upson 1960).

Groundwater Level Trends

Most of the wells currently monitored by the Department of Water Resources and Napa County are screened in the alluvial deposits of the Napa Valley. Annual fluctuations generally range from 5 to 10 feet. Long-term fluctuations generally follow climatic trends, with the lowest levels approximately corresponding to the 1976-1977 drought. In general the long-term water levels in most of the county have remained unchanged. An exception to this is the " Milliken-Sarco-Tulucay Creeks Area" located east and northeast of the city of Napa. Most of the wells in this area produce water from the Sonoma Volcanics. Long-term fluctuations are also climatically influenced here. However, the overall water level trend in many of the monitored wells is downward (DWR 1995).

Groundwater Storage

Groundwater Storage Capacity. Groundwater storage in the Napa Valley Subbasin is estimated to be 300,000 acre-feet (Kunkel and Upson 1960). This estimate is based on the area underlain by the Younger and Pleistocene Alluvium, which closely corresponds to the area of the Napa Valley Groundwater Subbasin as defined by the Department of Water Resources in this Bulletin. Estimated specific yields were applied to the strata based on available data from well logs. Storage was computed for depths between 10 and 200 feet. These depth parameters conform to those used in other studies conducted by the US Geological Survey for determining groundwater storage capacities, of thick bodies of water bearing alluvial deposits, in similar northern California valleys (Kunkel and Upson 1960). Additionally, James M. Montgomery Consulting Engineers conducted a study for the Napa County Flood Control and Conservation District. The study area covers the valley floor extending from Calistoga in the north to Oak Knoll Avenue near the city of Napa in the south. This study encompassed an area of approximately 60 square miles, somewhat smaller than the 70 square miles included in DWR's Napa Valley Subbasin. Montgomery estimated the storage capacity of the alluvial deposits to be 190,000 acre-feet (Montgomery 1991).

Groundwater Budget (Type A)

A detailed groundwater budget exists for the northern portion of the Subbasin. Total annual extraction is estimated at 13,150 AFY, stream loss at 12,690 AFY, and subsurface outflow at 1,100 AFY for a total basin outflow of 26,940 AFY. Total recharge is estimated at 26,580 AFY and subsurface inflow at 360 AFY, for a total basin inflow of 26,940 AFY (Montgomery 1991). Similarities between the northern portion of the Subbasin and the southern portion of the subbasin could allow for the methodology developed in the Montgomery report to be applied to the entire subbasin.

Groundwater Quality

Characterization. Chemical analysis of samples collected from the alluvium north of the city of Napa show that the water is somewhat hard and bicarbonate, with small concentrations of sulfate, chloride, and other minerals. Water extracted from the alluvial aquifers is generally good for most uses. Analysis of samples collected from the Sonoma Volcanics indicates that the normal chloride concentration is not more than 40 ppm and that the groundwater is relatively low in sulfate, calcium, and magnesium. Groundwater of the Sonoma Volcanics is generally of good quality at most places (Kunkel and Upson 1960). In the southern portion of the Napa Valley the Napa River is tidally influenced. Seawater intrusion has occurred in shallow wells in areas of concentrated pumping. Water from some wells in the Napa Valley has elevated boron concentrations making some water unfit for irrigation. Geothermal groundwater high in total dissolved salts, iron, and boron is produced from wells in the Calistoga area (Taylor et al 1981). Groundwater from wells along Milliken and Tulacay Creeks reportedly has elevated iron concentrations, which has caused discoloration of plumbing fixtures (Kunkel and Upson 1960).

Well Characteristics

	Well yields (gal/min)	
Municipal/Irrigation	Range: 0 – 5,708	Average: 147 (based on 612 well completion reports [WCRs])
	Total depths (ft)	
Domestic	Range: 19 – 1,020	Average: 310 (based on 1,350 WCRs)
Municipal/Irrigation	Range: 16 – 1,140	Average: 463 (based on 765 WCRs)

Active Monitoring Data

Agency	**Parameter**	**Number of wells /measurement frequency**
DWR	Groundwater levels	1 well/monthly 3 wells/semi-annually
County of Napa	Groundwater levels	74 wells/semi-annually
DWR	Miscellaneous water quality	3 wells/semi-annually
Department of Health Services and cooperators	Title 22 water quality	23 wells/annually

Basin Management

Groundwater management:	No water management agency exists in Napa County, but a Groundwater Resources Advisory Committee was established in June 2011 and a County-wide Groundwater Monitoring Plan was published in January 2013.
Water agencies	
Public	Napa County
Private	Unknown

References Cited

California Department of Water Resources (DWR). 1995. Historical Ground Water Levels in the Napa Valley.

Johnson MJ. 1977. Ground-Water Hydrology of the Lower Milliken-Sarco-Tulucay Creeks Area, Napa County, California. US Geological Survey, Water Resources Investigations 77-82 Open File Report.

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Taylor GC, Bacon CF, Chapman RH, Chase GW, Hasmukhrai HM. 1981. Drilling Addendum to Resource Assessment of Low-and Moderate-Temperature Geothermal Waters in Calistoga, Napa County, California: Report of the Second Year, 1979-1980 of the U.S. Department of Energy –California State Coupled Program.

Errata

Changes made to the basin description will be noted here.