Geology and Ground Water in Napa and Sonoma Valleys Napa and Sonoma Counties California

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GEOLOGY AND GROUND WATER IN NAPA AND SONOMA VALLEYS, NAPA AND SONOMA COUNTIES, CALIFORNIA

By Fred Kunkel and J. E. Upson

ABSTRACT

Napa and Sonoma Valleys are adjacent alluvium-filled valleys about 40 miles northeast of San Francisco. They occupy alined and structurally controlled depressions in the northern Coast Ranges physiographic province and drain south into San Pablo Bay. The valleys are surrounded and underlain by unconsolidated marine and continental sediments and volcanic rocks of Pliocene and Pleistocene age, which are water bearing in large part and together make up relatively extensive ground-water basins. Napa Valley, the eastern valley, is the larger and has a valley-floor area of about 85 square miles. Sonoma Valley has a valley-floor area of about 35 square miles; in addition, about 10 square miles is unreclaimed tidal marsh.

The rock units of Napa and Sonoma Valleys are divided into four classes on the basis of their distribution and relative capacity to yield water: (a) Consolidated virtually non-water-bearing chiefly sedimentary (some metamorphic) rocks that range in age from Jurassic(?) to Pliocene; (b) marine shale and sand of the Petaluma formation (Pliocene) and the Merced formation (Pliocene and Pleistocene?) that do not crop out within Napa or Sonoma Valleys but perhaps are penetrated by some deep wells drilled in Sonoma Valley; (c) Sonoma volcanics of Pliocene age, parts of which are non-water-bearing and parts of which locally yield large quantities of water; and (d) unconsolidated alluvial deposits mainly of Quaternary age. The deposits of classes (*c*) and (*d*) contain the most important aquifers in the area.

Most of the water used in these valleys is pumped from wells in the younger and older alluvium, in the Huichica and Glen Ellen formations, and in the Sonoma volcanics. The principal aquifers are the younger and older alluvium, but appreciable quantities of water are pumped locally from the Sonoma volcanics. The Huichica and Glen Ellen formations yield water in small quantities and at most places supply water only for limited domestic uses.

The younger alluvium consists of interbedded deposits of unconsolidated gravel, sand, silt, and, locally, peat. These deposits underlie the flood plains and channels of the Napa River, Sonoma Creek, and their tributaries, low alluvial fans or plains graded to these streams, and the tidal marshlands. The older alluvium of Napa and Sonoma Valleys is composed of lenticular deposits of unconsolidated and poorly sorted clay, silt, sand, and gravel. Where exposed, claypan or hardpan soil is characteristically developed at the surface. The Huichica formation is composed of deformed continental beds consisting mostly of yellow silt with some interbedded lenses of silt and gravel, and silt and boulders. At the base are beds of redeposited volcanic material, silt, clay,

and lenses of coarse gravel and boulders. The Glen Ellen formation consists of alluvial clay, silt, sand, and gravel in clearly stratified but generally lenticular beds.

The Sonoma volcanics constitute a thick and highly variable series of continental volcanic rocks, including andesite, basalt, and minor rhyolite flows and interbedded coarse- to fine-grained pyroclastic tuff and breccia, redeposited tuff and pumice, and diatomaceous mud, silt, and sand. A prominent body of rhyolite flows and tuff with some obsidian and perlitic glass, called the St. Helena rhyolite member, occurs in the upper part.

Estimated ground-water pumpage for all uses in the year 1949–50 was about 5,600 acre-feet in Napa Valley and about 2,400 acre-feet in Sonoma Valley. Of this quantity the amounts pumped for irrigation were about 2,900 and 1,900 acre-feet, respectively.

Water levels in wells in the central parts of the valleys range from a few feet above the land surface to about 50 feet below, with an average of about 25 feet. The quality of the water in most wells is satisfactory for domestic use and irrigation. Locally at the southern end of the valley some contamination of the native waters is caused by the movement of salty water into areas of concentrated pumping. Water from wells at a few places has concentrations of boron greater than 4 ppm (parts per million).

The estimated gross ground-water storage capacity to a depth of 200 feet in Napa Valley is about 300,000 acre-feet; however, about 60,000 acre-feet occurs in an area that may be contaminated by the infiltration of brackish water from the tidal part of the Napa River.

The estimated gross ground-water storage to a depth of 200 feet in Sonoma Valley is about 180,000 acre-feet. Because Sonoma Valley at its broad southern end is in contact with the tidal marshes and brackish water in the sloughs tributary to San Pablo Bay, an appreciable lowering of the water table in this area would cause the encroachment of salty water into areas where the water now is usable. Consequently, usable storage is considerably less than 180,000 acre-feet.

INTRODUCTION

LOCATION AND EXTENT OF THE AREA

The area of investigation, about 40 miles northeast of San Francisco, comprises the tidal marshlands, alluvial plains, and adjoining terraces, foothills, and mountain slopes of Napa and Sonoma Valleys, which are in Napa and Sonoma Counties (pl. 1). It is approximately between 38°05′ and 38°40′ north latitude and between 122°10′ and 122°40′ west longitude, and is shown on the U.S. Geological Survey topographic maps of the Calistoga, St. Helena, Santa Rosa, Sonoma, Mount Vaca, Mare Island, and Carquinez quadrangles, 15-minute series, scale 1:62,500.

PURPOSE AND SCOPE OF THE REPORT

This investigation and report were undertaken by the U.S. Geological Survey in cooperation with the California Department of Water Resources as part of the State's reappraisal of its water resources. The purpose of the Geological Survey's work is to determine the geologic features relating to ground-water conditions and to estimate the gross storage capacity of ground-water reservoirs in selected areas in the State.

The present report describes surface and subsurface geologic conditions relating to the occurrence, source, and movement of ground water; data on water wells; data on the fluctuations of water levels in observation wells during the period of the investigation; representative well logs; available data on the chemical quality of ground and surface waters; an estimate of the ground water pumped in certain recent years; and a preliminary estimate of the ground-water storage capacity of deposits within the main valley portions of the areas.

Fieldwork was begun in September 1949, and most wells were located by the autumn of 1950. Geologic mapping and other field studies were completed by March 1952.

The investigation by the Geological Survey was made under the immediate supervision of J. F. Poland, then district geologist of the Ground Water Branch of the Survey for California.

EARLIER WORK

The earliest geologic work within the immediate vicinity of Napa and Sonoma Valleys was that of Osmont (1905). This was followed by Dickerson's study (1922) of the volcanic rocks, and subsequently by Weaver's more detailed mapping (1949) of the volcanic rocks, older consolidated sedimentary rocks, and younger unconsolidated deposits. Weaver's study, made over a considerable period of years, covered the entire sequence of formations from Jurassic(?) to Recent. Axelrod (1950) collected and identified fossil plants from deposits that occur near Napa. Reports of other geologists who worked in adjoining or nearby areas are referred to specifically at appropriate places throughout this report. Earlier studies of the water resources of Napa Valley were made by Clark (1919) and Bryan (1932).

ACKNOWLEDGMENTS

The collection of data on wells and the use of water was greatly facilitated by the willing cooperation of well drillers, property owners, and public officials, who freely supplied information. The Pacific Gas & Electric Co. gave valuable assistance in estimating ground-water pumpage. In particular, we wish to thank Mr. Keith Bissel, Napa County Farm Advisor, for furnishing many chemical analyses of water; Mr. Sibsee, engineer, Napa State Hospital; Mr. H. C. MacDonald, engineer, city of Napa; and Mr. W. A. Forbes of Adams & Forbes for furnishing data on water levels, pump efficiency, pumpage, and well logs; and Mr. T. A. Woods, engineer, the Pacific

Gas & Electric Co.; the Napa Housing Authority; the Basalt Co.; and the California Pacific Utilities Co. at Benicia for furnishing data on ground-water pumpage.

GEOGRAPHY

TOPOGRAPHIC FEATURES

The location of the area of this report is shown on plate 1 and the main features are shown on plate 2. Napa Valley on the east and Sonoma Valley on the west are clearly defined structural and topographic depressions at the southern end of the northern Coast Ranges. The Howell Mountains lie to the east and the Sonoma Mountains to the west; the Mayacmas Mountains lie between the valleys. On the south, the valleys merge around the southern end of the Mayacmas Mountains. They adjoin San Pablo Bay, the north arm of San Francisco Bay. Each valley consists of a low central alluvial plain and bordering terraces and mountain foothills.

The central alluvial plains consist mainly of alluvial fans that slope from the sides of the valleys and meet at the axial drainageways. The valleys are narrow at the north and generally broaden southward where they merge with extensive flat tidal marshlands. Bordering the plains are terraces that rise in fairly distinct steps to maximum heights of 300 to 400 feet and abut the adjacent foothills and mountains. These terraces are broadest and most prominent in the southern parts of the valleys and on the southern end of the Mayacmas Mountains; they are almost completely lacking farther north. The bordering hills and mountains rise rather abruptly to altitudes between 1,000 and 4,000 feet. The highest peak in the region is Mount St. Helena (4,344 feet), about 4½ miles north of the northern end of Napa Valley. These hills and mountains have steep brush-covered slopes unsuited for agriculture. Accordingly, the cultivated and developed areas are almost entirely on the alluvial plains and adjoining terraces and foothills.

Napa Valley is drained by the Napa River and several tributaries, largest of which are Conn and Milliken Creeks. The Napa River heads on the south flank of Mount St. Helena and is intermittent throughout most of its course. In the lower few miles, however, it is perennial, probably owing to discharge of ground water, and it is tidal downstream from a point about half a mile above Napa. The central alluvial plain of Napa Valley is about 32 miles long and ranges in width from less than 1 mile at the north end to nearly 4 miles just north of Napa. About 1 mile south of Napa the plain narrows to about 2,000 feet between the encroaching valley sides at the head of the tidal marsh. Thus, the greater part of Napa Valley is separated from the marshlands, and brackish [1] water from the bay has access to the valley only along the tidal part of Napa River.

The alluvial plain of Sonoma Valley is roughly triangular. It is about 8 miles from the apex at the north to the base at the south. The base is about 6 miles wide. The southern part of the plain grades almost imperceptibly into the tidal marshlands. Sonoma Valley is drained chiefly by Sonoma Creek, which heads on the west side of the Mayacmas Mountains and traverses the southern part of Kenwood Valley before entering Sonoma Valley about 1 mile below the town of Glen Ellen. Sonoma Creek is perennial below Glen Ellen, where it is sustained in part by ground-water discharge, but it is intermittent across part of the alluvial area, and becomes tidal in its lower course.

The tidal marshlands along San Pablo Bay which merge with the alluvial plains of Napa and Sonoma Valleys are a distinctive area but are not clearly separated from the rest of the valley floors. They are flat lands at or near sea level and are traversed by numerous winding tidal channels containing strongly brackish water. Considerable areas have been reclaimed through the construction of levees and drainage ditches. The marsh water seeps into these ditches and is thence pumped out over levees and into the tidal channels. Upon drying out and subsequent compaction of the underlying peat and marsh mud, the reclaimed areas settle, and some are as much as 5 feet below sea level.

CLIMATE

The climate of Napa and Sonoma Valleys is of the Mediterranean type, which is characterized by moderate temperatures and markedly seasonal precipitation. In this area, practically all the precipitation occurs as rain, and very little occurs in summer. Table 1 gives yearly precipitation by water years at eight representative stations in the area. These include most of the stations for which records are available, and are the ones having the longest records. Some records of monthly rainfall are available in publications, but some are in the files of the U.S. Weather Bureau in San Francisco and are not generally available. For that reason they are given here in full. Rec-

[1] In this report, the terms "brackish," "saline," and "salty" are used in particular senses. The term "brackish" means the mixture of fresh and sea water that occurs in San Pablo Bay, in the tidal estuaries, and in the tidal parts of the Napa River and Sonoma Creek. "Saline" refers to water, not necessarily brackish as defined above, having a concentration of dissolved solids greater than 1,000 ppm (parts per million). "Salty" refers primarily to the presence of chloride or sodium chloride, and is used for water having a chloride concentration greater than 250 ppm. Whereas the chemical concentrations of these waters may fall within the same range, the origin of the salts is different. Hence, the terms are mutually exclusive and each is applied in the sense most appropriate to the particular water described.

ords from five other stations are not included here because they are for short periods or because the stations are close to others for which the records are included. These five stations and the period of record at each are as follows:

Station	*Period of record* [1]
Atlas Road	January 1940–September 1951
Napa	December 1945–September 1951
Oakville, 4 miles southwest	May 1943–September 1951
St. Helena, 4 miles west	January 1940–September 1951
7 miles northwest	November 1940–September 1951

[1] Information not tabulated by U.S. Geological Survey beyond date shown.

TABLE 1.—*Annual precipitation, in inches, at representative stations in Napa and Sonoma Valleys*

[Except as indicated, from published and unpublished records of the U.S. Weather Bureau. "Inc." indicates that record for the year is incomplete]

Water year [1]	Mount St. Helena (Alt 2,300 ft)	Calistoga (Alt 363 ft)	St. Helena (Alt 255 ft)	Conn Dam [2] (Alt 210 ft)	Oakville and Oakville 1 mile west [3] (Alt 153 and 170 ft)	Angwin (Alt 1,610 ft)	Napa State Hospital (Alt 60 ft)	Sonoma (Alt 30 ft)
1872-73		Inc.						
1873-74		30.72						
1874-75		24.60						
1875-76		39.84						
1876-77		21.84					Inc.	
1877-78		50.69					36.13	
1878-79		36.19					24.66	
1879-80		38.10					26.39	
1880-81		40.96					28.32	
1881-82		23.08					19.06	
1882-83		25.41					18.78	
1883-84		32.67					23.58	
1884-85		22.38					15.21	
1885-86		41.60					28.17	Inc.
1886-87		23.18					19.51	21.00
1887-88		25.23					17.39	21.29
1888-89		30.74					21.67	21.93
1889-90		67.61					48.29	53.15
1890-91		27.16					21.65	22.64
1891-92		29.60					22.24	22.89
1892-93		49.28					26.44	33.78
1893-94		44.90					22.57	27.80
1894-95		52.91					30.27	Inc.
1895-96		40.22					24.69	
1896-97		45.88					24.79	
1897-98		25.40					13.63	Inc.
1898-99		26.79					16.69	20.50
1899-1900		37.30					20.58	26.16
1900-01	Inc.	45.91					25.74	27.52
1901-02	68.44	42.00					28.55	28.76
1902-03	58.70	37.09					23.56	25.81
1903-04	85.07	58.47					30.84	36.92
1904-05	64.67	28.97					21.19	28.43
1905-06	72.31	45.25					23.77	28.36
1906-07	79.53	53.69	Inc.		Inc.		30.84	Inc.
1907-08	33.01	27.51	23.42		19.05		14.91	
1908-09	75.47	55.14	52.15		45.93		31.10	
1909-10	42.73	32.48	30.60		27.90		20.03	
1910-11	47.80	40.90	37.54		36.67		25.03	
1911-12	37.58	23.93	23.01		22.08		17.44	
1912-13	Inc.	24.99	24.03		20.24		14.44	
1913-14		59.51	58.98		Inc.		34.50	

See footnotes at end of table.

TABLE 1.—*Annual precipitation, in inches, at representative stations in Napa and Sonoma Valleys*—Continued

Water year [1]	Mount St. Helena (Alt 2,300 ft)	Calistoga (Alt 363 ft)	St. Helena (Alt ft)	Conn Dam [2] (Alt 210 ft)	Oakville and Oakville 1 mile west [3] (Alt 153 and 170 ft)	Angwin (Alt 1,610 ft)	Napa State Hospital (Alt 60 ft)	Sonoma (Alt 30 ft)
1914–15		50.42	49.61				Inc.	
1915–16		40.41	43.63				Inc.	
1916–17		26.25	29.04				Inc.	
1917–18		Inc.	21.50				15.66	
1918–19			30.73				24.65	
1919–20			18.36				12.11	
1920–21			42.42				23.92	
1921–22			24.85				19.59	
1922–23			31.55				26.99	
1923–24			12.02				9.52	
1924–25			43.18				32.16	
1925–26			32.91				23.70	
1926–27			43.90				34.79	
1927–28			29.98				24.92	
1928–29			21.43				13.74	
1929–30			30.53				19.67	
1930–31			17.96				15.80	
1931–32			28.60				23.42	
1932–33			21.51				16.38	
1933–34			23.38				14.58	
1934–35			35.66				25.51	
1935–36			36.19				24.60	
1936–37			28.14				21.74	
1937–38			47.64				34.12	
1938–39			15.80				12.19	
1939–40		Inc.	42.66			Inc.	30.10	
1940–41		58.57	57.61			64.19	41.86	
1941–42		47.93	47.54			58.79	36.62	
1942–43		34.40	32.52			38.72	25.23	
1943–44		28.12	25.73		Inc.	31.39	21.97	
1944–45		31.75	28.07		27.35	31.03	20.69	
1945–46		32.67	30.92	Inc.	31.20	28.94	22.56	
1946–47		25.64	21.98	19.16	21.55	23.04	17.46	
1947–48		30.16	25.94	14.49	25.60	26.21	19.44	
1948–49		25.95	22.30	18.41	29.39	24.72	17.47	
1949–50		29.70	26.79	18.09	27.61	28.71	19.82	
1950–51		38.21	36.76	28.65	Inc.	45.55	30.54	
Number of complete years	11	55	44	5	12	11	71	16
Average	60.48	36.31	32.02	19.76	27.88	36.48	23.47	27.93

[1] From Oct. 1 of one year to Sept. 30 of the next year.
[2] From records of the Napa city engineer.
[3] Station was at Oakville from January 1907 to June 1914; at 1 mile west of Oakville beginning in December 1943.

The average annual precipitation differs considerably from one part of Napa Valley to another. As indicated in table 1, the yearly precipitation at the several stations is not directly comparable because the periods of record do not coincide. Nevertheless, the average annual precipitation based on these records ranges from about 23 inches at the Napa State Hospital to about 32 inches at St. Helena and about 60 inches at Mount St. Helena. The average precipitation at Calistoga seems to be a little more than at St. Helena. Thus, in general, the southern part of Napa Valley receives less rain than the northern part, and probably the valley floor receives less rain than the adjoining mountain areas. The figures for St. Helena, Conn Dam, the Oakville stations, and Angwin are for periods that are too short to be truly representative, but they probably suggest the order of magnitude of the average precipitation.

The only record for Sonoma Valley—and that for a broken period between 1885 and 1907—is for a station at Sonoma. The rainfall in those years, however, is consistently a few inches higher than at Napa State Hospital for the same years.

Night and morning fog, blown in from San Pablo Bay, is common at all seasons of the year, particularly in the southern parts of the valleys. Because the fog acts as an insulator, it decreases the amount of heat received from the sun in the summer, and decreases the radiation of heat from the earth in the winter. Therefore, the temperature of Napa and Sonoma Valleys is moderate compared to that of the Great Central Valley of California. The mean annual temperature is about 60°F. During the winter, temperatures below freezing are infrequent and usually occur only during clear nights. The temperature range is greater at the northern ends of the valleys than at the southern ends. However, the extreme possible range between winter and summer temperatures is large. Although not in the same year, the recorded maximum and minimum temperatures are 110° and 17°F at Napa and 115° and 10°F at St. Helena.

CULTURE

In Napa County about 2,000 farms contain 375,000 acres of land. Of this acreage, about 67,000 acres is cropland and 41,000 acres woodland. The remainder of the land, or about 267,000 acres, is largely mountainous, having pronounced relief and a dense growth of chaparral. It is suitable for nothing but grazing, and a given area can be grazed for only a short time each year. Corresponding figures are not available for Sonoma County, but the land is similar and the proportions about the same.

Nearly all the cultivated parts of both Napa and Sonoma Valleys are on the alluvial plains and bordering terraces and foothills. The alluvial plains are ideally suited to dry farming of grapes and prunes and to irrigation of permanent pasture. Some land on the alluvial plains and some on the gentler slopes of the mountainous areas is devoted to dry farming of hay and grain. Cattle, hogs, sheep, and poultry also are raised throughout the two areas. A great many wineries, both large and small, many fine dairies, and numerous small chicken and turkey ranches contribute to the economy of the area.

The principal towns are Napa, St. Helena, and Calistoga in Napa Valley and Sonoma in Sonoma Valley. Napa is the county seat of Napa County, and Sonoma was at one time the county seat of Sonoma County (the present county seat is Santa Rosa, in Santa Rosa Valley). All these towns are the centers of business and social activity for their respective districts, and they are all surrounded by areas of attractive suburban development. A number of small unincorporated towns are rather evenly distributed throughout both valleys, and a well-integrated system of paved roads connects the ranches to main highways which lead directly to San Francisco. Thus, transportation of goods and movement of people to and from the metropolitan center are rapid. Even though the economy of the valleys is predominantly agricultural, a cosmopolitan attitude and way of life exist throughout the area. In addition to the highways, branch lines of the Southern Pacific and the Northwestern Pacific Railroad serve the valleys.

Probably most of the water used in Napa and Sonoma Valleys is for domestic and related consumption, and much of that is from surface supplies. Because the rainfall is relatively high in winter and because nights in summer are cool and moist, prunes and grapes mature without irrigation. Accordingly, no vineyards are irrigated and only about 1,500 acres of orchard and about 2,000 acres of permanent pasture are irrigated, the water being obtained from wells. A few fields of tomatoes and truck crops also are irrigated, the water being obtained either from wells or the Napa River.

In Sonoma Valley, individual homes, ranches, business establishments, and towns obtain water from wells. The supply is not abundant, and in some parts of the valley it is inadequate. In Napa Valley, the towns and ranches formerly obtained water from wells, which was adequate for most domestic needs. However, the supply from wells in many parts of the valley failed to keep pace with expanding demands, and in 1948 Conn Dam was completed, impounding Lake Hennessy, the present surface-water supply of Napa. Subsequently, the municipal systems of the towns from St. Helena south and many ranches have made connections to the pipeline from Lake Hennessy.

Several other formerly large users of ground water in Napa Valley are now using surface water instead. For example, the Napa State Hospital formerly derived its entire supply of water, about 500,000 gpd (gallons per day), from deep wells drilled into the volcanic rocks in the vicinity of the hospital. Beginning in 1951 the hospital obtained water from Lake Hennessy and now uses wells for a supplementary supply only. From another group of wells, known as the Suscol wells, drilled during the period from 1919 to 1933, large quantities of water were pumped at various times for the towns of Crockett, Benicia, and Vallejo. Since 1950, however, pumping from these wells has been greatly reduced.

In several growing residential areas near Napa Valley, particularly Browns Valley, Congress Valley, and a subdivision called Hilton Acres situated about a mile south of Napa, supplies of water from wells are inadequate.

WELL-NUMBERING SYSTEM

The well-numbering system used by the Geological Survey in Napa and Sonoma Valleys shows the locations of wells and a few springs according to the rectangular system for the subdivision of public land. For example, in the number 6/4–6R2, which was assigned to a well in Napa Valley, the part of the number preceding the solidus indicates the township (T. 6 N.); the number between the solidus and the hyphen indicates the range (R. 4 W.); the digits between the hyphen and the letter indicate the section (sec. 6); and the letter following the section number indicates the 40-acre subdivision of the section, as shown in figure 1. Within each 40-acre tract the wells are numbered serially, as indicated by the final digit of the number.

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

FIGURE 1.—Well-numbering system.

Thus, well 6/4–6R2 is the second well to be listed in the SE¼SE¼ sec. 6. As all the area of the present investigation is north and west of the Mount Diablo base line and meridian, the foregoing abbreviation of the township and range is sufficient. For parts of the valleys that have never been public land or where survey lines are irrecoverable, the system of subdivision has been projected for reference only.

Incomplete numbers, such as 5/4–35E or 7/5–19, indicate the approximate location of wells, springs, or sampling points that are not shown on the base map.

GEOLOGY

GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES

For the present report, the geologic formations of Napa and Sonoma Valleys are divided into four classes as follows:

1. Consolidated sedimentary and metamorphic rocks. These rocks, which range in age from Jurassic(?) to Pliocene, yield practically no water.
2. Petaluma and Merced formations. The Petaluma formation (Pliocene) and the Merced formation (Pliocene and Pleistocene?) do not crop out within Napa or Sonoma Valley, but possibly are penetrated by some deep wells drilled in Sonoma Valley.
3. Sonoma volcanics of Pliocene age, some of which are non-water-bearing and some of which yield large quantities of water.
4. Unconsolidated alluvial deposits mainly of Quaternary age.

The deposits of classes 3 and 4 contain the most important aquifers in the area.

Plate 2 shows the areal distribution of the rocks of these classes. For the first two classes, separate formations are not distinguished on the map, but for the third and fourth classes some differentiation is made. Plate 2 shows the structure and relationships of these units to each other; plate 3 shows the detailed lithology of the water-bearing formations as determined from drillers' logs of water wells. Table 2 shows the stratigraphic units in Napa and Sonoma Valleys and their relationship to each other.

CONSOLIDATED SEDIMENTARY AND METAMORPHIC ROCKS

The consolidated sedimentary and metamorphic rocks in the Napa and Sonoma Valleys include representatives and correlatives of the Franciscan group of Jurassic age or older, the Knoxville formation of Jurassic age, the Horsetown(?) and Chico formations of Cretaceous age, the Capay shale, Domengine sandstone, and Markley sandstone of Eocene age, the San Ramon sandstone of Oligocene age, and the Monterey shale and San Pablo group of Miocene age. All these formations and groups were originally recognized and defined by others largely in other areas but were distinguished and correlated in the Napa and Sonoma areas by Weaver (1949). Weaver considered the Knoxville and Horsetown(?) formations as a unit and mapped the San Pablo group as undifferentiated except along the west side of Carneros Creek where he mapped the Neroly sandstone separately.

On plate 2, these formations and groups are shown as a single unit (undifferentiated pre-Sonoma rocks). Their distribution is taken largely from Weaver. Although they are generally non-water-bearing, nearly all are penetrated by a few water wells.

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TABLE 2.—*Stratigraphic units distinguished in Napa and Sonoma Valleys*

Period	Epoch or series	Group	Formation or unit	General character	Water-bearing properties
QUATERNARY	Recent		Younger alluvium	Unconsolidated clay, silt, sand, and gravel. Underlies the alluvial plain in Napa Valley, the flood plain and channels of the Napa River and Sonoma Creek, and the tidal marshlands north of San Pablo Bay. Extends as tongues into small stream valleys. The thickness in most places is less than 30 ft, but locally in the tidal marshlands is more than 120 ft.	Saturated with water at shallow depth and yields water freely to wells. Except in Napa Valley north of Yountville, the thickness is generally insufficient for wells to yield large quantities of water.
	Pleistocene		Terrace deposits and older alluvial fans	Unconsolidated clay silt, sand, and gravel, partly thin terrace cover and partly steep alluvial fans along the margins of Napa Valley. Terrace deposits may be partly alluvial and partly marine. Maximum known thickness is almost 15 ft.	Terrace deposits generally above the saturated zone and generally not tapped by wells; older alluvial fans may yield small quantities of water to wells.
			Older alluvium	Unconsolidated and poorly sorted clay, silt, sand, and gravel. Underlies younger alluvium or occurs beneath gently rolling alluvial plain characterized by hardpan soil. Maximum thickness is more than 500 ft.	Yields water in moderate quantities from lenses of gravel and clay and gravel. Because of the many wells in this deposit, it is one of the principal sources of water in both Napa and Sonoma Valleys.
			Huichica formation	Unconsolidated and poorly sorted generally fine-grained clay and silt and scattered lenses of clay and gravel. Basal 200 to 300 ft consists of reworked pumice and tuff, and some primary tuff interbedded with coarse andesitic gravel or cobbles. Maximum thickness is more than 900 ft.	Permeability low; generally yields insufficient water even for domestic needs.
	Pleistocene and Pliocene(?)		Glen Ellen formation	Unconsolidated clay, silt, sand, and gravel, generally fine grained and poorly sorted. Basal beds interbedded with uppermost Sonoma volcanics. Occurs only at north end of Sonoma Valley, and is possibly the equivalent of the Huichica formation. Thickness is unknown.	Permeability low; generally yields insufficient water even for domestic needs.

TERTIARY	Pliocene		Sonoma volcanics	St. Helena rhyolite member	Banded rhyolitic flows, welded rhyolitic tuff, and at places a basal layer of perlitic obsidian. Maximum thickness is several hundred feet.	Permeability doubtless very low; tapped by few wells.
				Diatomaceous member	Fine-grained massive diatomaceous clay and diatomaceous water-laid tuff. Maximum thickness is several hundred feet.	Yields small amounts of water, mostly of poor quality.
				Andesite and basalt flows, pumice, and tuff	May be younger than the diatomaceous member. Maximum thickness is several hundred feet.	Only pumice and tuff yield water freely to wells.
	Miocene	San Pablo	Neroly sandstone Cierbo sandstone Briones sandstone		Consolidated sedimentary and metamorphic rocks (Weaver, 1949).	Locally yield small quantities of water from fractures and permeable lenses.
			Monterey shale			
	Oligocene		San Ramon sandstone			
	Eocene		Markley sandstone Domengine sandstone Capay shale			
CRETACEOUS			Chico			
	Shasta	Franciscan	Horsetown(?)			
JURASSIC			Knoxville			
JURASSIC OR OLDER			Unnamed units			

The hard, dense sandstone, chert, and serpentine of the Franciscan group are virtually non-water-bearing except for very small amounts of water in fractures. The Knoxville, Horsetown(?), and Chico formations are chiefly sandstone and shale and a few beds of conglomerate; where penetrated by wells, they yield little or no water, or water of such high chloride concentration that it is unsuitable for most uses. For example, well 5/4–29C2, drilled to a depth of 1,010 feet, was abandoned as a "dry hole." Well 5/4–5Q1, drilled to a depth of 140 feet, produced a sufficient quantity of water for domestic supply, but the water was unusable. Two analyses from that well showed chloride concentrations of 2,800 and 3,200 ppm (parts per million), respectively (table 15). The Capay shale is grayish-brown sandy shale having water-bearing characteristics similar to those of shales of the Knoxville formation. Well 5/4–17F1, drilled to a depth of 160 feet in the Capay shale, obtained water having a chloride concentration of 3,970 ppm. The Domengine and San Ramon sandstones are penetrated by a few shallow wells that yield enough water of good quality for minimum domestic supplies. (See wells in sec. 19, T. 5 N., R. 4 W.) Deeper wells would probably yield water of poor quality.

The Markley sandstone of Eocene age, sandstones and shales of the Monterey shale, and sandstones of the San Pablo group of Miocene age are not tapped by wells in most areas. However, except for the Neroly sandstone in the San Pablo group, these formations are consolidated and would probably yield little or no water to wells. Water found at depth would probably be of poor quality.

The Neroly sandstone is the only formation of the San Pablo group that Weaver mapped separately in this area. Along the west side of Carneros Creek the Neroly sandstone forms a steep cliff capped by basalt of the Sonoma volcanics. Here the Neroly is at least 700 feet thick and consists of white to bluish-gray coarse-grained sandstone and subordinate amounts of tuff, shale, and pebbly layers (Weaver, 1949, p. 85). Brachiopod fossils are common in some beds that crop out west of Carneros Creek in sec. 19, T. 5 N., R. 5 W. The entire formation is friable and appears able to transmit water fairly readily.

Although water occurs in all the pore space in all the rocks below the water table, the probability of obtaining water in the consolidated marine formations in quantities large enough and of good enough quality to be useful is extremely unlikely. Two wells, 5/4–19J2 and 5/4–30B2, penetrate the Neroly sandstone and obtain moderate quantities of water. But other wells near these, such as 5/4–19R1 and 5/4–29C2, drilled largely in shale or cemented sandstone yield virtually no water. Well 5/4–30R1 drilled into the same sandstone as well 5/4–30B2 yields water too saline for most uses.

Wells drilled into the consolidated rocks in Browns Valley and Congress Valley yield little or no water. Ranches in these small areas not supplied by springs or surface sources often haul water for domestic and stock use. Elsewhere in Napa Valley few wells are drilled in the older marine formations.

PETALUMA AND MERCED FORMATIONS

The Petaluma formation, named by Dickerson (1922, p. 540–542), is a series of light-brown massive and bedded sandstone, pebby conglomerate, and interbedded greenish-gray clay shale of shallow-water marine and continental origin. It crops out along the northeast side of Petaluma Valley. According to Weaver (1949, p. 91), the Petaluma formation is older than the Sonoma volcanics and was uplifted, folded, and beveled by erosion before the accumulation of those rocks.

The Merced formation, as it occurs in Sonoma and Marin Counties (Weaver, 1949, p. 92), is composed of marine sandstones and sandy shales generally less than 300 feet thick and probably the equivalent of the lower Merced of Lawson's type section (1893).

Neither the Petaluma nor the Merced formation crops out in the Napa and Sonoma Valleys. However, well 4/5–14D2, drilled to a depth of 1,620 feet, did not penetrate recognizable Sonoma volcanics at the approximate depth of 900 feet as expected from a projection of the exposed geologic structure. Instead, it penetrated cemented gravel, sand, and clay (apparently nonvolcanic) to the full depth. This deep-lying material either is of Pleistocene age and was accumulated and preserved in a down-faulted or down-warped block, is older and represents a nonvolcanic correlative of the Sonoma volcanics deposited south of their southernmost known extent, or represents a formation older than the Sonoma volcanics, possibly a continental or estuarine equivalent of the Petaluma formation.

An electric log of well 4/5–14D2 indicates that the material below 1,370 feet contains saline water, whereas the water in the formation between 190 and 1,370 feet is relatively fresh. The evidence, though not conclusive, supports the hypothesis that this nonvolcanic material below 1,370 feet may be either the Merced or the Petaluma formation.

SONOMA VOLCANICS

GENERAL FEATURES

Definition and age.—The name Sonoma tuff was first applied by Osmont (1905) to a thick accumulation of andesitic and basaltic tuff containing interbedded lava flows and beds of sand and of gravel. In the area of Osmont's work, between Santa Rosa Valley and Mount St. Helena, these tuffs rest on a body of predominantly andesite flows—

which he called the Mark West andesite—and underlie a generally distinctive body of rhyolitic rocks called the St. Helena rhyolite member. Dickerson (1922) applied the name Sonoma group to all three. Weaver (1949, p. 122–123) considered that the Sonoma tuff and Mark West andesite of Osmont (1905) are in effect local variations of the same unit, and placed them both under the inclusive term, Sonoma volcanics. Weaver implied that the St. Helena is a distinct unit and attempted to map it separately; nevertheless, he included it as a member in the Sonoma volcanics. Weaver's usage is followed here, though it is felt that the St. Helena perhaps should be regarded as a separate formation; there is also some merit to Osmont's separation of the volcanic rocks into a lower body primarily of flows and an upper body mostly of tuffs.

As defined and as exposed in Napa and Sonoma Valleys, the Sonoma volcanics constitute a thick and highly variable series of continental volcanic rocks, including andesite, basalt, and minor rhyolite flows with interbedded coarse- to fine-grained pyroclastic tuff and breccia, redeposited tuff and pumice, and diatomaceous mud, silt, and sand; also, a prominent body of rhyolite flows and tuff with some obsidian and perlitic glass.

As mapped in Napa and Sonoma Valleys the Sonoma volcanics are divisible into three units—(1) an undifferentiated volcanic unit, composed predominantly of massive flows of andesite and basalt and for the most part stratified but generally pyroclastic tuff, breccia, and agglomerate containing interbedded flows of basalt and andesite; (2) a diatomaceous member composed of stratified and largely redeposited volcanic sand and gravel, with pumice, at least one thick body of diatomaceous mud and siltstone, and thin interbedded basalt flows; and (3) an upper member, the St. Helena rhyolite, composed of pumice, welded tuff, and flows of primarily rhyolitic composition. The diatomaceous member is believed to be near the middle of the formation, and the St. Helena rhyolite member is at the top. These members are differentiated and mapped only in the Milliken-Tulucay Creeks area and in another area farther north along the east side of Napa Valley. If present elsewhere, they are not mapped separately from the undifferentiated Sonoma volcanics.

From their stratigraphic relationships with other units, the Sonoma volcanics in Napa and Sonoma Valleys are believed to have been formed in the interval between late Miocene and early Pleistocene times. They rest unconformably on the Neroly sandstone of Miocene age, and the St. Helena rhyolite member underlies with some unconformity the Huichica formation of supposed Pleistocene age. West of Sonoma Valley the Sonoma volcanics lie unconformably on the Petaluma formation of Pliocene age (Weaver, 1949;

Dickerson, 1922). In Santa Rosa Valley the volcanic rocks interfinger with beds of the Merced formation of Pliocene and Pleistocene(?) age. Axelrod (1950, p. 45) collected plant fossils from the diatomaceous clays in the volcanic rocks at a locality east of Napa and concluded that the floral assemblage is in keeping with an early late Pliocene stage of plant evolution in west-central California. What appears to be a similar floral assemblage was collected by the present authors at the Basalt Co. quarry about 2 miles due east of Napa, about 800 feet due north of North Avenue, and about 1,800 feet east of Second Avenue, which is about 2 miles south of the locality described by Axelrod. These fossils were identified by Mr. R. W. Brown, of the U.S. Geological Survey (written communication, October 6, 1952) as Pliocene in age. Diatoms from the same beds were referred to the late Pliocene by Mr. K. E. Lohman, of the Survey (written communication, March 6, 1953).

Thus, stratigraphic position and contained fossils indicate that the Sonoma volcanics are later than early Pliocene in age, and probably entirely Pliocene, but that their deposition may have extended into the early Pleistocene.

Distribution.—The Sonoma volcanics underlie and form most of the mountain areas bordering the Napa and Sonoma Valleys except for small areas underlain by the older sedimentary and metamorphic rocks (pl. 2). A thick extensive body of tuffs and flows forms the Howell Mountains east of Napa and extends from Jamison Canyon northward into the unmapped area north of Mount St. Helena. The volcanic rocks crop out in a narrow, discontinuous strip along the west side of the alluvial plain of Napa Valley, and on that side also they extend northward to Mount St. Helena. They compose most of the Mayacmas Mountains and flank the east and north sides of Sonoma Valley. They occur along the west side of Sonoma Valley, where they form the Sonoma Mountains. These bodies are parts of a once-continuous mass that probably extended from San Pablo Bay northward into southern Lake County, and from Green Valley in Solano County westward to Santa Rosa Valley. The Sonoma volcanics are several thousand feet thick.

The rocks have been strongly folded and probably have been broken by faults. Some faulting, and cross structure associated with faulting, can be seen at a quarry in the SW¼ sec. 5, T. 5 N., R. 4 W., and along the east side of Napa Valley in the NW¼ sec. 2, T. 5 N., R. 4 W. Also, the logs of wells 5/4–14L1, 5/4–14L2, 5/4–27A1, and 5/4–26E1 along the line of a projected fault indicate that the Sonoma volcanics were penetrated at depths less than 200 feet below the land surface, and the logs of wells 5/4–14P1, 5/4–27H1, and 5/4–27H2 farther west indicate that the Sonoma volcanics were penetrated at depths greater than 350 feet below the land surface. (See pl. 3.) This evidence is not conclusive, but it does support the possibility of considerable faulting along the east side of Napa Valley which may constitute a barrier to ground-water movement. (See p. 43.) Apparently, dropped blocks underlie the Napa and Sonoma Valleys and constitute the basic framework of those valleys.

Origin.—The materials composing the Sonoma volcanics were erupted probably from several vents within the area, and intermittently over a period perhaps more than 1 million years long. The materials were extremely varied in chemical composition and in eruptive character, so that they formed a complex assemblage of flows, dikes, plugs, mudflows, breccias, pumice beds, and intercalated bodies of stratified material mostly volcanic in composition but sedimentary in deposition. Except for dikes and plugs, the materials were highly lenticular.

After an initial extrusion of flows which form the basal part of the Sonoma volcanics, ash or pumice was ejected to fall as a uniform blanket over relatively large areas, subsequently perhaps to be covered by younger lava flows, which in turn were covered by tuffs and flows. At other times and places, ash or pumice along with fragments of rock fell on moderately steep slopes where the accumulations were unstable, and, lubricated and made viscous by rains, they moved down the slope as mudflows (part of unit 1, see p. 16).

The flows and tuffs extruded from localized fissures and vents must have formed a rugged terrane of considerable relief and unintegrated drainage. As a result, lakes, swamps, and playas intermittently came into existence, and then were filled with lacustrine or swamp deposits (unit 2), or buried under flows, ash, or tuff (unit 1).

Some lakes and swamps on the volcanic terrane were closely associated with siliceous pumice and tuff, and, as a result, the silica content of the water in the lakes and swamps was high. Consequently, diatoms—microscopic plants having a siliceous shell—thrived in great numbers (Taliaferro, 1933). In some lakes or swamps, where little mud, silt, or sand was washed in, the siliceous shells of the diatoms made up the greater part of the deposits. In others, water-laid clay, sand, and gravel composed the bulk of the material (unit 2).

During periods of relative quiescence, drainage in the area was integrated in the normal processes of erosion. Low places were soon filled with wash or "mudflow" from the high places, low divides were eroded, and some of the lakes and swamps were drained. When the periods of quiescence were relatively long, larger streams heading outside the area of volcanic eruptions brought nonvolcanic debris into the area.

In the final stages of volcanic activity extrusions or ejections of silicic material formed deposits of pumice, welded tuff, and flows of primarily rhyolitic composition mapped as the St. Helena rhyolite member (unit 3).

LITHOLOGY AND WATER-BEARING PROPERTIES

SONOMA VOLCANICS, UNDIFFERENTIATED

The Sonoma volcanics, undifferentiated, consist mainly of andesite tuffs and interbedded flows of andesite and basalt. In some areas flows predominate, as in the steep canyons at the head of Green Valley just east of the southern part of Napa Valley. These flows make a dense body of massive flows several hundred feet thick, which may correspond with the Mark West andesite of Osmont (1905). They are poorly water bearing but are generally outside the lowland areas of Napa and Sonoma Valleys.

Elsewhere in the mapped area the undifferentiated volcanic rocks comprise tuffs and interbedded flows. These flows are of massive to vesicular basalt, andesite, and some rhyolite. The flows form the steep cliffs along parts of both sides of Napa and Sonoma Valleys, which are separated by reaches of gentler slope underlain by tuff. In general, the flows are discontinuous, and they range in thickness from a few feet to a few tens of feet. Although they contain water in fractures and doubtless can transmit some water, the flows are generally poor aquifers. As nearly as can be determined from the drillers' logs, wells that penetrate the volcanic rocks obtain water chiefly from the tuffs.

The tuffs occur throughout the area and form a large part of the Sonoma volcanics, undifferentiated. They also form part of the distinctive diatomaceous member in the Milliken-Tulucay Creeks area. Except in the latter area, the tuffs are a heterogeneous assemblage of different types of volcanic ejecta including fragmental pumice and ash, mudflow agglomerate, welded tuff, scoria, and minor amounts of water-laid volcanic material. The general character of the formation is well indicated by the section along the highway west of the central part of Wooden Valley described by Weaver (1949, p. 124).

The fragmental pumice is coarse, unsorted, slightly compacted and angular, with angular inclusions of hard volcanic rock, many 4 or 5 feet across. These are fragments of the rock through which the eruptive material passed. This type of deposit occurs near an explosive vent and is progressively thinner, finer grained, and more uniform in grain size away from the vent, though it may contain scattered larger fragments. Individual fragments of the pumice contain many airholes caused by explosive action on liquid lava. An excellent exposure of the pumice with included fragments of lava is at the Basalt Co. quarry in the NE¼NE¼ sec. 25, T. 6 N., R. 4 W.

Water-well drillers usually log this material correctly as pumice, ash, or tuff, but they may mistake large erratic boulders for lava flows. Occasionally tuff is incorrectly logged as "tufa."[2] Where pumice or tuff is penetrated below the water table it yields moderate to large quantities of water to wells, as much as several hundred gallons per minute. Material penetrated by wells 6/4–25B1 and 6/4–25B2 (table 17, p. 197) is typical. Well 5/4–26B1 (table 17, p. 180) also penetrates, in part, material of this type.

Fragmental mudflow agglomerate is composed of subrounded fragments of lava in a matrix of fine-grained white to gray ash. This material represents eruptive volcanic debris composed of rock fragments and ash which was deposited on a land surface of moderate to steep relief and which has moved as a mudflow to a more stable position. These deposits are poorly sorted and generally compact, and accordingly do not yield water readily. Typical exposures of mudflow agglomerate occur in the SW¼SW¼ sec. 9, T. 5 N., R. 4 W., along the Sonoma Highway, and in the NE¼ sec. 2, T. 5 N., R. 4 W., beneath the St. Helena rhyolite member. This material is not a true water-laid sedimentary deposit, but water-well drillers frequently describe it as "clay and boulders" or "clay and ash" because of the included fragments of lava found in drilling. The log of well 5/4–9L1 is typical of a well drilled in this type of material. The yield of this well is less than 10 gpm, and other wells in deposits of this type generally have similar yields.

Welded tuff is similar to fragmental agglomerate except that inclusions of lava are less numerous, and the whole mass is compacted and welded into a hard rock by its own heat. An excellent exposure of this type of material can be seen along the north side of the Monticello road in the SW¼SW¼ sec. 20, T. 6 N., R. 3 W. This material is hard and compact, has little pore space, and is frequently confused with lava in well logs. Like lava flows, welded tuff is virtually nonwater-bearing. Material of this type was probably penetrated by well 6/4–23J1 between 333 and 437 feet.

Scoria is generally red and vesicular and looks like red pumice. This material probably is extrusive, but at some places it forms the filling of a volcanic fissure or vent. It occurs chiefly in small areas. Scoria from an outcrop in the NW¼NE¼ sec. 24, T. 6 N., R. 4 W., has an index of refraction of 1.565, indicating a composition approximating andesite. Although it is locally very porous, the scoria generally is not a good aquifer because of its limited extent. Drillers

[2] Tufa is a porous rock formed as a deposit from springs. Tuff is a fragmental volcanic rock composed of the finer grained varieties of explosively ejected particles.

log this material as "red volcanic ash" or "red volcanics." An excellent exposure of this red scoria can be seen in the face of the Basalt Co. quarry in the NW¼NE¼ sec. 24, T. 5 N., R. 5 W.

Well 5/4–13L1 penetrates a thick section of scoria and other extrusive and intrusive volcanics. The material indicated in the log (table 17) as "pink in color" is probably scoria.

Water occurs throughout the Sonoma volcanics within the zone of saturation. The principal aquifers in the Sonoma volcanics are the tuffs which include pumice beds, and, to a lesser degree, the agglomerates. The flows of andesite and basalt are generally impermeable, are not much fractured, and hence are poor water bearers. Small to moderate yields and, locally, large yields can be obtained from wells that penetrate a sufficient thickness of saturated tuff of the Sonoma volcanics. Typical wells drilled in the Sonoma volcanics in Napa Valley are 5/4–1F1, 6/3–19M1, 6/3–33J1, 6/4–4E1, 6/4–35F1, and 9/7–26G1.

The deepest wells in Napa Valley are in the Sonoma volcanics in the Suscol area; the deepest well 5/4–26B1, reported to be 1,440 feet deep. Nearly all the wells of large yield are more than 400 feet deep. Yields are as much as 400 gpm and are roughly proportional to the thickness of tuff penetrated beneath the water table. The pumping rates that are known are given in table 13.

Along the margins of Sonoma Valley the outcrop area of the Sonoma volcanics is generally unsuited to agriculture and only a few wells are drilled there. The yield of wells in the outcrop area of the Sonoma volcanics is generally low, but it may range from a few gallons per minute to several hundred. For example, well 6/6–33K1, 101 feet deep, was bailed at the rate of 800 gph (gallons per hour) with a 70-foot drawdown, but well 6/6–15J1, only 75 feet deep, is reported to yield 350 gpm.

Many wells along the margins of the alluvial plain draw water in part from the Sonoma volcanics and in part from the overlying alluvial deposits; it is not known, therefore, how much of the water comes from the Sonoma volcanics. The yields of these wells range from a few gallons to 150 or 200 gpm but average less than about 50 gpm.

The volcanic rocks extend over many square miles in the hills bordering the Napa Valley and, considered as a whole, constitute a tremendous ground-water reservoir. Actually, the water is largely in distinct bodies, only partly interconnected through fractures in the flows that separate the more permeable tuffs. Only a few wells are in the hilly areas, and few details are known about the ground water.

DIATOMACEOUS MEMBER

The diatomaceous member consists mostly of volcanic material—water-laid ash and pumice and variable amounts of gravel, sand, and clay—all more or less diatomaceous. At some places these deposits are well sorted and evenly bedded; at other places they are poorly sorted, lenticular, and crossbedded. The beds are extremely variable in thickness and lateral extent. The coarser grained deposits that consist mostly of sand and gravelly pumice have relatively little diatomite. The finer grained, more evenly bedded deposits of clay, silt, and sand have large proportions of diatomite. Some of the highly diatomaceous parts are massive and distinctly light in weight. They are generally nearly white to light cream in color.

The diatomaceous member as thus defined is mapped separately on plate 2 in two areas: one east of Napa in the drainage basins of Milliken and Tulucay Creeks and the other along the east side of the northern part of Napa Valley.

In the Tulucay Creek drainage the diatomaceous member reaches considerable thickness. In the steep hills in the southeastern part of the area (secs. 4 and 5, T. 5 N., R. 3 W.), the beds contain appreciable quantities of coarse pumice and are interbedded with basalt flows. To the north and west the amount of pumice decreases, and the beds of silt and clay of increasing diatomite content become thicker and more numerous. In an area of several square miles (secs. 30 and 31, T. 6 N., R. 3 W., and secs. 6 and 7, T. 5 N., R. 3 W.) the material consists almost exclusively of diatomaceous silt and clay.

To the west, along Imola Avenue and Third Avenue (NE¼ sec. 13, T. 5 N., R. 4 W) the deposits are mostly of silt and sand, with little clay and a few beds of fine-grained gravel. Some of these strata are diatomaceous and massive, but others are distinctly bedded and locally crossbedded.

The best exposure of the mainly diatomaceous deposits is in the quarry of the Basalt Co. in the NE¼SW¼ sec. 6, T. 5 N., R. 3 W., where the deposits are as much as 150 feet thick. Fossil plants were collected by Ora P. Kunkel from diatomite beds in this quarry at a place about 800 feet north of North Avenue and 1,800 feet east of Second Avenue. The assemblage of species is similar to that collected by Axelrod (1950) at a small quarry in sec. 30, T. 6 N., R. 3 W. Axelrod assigned an early late Pliocene age to the fossils that he collected.

Rocks from the southerly locality also contained diatoms identified by K. E. Lohman, of the U.S. Geological Survey (written communication, 1952), as follows:

Diatoms

[R, rare; F, frequent; C. common; A, abundant]

Amphora ovalis Kützing	R
sp	R
Caloneis silicula tumida Hustedt	R
Cocconeis grovei Schmidt	F
placentula lineata (Ehrenberg) Cleve	F
sp	R
Cymbella affinis Kützing	F
mexicana (Ehrenberg) Cleve	F
tumida (Brebisson) Van Heurck	R
ventricosa Kützing	F
Diatoma vulgare ehrenbergii (Kutzing) Grunow	F
Diploneis ovalis (Hilse) Cleve	R
Epithemia sorex Kützing	R
cf. *E. turgida* (Ehrenberg) Kützing	F
Eunotia pectinalis (Kützing)	R
Fragilaria sp	F
Gomphoneis herculanea robusta Grunow	F
Gomphonema sp	R
Gyrosigma distortum parkeri Harrisson	F
Melosira italica (Ehrenberg) Kützing	R
italica subarctica O. Muller	R
Navicula cf. *N. gastrum* Ehrenberg	F
pupula Kützing	R
captitata Hustedt	R
radiosa Kützing	F
scutelloides mocarensis Grunow	R
tuscula (Ehrenberg) Grunow	R
Nitzchia sp	R
Pinnularia cf. *P. viridis* (Nitzsch) Ehrenberg	R
Rhoicosphenia curvata (Kützing) Grunow	F
Rhopalodia cf. *R. gibba* (Ehrenberg) O. Muller	R
gibberula (Ehrenberg) O. Muller	R
Stauroneis sp	R
Stephanodiscus astraea minutula (Kützing) Grunow	A
cf. *S. carconensis* Grunow	C
minor Grunow	C
Surirella robusta Ehrenberg	R
Tabellaria sp	R
Tetracyclus cf. *T. pagesi* Heribaud	R

Lohman reports that this assemblage of fresh-water diatoms suggests deposition in a shallow lake of moderate temperature. Of these species, 51 percent occur in the basal beds of the Tulare formation in the Kettleman Hills, Calif. (Lohman, 1938). The lower part of the Tulare formation is late Pliocene in age, and it seems probable that a similar age is represented by the diatom assemblage from Napa County. Comparisons with other Pliocene diatom floras strengthen this assignment.

Within the area east of Napa that is underlain by the diatomaceous beds, many water wells penetrate material logged by the drillers as "tule mud." No outcrops of this "tule mud" are known, but, as observed in cuttings and as described by the drillers, the material is uncompacted and varies in composition from leaves and wood fragments to black mud. The deposits generally have an odor of "decay." They are not a true peat, and the term "tule mud" is considered to be accurately descriptive. The material is considered to represent conditions of deposition similar to those existing at present near the shores of San Pablo Bay.

The water-bearing characteristics of the diatomaceous member vary somewhat. Wells in the vicinity of Milliken and Tulucay Creeks range in depth from 65 to 700 feet; most of them are more than 100 feet and less than 300 feet deep. In the southern part of the area, where the deposits contain considerable pumice, the pumping yield is roughly proportional to the thickness of coarse pumice or tuff penetrated beneath the water table and reportedly is as much as 830 gpm. No dry holes have been reported, and a well drilled to several hundred feet anywhere in this part of the area apparently will yield sufficient water for domestic needs at least.

Wells elsewhere in these deposits have small to moderate yields. The beds of diatomaceous clay and silt contain little water of good quality, but generally they seem to overlie good water-yielding deposits in the adjoining tuffs of the Sonoma volcanics. The diatomaceous beds themselves may act as a confining layer holding the ground water in the underlying materials under artesian pressure. As is discussed more fully under ground water, many wells in the area flow either perennially or in winter when summer draft on the aquifers has ceased.

ST. HELENA RHYOLITE MEMBER

The St. Helena rhyolite member, the upper member of the Sonoma volcanics, is differentiated in the southern part of Napa Valley and along the east side of Sonoma Valley. It is not differentiated in the northern part of Napa Valley. As mapped in the present study the distribution of the member is somewhat different from that of Weaver, because certain rhyolites that are generally similar petrographically to the St. Helena, but actually belong in the main body of the Sonoma volcanics, were mapped as the St. Helena rhyolite by Weaver.

The unit consists of banded rhyolite flows, hard welded tuffs, locally some pumiceous deposits, and a layer of perlitic obsidian or similar glassy material almost invariably present at the base of the member. The obsidian is 6 to 10 feet thick and is generally a highly fractured perlitic glass but is locally porphyritic. It is generally black to dark brown, but it may also be white, gray, green, or red. The relation of the tuffs of the Sonoma volcanics, the perlitic obsidian, and the coarse-textured phase of the St. Helena rhyolite member are well displayed along the private road across the SE¼ sec. 30, T. 6 N., R. 3 W. There the bulk of the member is a bluish-gray porphyritic rock having well-defined banding and flow structure. In the vicinity of Milliken Creek the uppermost part of the St. Helena rhyolite member is a coarse welded tuff.

The St. Helena rhyolite member commonly is several hundred feet thick but locally is as thin as 10 feet. Existing bodies are evidently remnants of a once-continuous and extensive mass. They occur now chiefly in the higher parts of the hills and mountains bordering Napa and Sonoma Valleys. The rhyolite extends beneath the valley floors at only a few places.

In the outcrop the St. Helena is a compact material that would not yield water readily. It is probably penetrated by water wells at places, such as in the northern part of the Milliken-Tulucay Creeks area, but it is not distinguished by drillers from the underlying tuffs of the Sonoma volcanics.

UNCONSOLIDATED DEPOSITS OF LATE PLIOCENE(?) TO RECENT AGE

GLEN ELLEN FORMATION

Definition and age.—The Glen Ellen formation, named by Weaver (1949, p. 98) from the town of Glen Ellen at the northern end of Sonoma Valley, consists of alluvial clay, silt, sand, and gravel in clearly stratified but generally lenticular beds. The Glen Ellen unconformably underlies the younger and older alluvium and terrace deposits in Sonoma Valley, and is doubtless in contact with the Huichica formation beneath the alluvial plain. It does not occur in Napa Valley, but it underlies a considerable area in Kenwood Valley and in the hills and mountains northeast of Santa Rosa Valley; it has a highly varied lithology in those areas. It is described more fully in a report on Santa Rosa and Kenwood Valleys by G. T. Cardwell (1958).

The lower beds of the Glen Ellen formation appear to be interbedded with the uppermost flows of the Sonoma volcanics. The formation also contains considerable andesitic debris derived from the Sonoma volcanics, and accordingly is thought to range in age from late Pliocene to early Pleistocene, though no fossils have been found in it. Weaver evidently believed that the Glen Ellen formation rests unconformably on the volcanic rocks, and he considered it to be of Pleistocene age. It is in large part equivalent to the Huichica formation of Pleistocene age. The Glen Ellen formation is deformed, and dips as much as 50° in some places.

Distribution.—Within the area of Napa and Sonoma Valleys, the Glen Ellen formation crops out only along the west side of Sonoma Valley from sec. 3, T. 5 N., R. 6 W., northward into Kenwood Valley beyond the mapped area. The formation occurs also at depth beneath the alluvial plain of Sonoma Valley.

Mode of origin and lithology.—The Glen Ellen formation was deposited by streams in a subsiding basin or basins within and near the edge of the Sonoma volcanics terrane. It is composed mainly of alluvial-fan material. The lower part of the formation at places contains strata of pumice and tuff, which indicates that deposition began, at least locally, before the final eruption of the Sonoma volcanics. The formation consists generally of poorly sorted lenticular beds of clay, silt, sand, and gravel. The material is mostly andesitic in composition, and some gravel beds contain andesite cobbles as large as 6 inches in diameter. In the outcrop area in Sonoma Valley the formation consists mostly of fairly compact clay, silt, and sand interbedded with lenses of pebbles. The formation is well exposed for several miles south of Glen Ellen along the west side of Sonoma Valley.

Where penetrated by wells, the Glen Ellen formation appears to have much the same character as in exposures. The chief materials are clay and boulders, and clay. (See logs of wells 6/6–16J2, 6/6–22R3, and 6/6–34C1, table 22.)

Water-bearing properties.—The Glen Ellen formation does not yield water freely to wells. Most of the material is fine grained and the permeability is comparatively low. For example, well 6/6–27D1 drilled in the Glen Ellen formation to a depth of 780 feet was reported (log not available) to penetrate clay for almost the entire depth and was abandoned because of an insufficient quantity of water. Some water can be obtained from lenses of gravel, but even the gravel contains such a high percentage of silt and clay that the quantity of water available is rarely sufficient for more than domestic needs.

HUICHICA FORMATION

Definition and age.—The Huichica formation, named by Weaver (1949, p. 98) from Huichica Creek at the head of San Pablo Bay in the northern part of the Mare Island quadrangle, is composed of deformed continental beds consisting mostly of massive yellow silt and some interbedded lenses of silt and gravel, and silt and boulders. At the base are beds of redeposited volcanic material, silt, clay, and lenses of coarse gravel and boulders. Weaver considered that residual gravel deposits forming terraces at several altitudes in this region are interbedded with and part of the Huichica formation, but the present writers believe that they are not. The total thickness of the Huichica formation has not been determined, but it may be more than 900 feet.

The Huichica formation rests unconformably on the Sonoma volcanics and underlies the older and the younger alluvium in both Napa and Sonoma Valleys. The Huichica formation is probably in contact or interbedded with the Glen Ellen formation beneath the alluvium of Sonoma Valley. On the basis of corresponding stratigraphic position and similar lithology, it is considered equivalent to at least the upper part of the Glen Ellen. No fossils have been collected from it. However, because the beds, at least locally, are rather strongly deformed and because they rest unconformably on the tilted Sonoma volcanics, they are presumed to be early Pleistocene in age.

Distribution.—The type locality and the largest outcrop area of the Huichica formation is at the southern end of the Mayacmas Mountains, north of the tidal marshlands of San Pablo Bay. From there the deposits extend as a thin strip along the east side of Sonoma Valley in sec. 9, 16, and 22, T. 5 N., R. 5 W. Similar deposits occur also in a small area east of Napa in the valleys of Sarco and Milliken Creeks. These deposits were mapped as the Montezuma formation by Weaver (1949) but are here considered part of the Huichica formation because they are somewhat deformed and have a stratigraphic position and lithology similar to those of the Huichica in the type locality. Although difficult to identify in well logs, the Huichica formation occurs also beneath the eastern part of the older alluvial plain of Sonoma Valley and part of Napa Valley near Napa.

Mode of origin.—On the basis of examination of outcrops, the Huichica formation is thought to have been deposited as alluvial fans by streams principally draining uplifted areas of the Sonoma volcanics and flowing into basins which may have been closed, at least at times. The relief at the time was moderate, and the streams were probably about as short as present streams in the region, and flowed at relatively gentle gradients. The lowermost beds contain considerable tuffaceous material and are interbedded with thin lenses of predominantly pumiceous material; these facts indicate that the early stages of deposition locally began before the last eruption of the Sonoma volcanics. These deposits closely resemble the water-laid deposits within the Sonoma volcanics. The upper part of the Huichica formation was deposited as an alluvial fill in both Napa and Sonoma Valleys.

As penetrated by wells in Sonoma Valley and possibly in part of Napa Valley, the formation contains a thick body of clay and silt which may represent lake, swamp, or lagoonal conditions of deposition.

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Lithology.—The Huichica formation, like the Glen Ellen formation, is typically poorly sorted, lenticular, and somewhat crossbedded, and is predominantly fine grained except at the very bottom. The basal 200 or 300 feet of the Huichica formation in both Napa and Sonoma Valleys consists largely of sandy silt, reworked pumice and tuff, and some primary tuff interbedded with lenses of coarse gravel or cobbles derived mostly from the andesitic Sonoma volcanics. The beds of coarse gravel are commonly crossbedded, but those of silt and tuff are generally regular and even. The basal part of the deposit is well exposed east of Napa along the south bank of Sarco Creek at Vichy Avenue and along Atlas Peak Road in sec. 14, T. 6 N., R. 4 W., and in Sonoma Valley along the Sonoma Highway in secs. 22, 26, and 27, T. 5 N., R. 5 W.

The upper part of the Huichica formation, 500 feet or more in thickness, consists of rather compact clay and yellow silt and a few interbedded lenses of gravel, and some sand. This section is well exposed along Huichica Creek and along Duhig Road in secs. 1 and 2, T. 4 N., R. 5 W. The silt is uniformly yellow; the clay is mottled yellow and blue. Discontinuous lenses of crossbedded gravel occur throughout. In general, this part of the formation is massive, and discernible bedding planes are rare.

Except along Huichica Creek, in road cuts, and in a few gullies, most of the formation is covered with grass, and few exposures of the underlying material crop out. Where gullied or exposed, the upper part of the formation is very susceptible to landslides. Therefore, it is very difficult to determine the lithology and structure throughout much of the formation. Logs (table 17) typical of wells drilled into the upper part of the Huichica formation are those of 5/4–29N2, 5/4–29Q1, 5/4–29Q2, and 5/4–30P1.

Well 4/5–14D2 in Sonoma Valley, drilled to a depth of 1,620 feet, probably penetrates the entire thickness of the Huichica formation. (See log in table 22.) From 338 to 683 feet the material penetrated in drilling was very similar to the material exposed along Huichica Creek in the type area. From 683 to 1,370 feet the material penetrated was a nearly uniform clay or sandy silt, mostly blue in color. Similar material is penetrated in many of the wells in Sonoma Valley, as shown by the logs (table 22) of wells 5/5–8P1, 5/5–17N1, and 5/5–20R1. These blue clays and shales are evidently the buried continuation of the material which is exposed along the eastern margin of the valley, and which apparently constitutes a fine-grained facies of the formation.

Water-bearing properties.—As indicated in the foregoing description, the Huichica formation is composed of reworked tuff, silt, clay, and lenses of boulders or gravel. Of these, the silt and clay are too fine grained to yield water readily, and even the lenses of gravel contain enough fine material to impede the flow of water. No wells draw large quantities of water from this formation.

In Sonoma Valley and south of the Sonoma Highway between Napa and Sonoma Valleys, wells drilled into the upper part of the Huichica formation have low yields, and some do not yield sufficient water for minimum domestic needs. These wells all penetrate a thick section of clay or silt and a variable amount of clay and gravel. Well 4/5–14D2, which draws water from material between 260 and 620 feet, probably is drilled in the lower part of the older alluvium and the Huichica formation. The well was reported to yield 395 gpm with a drawdown of 140 feet. This gives a specific capacity of less than 3 gpm per foot, which is rather small.

Wells in the Sarco-Milliken Creeks area drilled only in the basal part of the Huichica formation generally yield less than 20 gpm, according to the reports of well drillers. The flowing wells and wells of large yield in the Sarco-Milliken Creeks area that start in the basal part of the Huichica formation are drilled through the Huichica formation and obtain most of their water from the underlying Sonoma volcanics. This is true also of the flowing wells along the east side of Sonoma Valley.

East of Napa the Huichica formation crops out along both sides of Milliken Creek, but nearly all the wells drilled in this area draw water from the tuffs of the underlying Sonoma volcanics. However, wells 6/4–23F1 and 6/4–23Q1, which do draw water from the Huichica formation, pump less than 20 gpm. Well 6/4–23F1 was reported to have been pumped "dry" in October 1949.

West of Napa, south of the Sonoma Highway and east of the Napa-Sonoma County line, in an area locally called the Carneros area, wells drilled into the Huichica formation generally yield 5 gpm or less. The yields of some wells in this area are inadequate for minimum household needs, and some families must haul water during the summer and fall for drinking and washing. For example, static levels before pumping are in many places at or near the land surface, but after only a few hundred gallons is pumped the water level may be 70 or 80 feet below the land surface, and 24 hours may be required for the water level to recover to 20 feet below the surface.

OLDER ALLUVIUM

Definition and age.—The older alluvium of Napa and Sonoma Valleys is composed of lenticular deposits of unconsolidated and poorly sorted clay, silt, sand, and gravel. Where the alluvium is exposed, claypan or hardpan soil characteristically has developed on the surface. The beds are undeformed. As interpreted from drillers' logs the older alluvium reaches a thickness of at least 500 feet in Napa Valley, but the maximum is not known. It thins to a featheredge at the margins of the valley. The older alluvium generally overlies the Glen Ellen and Huichica formations, and in a few areas it overlies the Sonoma volcanics or older formations. It underlies the younger alluvium of Recent age. The older alluvium includes parts of the Montezuma formation as mapped by Weaver (1949) and possibly other deposits that may be the equivalent of the Merritt and Posey formations of San Francisco Bay as described by Trask and Rolston (1951).

Many of the water wells in Napa Valley start in the older alluvium or penetrate older alluvium at shallow depths. However, most logs of these wells are not sufficiently detailed to permit a precise differentiation of the younger alluvium, older alluvium, and Huichica formation. Nevertheless, these logs suggest that the older alluvium generally consists of yellow clay and gravel, and the Huichica or Glen Ellen formations are predominantly yellow and blue clay. It is not always possible to identify the contact between the older alluvium and the underlying formations.

Although the older alluvium is undeformed, it is separated from the overlying Recent alluvium by an erosional unconformity, and, therefore, is considered late Pleistocene in age.

Distribution.—In Sonoma Valley the older alluvium lies at the surface on most of the low alluvial plain, except along the flood channel of Sonoma Creek. However, exposures are concealed in most places by soil and grasses. The best exposures are in the channels of the tributary creeks along the east side of Sonoma Creek. Because the older alluvium is free of flooding and is good land, the town of Sonoma, most of the surrounding suburban development, and the smaller ranches are built on this formation. In Napa Valley the older alluvium occurs mainly in the area of the alluvial plain, where it is largely covered by a thin veneer of younger alluvium. At the southern end of the valley, in the vicinity of Napa, numerous scattered and discontinuous bodies of older alluvium occur along the margins of the valley or as windows within the area of younger alluvium. The town of Yountville is built on a small area of older alluvium. Several other small hills of older alluvium occur in Napa Valley between Yountville and Calistoga.

The older alluvium is well exposed in Napa Valley, the best exposures being along the Napa River. Deposits of reddish clay, sand, and gravel crop out in the river channel for several miles north of a point about half a mile north of Trancas Road. A section of yellow silt or clay is exposed in the Napa River channel between Trancas

Road and Oak Knoll Avenue; and north of Oak Knoll Avenue a sequence of alternating beds of yellow silt, sand, and gravel is exposed. About half a mile north of Oak Knoll Avenue, the Napa River has exposed yellow hard clay or silt. Similar deposits are less well exposed in the bluff along the Silverado Trail east and northeast of Napa and in road cuts along Hardman Avenue east of the Silverado Trail between Milliken and Soda Creeks.

Mode of origin.—The older alluvium is composed of stream-channel and alluvial-fan material deposited in Napa and Sonoma Valleys after the deposition of the Huichica and Glen Ellen formations and after the Pleistocene deformation that folded these formations. Considerable evidence indicates that along the California coast the relative position of sea level fluctuated several times during the late Pleistocene. Undoubtedly each of these fluctuations caused a readjustment of drainage in Napa and Sonoma Valleys, which in turn resulted in either an episode of downcutting or one of backfilling. Therefore, the older alluvium probably includes deposits formed in several cycles of erosion and deposition, though these deposits cannot be differentiated in this area.

Lithology.—In Napa and Sonoma Valleys the older alluvium where exposed at the surface is predominantly reddish-brown cross-bedded poorly sorted clay and silt, and some lenses of sand and of gravel. The material is unconsolidated but somewhat compacted, and some of the lenses of gravel are cemented. The sand and gravel fragments are composed mainly of andesitic debris, but they include a few pebbles of chert from the Franciscan group and other nonvolcanic rocks. Included also are a few seams of black sand composed of andesitic debris but coated with a manganese stain. No tuff is known to occur in the older alluvium. In Napa Valley a piece of an incompletely carbonized redwood log was found in place. Some of the lenses of sand and gravel and of clay and gravel are as much as 10 feet thick and extend laterally for many tens of feet. Also, according to well logs, thick beds of yellow or gray hard silt and clay are common and form a large part of the older alluvial deposits.

Logs of wells in Napa Valley that start in, and probably penetrate, the older alluvium for most of their depth are 6/4–15Q3, 6/4–27C2, 6/4–27M1, 6/4–27N1, 6/4–28F1, 6/4–28K2, 6/4–28Q1, 6/4–30C1, and 6/4–34D2 (table 17). These logs show alternating beds of clay and gravel. However, most of the material logged as gravel contains some clay.

In Sonoma Valley the older alluvium underlies a larger area, but is thinner and not so well exposed in section as in Napa Valley. Typical logs of water wells that start in the older alluvium of

Sonoma Valley are 5/5–8P1, 5/5–9N2, 5/5–16E1, 5/5–17B1, 5/5–17C4, 5/5–17J1, 5/5–17N1, 5/5–17R2, 5/5–18K1, and 5/5–21R1. Most of the wells pass through the older alluvium and enter the clay of the Huichica or the Glen Ellen formation at relatively shallow depth.

Water-bearing properties.—Most of the wells in the older alluvium are less than 200 feet deep and penetrate some lenses of gravel or clay and gravel. The yield of these wells is proportional to the quantity of gravel or clay and gravel penetrated beneath the water table and ranges from almost nothing to more than 400 gpm. Much of the material in the older alluvium is so fine grained that wells producing more than 50 gpm are rare. Even the material logged as gravel is rather poorly sorted, is generally mixed with variable amounts of clay, and is sometimes slightly cemented and compacted, so that it yields only moderate amounts of water. However, nearly all wells drilled through more than 100 feet of older alluvium penetrates enough sand and gravel to yield sufficient water for domestic needs. In parts of both Napa and Sonoma Valleys the older alluvium is thin. Some wells that start in the older alluvium penetrate non-water-bearing material beneath it and do not produce sufficient water for even domestic needs. Nevertheless, the outcrop area of the older alluvium is generally well suited for homesites and agriculture. Therefore, the number of wells in the older alluvium is large, and it is one of the principal sources of water in both Napa and Sonoma Valleys.

TERRACE DEPOSITS AND OLDER ALLUVIAL FANS

Terrace deposits include numerous isolated bodies of unconsolidated clay, sand, gravel, and cobbles that cap hilltops and benches or border the base of steep hills and mountain slopes. All these bodies are thin, of small extent, and locally conceal the older formations on which they lie unconformably. Some are remnants of former river-channel or flood-plain deposits, some may be marine terrace deposits, and some are older alluvial-fan deposits. They occur at several altitudes above present sea level and present stream grades. They range in thickness from 0 to 10 or 15 feet, except for the alluvial fans which may be considerably thicker. No fossils have been found in these deposits, but their stratigraphic position indicates an age from late Pleistocene to Recent. They may be equivalent in part to the older alluvium.

These deposits are unconsolidated and in most places contain a large proportion of sand and gravel. They are mainly non-water-bearing, however, because generally they are thin and occur above the water table. Where these deposits overlie the Huichica or the

Glen Ellen formation, the coarse gravel of the terrace deposit easily may be mistaken for gravel interbedded with the underlying formations, and a false impression of the water-bearing character of the underlying formations may be inferred. Because these deposits are mainly non-water-bearing they have been mapped only where they are relatively thick, or where they obscure the nature of the underlying formations.

YOUNGER ALLUVIUM

Definition and age.—The younger alluvium consists of interbedded unconsolidated gravel, sand, silt, clay, and peat. It underlies the flood plains and channels of the Napa River, Sonoma Creek, their tributaries, low alluvial fans or plains graded to these streams, and the tidal marshlands. It comprises channel, flood-plain, alluvial-fan, and salt-marsh deposits.

These deposits overlie or overlap all other formations in Napa and Sonoma Valleys. They were deposited by the streams much as we see them today in valleys cut by streams graded to a lower position of sea level thought to correspond with a late Pleistocene glacial stage (Upson, 1949; Louderback, 1951). Hence, the younger alluvium may be in part late Pleistocene, but for the most part it is considered to be Recent because deposition is continuing.

Distribution.—The younger alluvium occurs along the channel of Sonoma Creek as a long, narrow strip in most places less than a mile wide. This strip comprises the channel and flood-plain deposits of Sonoma Creek and the low alluvial fans of the tributary creeks. No large or extensive alluvial fans have developed or are being formed in Sonoma Valley at present. Similar channel and flood-plain deposits occur along the channel of the Napa River. However, many of the tributary streams are forming alluvial fans of low slope. These fans are well developed where Napa, Dry, and Sulphur Creeks and other smaller creeks enter the floor of Napa Valley. They rest on and partly conceal the older alluvium. Therefore, except for inliers of older alluvium, the plain of Napa Valley is underlain by the younger alluvium. Recent alluvial deposits occur also in the tidal marshland bordering San Pablo Bay (pl. 2).

Mode of origin.—The younger alluvial plain north of San Pablo Bay is being extended by the accumulation of fine-grained debris which is carried into the bay by the Napa River and Sonoma Creek. The flood plains in Napa and Sonoma Valleys also are accumulating debris though not so noticeably. The channels of both the Napa River and Sonoma Creek locally are cut into the underlying older alluvium and on casual inspection these streams appear to be actively downcutting their channels, but they may not be. Every winter and spring large quantities of water discharge down these channels and in places overflow the banks, and every few years the volume of water has been enough to flood large areas. During these floods appreciable quantities of clay, silt, and gravel are deposited on the alluvial plain. Consequently, these rivers are aggrading, even though their channels may cut into underlying materials.

Alluvial fans of low slope are deposited by streams where they emerge from confined channels of hard rock and enter the main part of Napa and Sonoma Valleys. There the channels widen, the velocity of the water decreases, and the streams deposit some of their load. Over a period of time the channels fill up with debris, and eventually the streams spill out of the old channels and form new channels which also eventually fill up, and the process is repeated. Over a short period of time some parts of the alluvial fan receive little debris, but over an extended period all parts of the fan receive some debris. The process in Napa and Sonoma Valleys is not so readily apparent as in arid regions.

In Sonoma Valley the Recent alluvial fans are small and are confined to the lowest parts of the tributary stream courses adjacent to the flood plain of Sonoma Creek. Most fans of streams tributary to Napa Creek are small, but the extent of the alluvial fans of Napa, Dry, and Sulphur Creeks and a few others is large.

North of Napa the channel of Napa River is confined to the east side of the valley by the Recent alluvial fans of Dry and Napa Creeks. The present channel of Dry Creek is along the north edge of its alluvial fan and the creek is currently extending its fan in that direction.

Lithology.—The channel deposits of the Napa River, Sonoma Creek, and their tributaries consist almost entirely of well-sorted gravel and sand and some silt, tin cans, broken glass, and old automobile bodies. The flood-plain deposits consist predominantly of silt and sand interbedded with the gravel of channel deposits of the streams. These materials are well exposed along the banks of the Napa River and Sonoma Creek.

The alluvial fans consist of poorly sorted coarse gravel, sand, silt, and clay. This material is nowhere well exposed in section, and, as described in drillers' logs of water wells, it is indistinguishable from the older alluvium. However, for most of the area the younger alluvium probably is less than 30 feet thick. The deposits of the tidal sloughs and San Pablo Bay consist of fine sand, silt, and clay or mud, interbedded with large amounts of organic material. This type of material was penetrated in well 4/5–14D2 from the surface to 49 feet, and, though logs are not available, it also was reportedly penetrated in wells 3/4–3P2, 3/4–6J1, and 4/4–32R1 to depths of 100 to 120 feet.

Water-bearing properties.—Because the younger alluvium is composed of a large percentage of loose sand and gravel, it yields water freely to wells wherever a sufficient thickness of material occurs beneath the water table. Most of the best irrigation wells, such as 5/4–3H1, 5/6–13K1, and 6/4–17A1, obtain water from these deposits. Throughout a large part of Napa and Sonoma Valleys, however, the younger alluvium is only a thin veneer covering the older alluvium. In these areas, many wells penetrate the full thickness of the younger alluvium and derive water also from one or another of the underlying formations.

GEOLOGIC HISTORY

In Napa and Sonoma Valleys the decipherable geologic history begins in the Jurassic. The Jurassic to Miocene history of the California Coast Ranges in Napa and Sonoma Valleys does not bear a direct relation to the present ground-water bodies and the existing hydrologic problems, and is therefore summarized only briefly. This summary has been drawn from more complete accounts, principally by Reed (1933), Taliaferro (1943a, b), Weaver (1949), and Howard (1951). The geologic history from the Pliocene to Recent is directly related to the occurrence, source, and movement of most of the usable ground water in Napa and Sonoma Valleys and is therefore covered more fully.

In late Jurassic(?) time, detritus from a western source accumulated in a shallow geosynclinal sea, which covered the area now occupied by Napa and Sonoma Valleys, to become the sedimentary and metamorphic rocks of the Franciscan group, or the Franciscan-Knoxville group of Taliaferro. During and after the deposition of these sediments they were extensively intruded and locally covered by ultrabasic igneous rocks in the form of dikes, sills, and flows now wholly serpentinized. Throughout the Coast Ranges the Jurassic eroded with uplift and local warping, but the geosyncline was not destroyed.

During the Cretaceous period, fine-grained detritus accumulated in the same depression. These sediments became the Shasta series and Chico formation. Deposition was brought to a close near the end of the period by folding and uplift accompanying a minor orogeny.

In early Tertiary time the sea again invaded the area of Napa and Sonoma Valleys and mud, silt, and sand were deposited. During this time there were several transgressions and regressions of the sea, and some minor deformation, which separated the sediments into distinct lithologic groups now recognized as the Capay, Domengine, Markley, San Ramon, Monterey, Briones, Cierbo, and Neroly formations (Weaver, 1949).

The material that formed these early rocks was derived largely from the Sierra Nevada to the east, and, as a result the mineral composition of the detritus at most places, is akin to the sierran rocks rather than to those of the Coast Ranges. During middle Miocene time a weak orogenic movement began a period of uplift in the Coast Ranges region; by the end of Miocene time a long, low coastal range had risen west of Napa and Sonoma Valleys. This range greatly modified the conditions of deposition in succeeding epochs.

The Miocene uplift probably extended into the early Pliocene and brought about widespread uplift and withdrawal of the sea from most of the region.

Early and middle Pliocene time was one of relative stability, but it was brought to a close by the most important episode of mountain building since the late Jurassic. Movements that accompanied this episode, which ultimately formed the modern Coast Ranges, reached a climax in the late Pliocene or early Pleistocene (Taliaferro, 1951, p. 146), and have continued intermittently to the present. Uplift probably took place at slightly different times in different parts of the region. Thus, even though erosion of the land surface at any one place in the northern Coast Ranges began immediately after the elevation, the resulting sediments deposited in different areas are not necessarily fully contemporaneous. Also, the exact dating of the disturbance is open to question because the dating by invertebrate fossils is not in agreement with that by vertebrate finds (Taliaferro, 1951, p. 142).

In early Pliocene time, some mud and sand of the Petaluma formation may have been deposited in the western part of Sonoma Valley. Although throughout most of the Pliocene the land in Napa and Sonoma Valleys was above sea level, the prevailing crustal unrest was expressed by extensive volcanic activity, and large areas were covered by many interbedded flows of basalt, andesite, and rhyolite, and by blankets of pumice and ash. During periods of relative quiescence, gravel, sand, and clay were deposited on the volcanic terrane. Also, in small areas, fresh- or brackish-water lakes were formed in which large numbers of diatoms grew, their skeletons ultimately forming beds of diatomite or diatomaceous clay. All these water-laid deposits were buried by pumice, ash, or flows. The last extrusions were widespread tuffs and flows of rhyolitic composition. These volcanic rocks and associated deposits comprise the undifferentiated Sonoma volcanics, the diatomaceous member, and the St. Helena rhyolite member.

During the extrusion of the Sonoma volcanics a marine embayment may have extended eastward south of the Sonoma Mountains and possibly south of the Mayacmas Mountains.

Late in the Pliocene, and continuing into the early Pleistocene, the Coast Ranges region was uplifted, folded, and faulted. The Sonoma volcanics, including the St. Helena rhyolite member, were folded and faulted into synclinal and anticlinal structures. Napa and Sonoma Valleys were broadly outlined by the formation of the ancestral Howell, Mayacmas, and Sonoma Mountains, and coarse sediments derived from the mountain areas began to accumulate in the depressions.

This alluvial sand, gravel, and mud, whose deposition continued into the early Pleistocene in the newly formed Napa and Sonoma synclinal areas, became the Huichica and Glen Ellen formations. The sediments first deposited were derived largely from the Sonoma volcanics and hence are composed mainly of volcanic detritus. Parts of these formations are undoubtedly contemporaneous. Some folding continued during and after the deposition of these beds, as they are noticeably tilted at most places.

This deposition was brought to a close in middle or late Pleistocene time by general uplift, and the region was subjected to erosion. Alluvial fans, terrace deposits, and cut terraces related to several cycles of differential movement between the land and sea were formed. These sediments are the undeformed deposits mapped as older alluvium and undifferentiated terrace deposits. Because both land and sea level moved independently during the Pleistocene, it is impossible to determine the relationship of these deposits to each other or to determine which of the deposits are related to a change in land level and which are related to a change in sea level.

Late in the Pleistocene, during one of the periods when sea level was several hundred feet lower than at present, streams cut valleys thought to be graded to a main river flowing out through the Golden Gate. A subsequent rise in sea level, thought by Louderback (1951, p. 88) to have occurred during the third interglacial stage, formed San Francisco Bay. Whether or not this dating is correct, the latest activity in the region has been continued erosion in most of the land area, and corresponding deposition of sediments in and immediately bordering the bay.

GROUND WATER

Except for connate sea water and brackish water from San Pablo Bay, the source of all ground water in Napa and Sonoma Valleys is precipitation on the alluvial plains and on the adjacent hills and mountains within the drainage area of each valley. Available evidence indicates no movement of underground water between these valleys or from valleys outside the drainage areas. Ground water does not move as a stream, nor in defined underground channels, but percolates through the pore spaces in the water-bearing formations from areas of replenishment toward areas of discharge.

The pore spaces in the rock formations below the water table are saturated with water. However, different formations yield water to wells at different rates. The pertinent features of the several formations in Napa and Sonoma Valleys have been described above. These features are related to the occurrence and availability of ground water, which are discussed in sections below. The total quantity of water available from a ground-water basin depends more on the annual recharge and storage capacity than on the rate at which a given well may produce water. These and other general principles of ground water have been described by Meinzer (1923a, b) and are not discussed in detail in this report, but they form the basis for the evaluation of the ground-water conditions of Napa and Sonoma Valleys.

NAPA VALLEY

The characteristics of ground-water occurrence and availability in Napa Valley are sufficiently different in the several formations that it is desirable to consider the ground water as divided into several bodies that are for the most part hydrologically distinct. The occurrence, source and movement, general quality, and temperature of ground water are discussed under the following subdivisions: (a) Water in the younger and older alluvium, (b) water in the Sonoma volcanics, (c) water in the Huichica formation, and (d) water in consolidated marine formations.

WATER IN THE YOUNGER AND OLDER ALLUVIUM

Occurrence.—Ground water in the younger and older alluvium constitutes a continuous body coextensive with these formations in Napa Valley. This water body extends from San Pablo Bay, on the south, northward to the edge of the alluvial plain north of Calistoga. Its extent is indicated by the heavy solid contours on plate 4. Water of this body occurs also in the minor arms of alluvium that extend up the stream valleys tributary to Napa Valley, but these do not constitute a major part of the body. The terrace and older alluvial-fan deposits are thin, are ordinarily above the water table, and are not a source of water.

The bottom of the water body in most parts of the area is placed at the base of the younger or older alluvium where it rests on the Huichica formation, the Sonoma volcanics, or older formations. At most places these underlying formations are substantially less permeable to the vertical movement of water than is the alluvium. However, at some places the younger or older alluvium rests on the tuffaceous beds of the Sonoma volcanics, which are relatively permeable. At such places, the bottom of the water body is actually at the first impermeable zone in the Sonoma volcanics. The same thing is true where the younger or older alluvium rests on beds of the Huichica formation that are more permeable than average.

Most of the water in this body is fresh. However, in the Suscol area in secs. 26 and 27, T. 5 N., R. 4 W., and in the tidal marshes south of Suscol Creek the water is brackish except for a thin surficial lens of fresh water. Brackish water occurs in the tidal reach of the Napa River, extending to Trancas Road a little north of Napa. Brackish water from this source has apparently entered the shallow water body locally along this reach. The quality of this water is discussed more fully in the section on quality of water.

In the younger and older alluvium in Napa Valley the temperature of water from wells 100 to 150 feet deep is ordinarily 62° or 63°F. The temperature normally fluctuates very little during the year, being greatest in shallow wells and least in deep wells. The temperature of water in wells 100 to 150 feet deep is usually constant and approximately equal to the mean annual temperature of the region. In deeper wells the temperature of the water is normally a little higher, and increases with depth. The average rate of increase, known as the geothermal gradient, is about 1° to 2°F for each 100 feet of depth.

The water in the younger alluvium and in most of the older alluvium is unconfined. There are no continuous impermeable beds within the older alluvium, but much of the lenticular older alluvial material is sufficiently fine grained that water is semiconfined locally.

Semiconfinement of water in the older alluvium is indicated by the following evidence. First, some wells, such as 7/5–23D2 and 8/5–30P1 (table 14) flow part of the year. Second, some wells, such as 6/4–21P2 and 8/5–31P1 (pl. 2), show a sudden drop in water level when pumps in nearby wells of comparable depth are started, and an equally sudden rise when the pumps are turned off. Such rapid response is generally indicative of confinement. Third, the water level in some wells, such as 6/4–34D2 (pl. 2), fluctuates in response to barometric changes. Finally, well drillers report that in many areas as a well is drilled the depth to water decreases with increased well depth. Such a decrease may indicate confinement, though it may also indicate upward movement of unconfined water, and as near a stream receiving ground-water discharge.

The water level in wells in the younger or older alluvium in Napa Valley generally ranges from land surface, or slightly above, to about 30 feet below (tables 13, 14). On high ground and at a few particular places the depth to water is somewhat greater.

Source and movement.—In Napa and Sonoma Valleys the direction of movement of the ground water is indicated by the several sets of water-level contour lines shown on plate 4. Ground water moves from areas of recharge, or of high head, toward areas of discharge, or of lower head. The altitude of the water level in a well is computed by subtracting the depth to water from the altitude of the land surface at the well. Except for a few altitudes determined by spirit level, altitudes were interpolated from the contour lines on topographic maps. South of latitude 38°30′ and east of longitude 122°15′, altitudes were interpolated from contours having a 5-foot interval, except for a few wells on steep slopes whose altitudes were interpolated from 20-foot contours. North of latitude 38°30′, altitudes were interpolated from 50-foot contours; and west of 122°15′, altitudes were interpolated from 25-foot contours.

The water-level contour lines were based on measurements made at different times over a total period of more than 1 year. During this period little change occurred in regional water level, and, as indicated in the explanation of plate 4, the water-level measurements for any one of the several water bodies were taken within a period of a few weeks. Therefore, even though not all parts of the water-level contour map represent the same time, the map does indicate the direction of movement, and hence gives information as to the source and discharge of ground water in Napa and Sonoma Valleys. Allowance was made for unusual levels in some wells resulting from special circumstances, such as excessive summer irrigation.

The contour lines indicate that the movement of water in the younger and older alluvium is generally from the sides of the valley toward the Napa River, and also southward down the length of the valley. Therefore, except for some evapotranspiration, natural discharge is into the Napa River. Ground-water discharge into the Napa River is further indicated by the continued flow in the summer when there is no inflow of surface water from tributary streams, and even in reaches downstream from certain sumps in the river channel from which all the surface flow is intercepted and pumped out for irrigation.

Some of the ground water originates by seepage out of the tributary stream channels, and probably by infiltration of surface runoff into the surficial material at the edges of the valley. Inasmuch as this water body is generally unconfined, and no extensive impermeable beds occur between the water table and the land surface, much of the water infiltrates from rain.

Where the older alluvium lies on more permeable parts of the Sonoma volcanics, some water may move upward from the volcanic rocks into the older alluvium. In secs. 26 and 35, T. 6 N., R. 4 W., water levels in wells in the younger and older alluvium are 10 or 15 feet lower than water levels in wells in the Sonoma volcanics. Thus, the water in the volcanic rocks is under some artesian pressure. Some upward movement of the deeper water may take place through small openings in the confining beds.

The impoundment of water from Conn Creek in Lake Hennessey has had some effect on the movement of ground water in Napa Valley. Before the construction of Conn Dam many shallow wells along the creek were reported to have large yields all year. For example, well 7/5–10C1 was reported to yield between 750 and 1,500 gpm. However, since the construction of Conn Dam the flow of Conn Creek has been greatly reduced in the winter, and eliminated entirely during the summer. Because of the resulting lowered ground-water levels, the shallow wells now have substantially lower yields.

The reduced streamflow and lowered water levels resulting from the creation of Lake Hennessey may conserve water. Under normal conditions water levels in Napa Valley were high, and the runoff from winter rains flowed into the Napa River and its tributaries, or into San Pablo Bay, and was lost. However, if water is held back in Lake Hennessey, or in other reservoirs which might be constructed, ground-water pumpage may dewater enough alluvium to create storage space into which winter surface-water runoff may infiltrate. Thus, water could be recovered that would normally discharge into San Pablo Bay.

WATER IN THE SONOMA VOLCANICS

In Napa Valley, three distinct ground-water bodies are recognized in the Sonoma volcanics. One is in the area of Milliken and Tulucay Creeks east of Napa, another is in the area south of Napa and north of Suscol, and the third is in the vicinity of Calistoga. These bodies are distinguished from the water in the younger and older alluvium largely by the water levels in wells, as illustrated by the independent sets of water-level contour lines on plate 4. Contour lines are not drawn for the water body in the vicinity of Calistoga.

MILLIKEN-TULUCAY CREEKS AREA

Occurrence.—East of Napa, in the depression crossed by Milliken and Tulucay Creeks, many wells obtain water from the tuffs of the Sonoma volcanics, which lie beneath the Huichica formation in the northern part of the area and beneath the diatomite in the southern part. The dotted contour lines on plate 4 represent the piezometric surface of this water. The water in these areas probably is in hydraulic continuity, but information from wells in the intervening area between Hagen Road and North Avenue is lacking.

In the vicinity of Milliken Creek all the flowing wells and most of the other wells deeper than 100 feet draw water from the coarse volcanic deposits. That this water is in a continuous body is indicated by the mutual interference of wells in the area. For example, the water levels in all the wells shown in sec. 31, T. 6 N., R. 3 W., decline when well 6/4–23J1 or 6/4–24M1 is being pumped, and recover when these wells are turned off. The other flowing wells and the deeper nonflowing wells in the intervening area also show a similar interference.

The temperature of the water in the wells more than 100 feet deep is between 67° and 85°F. Even allowing for a small increase of temperature with depth, these temperatures are above normal.

In the vicinity of Tulucay Creek also, water occurs mainly in coarse ash and pumice, which generally is associated or interbedded with diatomite. This water may be in hydraulic continuity with the water in the tuffs in the northern part of the area, but no interference between wells in the northern and southern parts has been observed.

The temperature of the water in wells more than 100 feet deep in the southern part of the area is between 63° and 69°F, which is lower than the temperature of the water in the northern part but higher than it would be with an average geothermal gradient.

Nearly all the wells in this area tap confined water. The material penetrated is not described clearly in the well logs, and it is difficult to determine the confining beds. Many of the flowing wells are drilled through diatomite. This material, where exposed at the land surface, prevents the infiltration of rainwater. Therefore, it is likely that the diatomite, where present, confines the water in the coarse-grained underlying deposits.

The first flowing wells in the Milliken-Tulucay Creeks area were drilled about 1910. The original head of these wells is unknown, but it is reported that the head of water in well 6/3–31N1, the first flowing well drilled, was sufficient to make water flow into a large tank about 40 feet above the well. This well no longer flows. Well 6/4–25D1, drilled in 1917, was reported to have a large flow. On March 23, 1950, the flow of this well was measured as 97 gpm. Well 6/3–30N1, drilled in 1910, had a measured flow on March 22, 1950, of 60 gpm. The flows of other wells in this area were measured or estimated at rates ranging from a few gallons a minute to as much as 24 gpm. Ordinarily the wells cease to flow in summer.

Source and movement.—The dotted contour lines on plate 4 indicate the direction of movement of ground water in the vicinity of Milliken and Tulucay Creeks. Movement is generally westward from the Howell Mountains toward Napa Valley. Because the water is confined, virtually no recharge occurs from precipitation within the area; rather, the body is replenished by infiltration of rainfall and seepage from Milliken and Tulucay Creeks and their tributaries within the outcrop area of the tuffs and coarse pumice, generally east of the area of the flowing wells.

The water in the vicinity of Milliken Creek moves westward through the Sonoma volcanics, which underlie the alluvium and the Huichica formation. A small amount of water may move upward from the Sonoma volcanics into the overlying rocks. The ground water in the vicinity of Tulucay Creek also moves westward toward Napa Valley. The map shows a strong discontinuity between the water in the Milliken-Tulucay Creek area and that within the valley proper, especially in the vicinity of sec. 13, T. 5 N., R. 4 W. The water levels in deep wells south of Napa, as indicated by heavy dashed contour lines (pl. 4), are drawn down by pumping. The steep differential of 110 feet in sec. 13 suggests the presence of a barrier to ground-water movement. (See p. 18 and cross section, pl. 3.)

SUSCOL AREA

Occurrence.—In the Suscol area, which is along the Napa River south of Imola Avenue and north of Suscol Creek, the Napa River is tidal and the water is brackish. During most of the year the water in the river is too salty for domestic use or irrigation. In the vicinity of Suscol, fresh water occurs in tuffaceous beds of the Sonoma volcanics beneath the alluvial deposits. The attitude of the formations, as shown in cross sections *C–C′* and *E–E′* (pls. 2, 3) is synclinal.

The ground water in the Sonoma volcanics in the Suscol area is considered a single body, but several partially separated water bodies might be distinguished if enough accurate data were available.

The known depth to water in the Sonoma volcanics ranges from about 20 to more than 100 feet below the land surface. The water levels represent the deep water body. Shallow water commonly is cased out of water wells because it is in hydraulic continuity with the Napa River and, therefore, is generally salty.

The deep fresh water in the Suscol area apparently is separated from the overlying shallow salty water by deposits of low permeability. The separation and confinement of the deep water body are indicated by the progressively higher heads observed as the wells were drilled deeper. Also, wells 5/4–14L2, 5/4–27A1, 5/4–27K1, and 5/4–27K2 initially flowed. During the winter of 1949-50 the water level in some of these wells was more than 50 feet below sea level, but water pumped from them was fresh except in the wells where the casing apparently had rusted through, allowing the shallow salty water to mix with the deep water.

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The temperature of the water pumped from the deep wells in this area is between 68° and 92°F. Even allowing for increased temperatures with increased depth, these temperatures are higher than would be expected from the average geothermal gradient.

Source and movement.—As shown by the water-level contour map (pl. 4), water moves into the Suscol area from all sides This movement is due in part to heavy withdrawals from the water body in this area. The source of the fresh water is infiltration of precipitation on the exposed tuff and pumice beds that crop out in the hills bordering the valley, and seepage from streams that flow over these intake areas. In the Suscol area the head of the deeper water is drawn down so that some water may enter the Sonoma volcanics from the overlying materials. However, these materials are of low permeability, and the quantity of water thus derived is probably small. Whether salty water is present in the extension of the volcanic rocks beneath San Pablo Bay and is being drawn toward the wells is not known.

CALISTOGA AREA

Occurrence.—Many wells in the vicinity of Calistoga obtain water from the Sonoma volcanics. Few well logs are available, but the available data indicate that wells do not penetrate large quantities of tuff or coarse pumice. Most of the shallower wells tap water in alluvium.

Water levels in the Sonoma volcanics in the Calistoga area range from slightly above the land surface to about 25 feet below. That all the flowing wells are deep and derive water from the volcanic rocks suggests some difference in water level between deep and shallow well in the alluvium. However, a comparison of water levels in observation wells 9/7–25N1, which is 149 feet deep, and 9/7–25N2, which is 26.5 feet deep (table 14), suggests that the difference in water levels between shallow and deep wells is not large and may be less than the accuracy of land-surface altitude as interpolated from topographic maps having a 25–foot contour interval.

The water temperature in most wells in the Sonoma volcanics in this area is considerably above the average geothermal gradient. The mud bailed from well 9/7–26P1 during drilling was 140°F. Wells 9/7–26J1, 9/7–26J2, and 9/7–26K1 periodically discharge hot water and superheated steam in the manner of a geyser. These "geysers" in this area and in a similar area north of Healdsburg, Calif., are described by Allen and Day (1927).

Source and movement.—The source of most of the water in the Sonoma volcanics in the Calistoga area is infiltration of precipitation and seepage from streams on the outcrop area bordering the valley.

Water-level data for wells in the Sonoma volcanics are insufficient to indicate the direction of movement of water in these rocks in this area. The movement, however, probably is toward the south under about the same gradient as that of water in the alluvium.

WATER IN THE HUICHICA FORMATION

Water occurs in the Huichica formation in two areas: near Milliken Creek east of Napa and in the Carneros area west of Napa. The water in the Huichica formation itself is apparently unconfined, but the fine silt and clay composing the formation locally confine water in the underlying Sonoma volcanics.

The source of the water in the Huichica formation is precipitation that falls on the outcrop area and infiltration from streams where they cross the formation. However the permeability of the formation is low and movement of water through the formation is very slow.

Water-level measurements are insufficient to enable drawing water-level contour lines for the Huichica formation.

PUMPAGE

No records of ground-water pumpage in Napa Valley for the period before 1920 are available but the quantity pumped was probably very small. Between 1920 and 1937 the so-called Suscol wells, in the Suscol area south of Napa and north of Suscol, were intermittently pumped for extended periods at a combined rate sometimes exceeding 2.3 mgd (million gallons per day). In later years irrigation became the predominant use of ground water and withdrawals for that use increased greatly. Table 3 shows that the estimated total ground-water pumpage for all uses in the valley in the year 1949–50 was about 5,500 acre-feet. The estimated pumpage for major uses over several years is tabulated and the method of estimation is described below.

TABLE 3.—*Estimate of total pumpage from wells in Napa Valley for the year ended March 31, 1950*

Wells or use of wells	*Total pumpage (acre-feet)*
Suscol wells, water exported	730
Irrigation wells; total number 64	2,900
Napa State Hospital wells	500
Nonirrigation dairy wells, generally pump more than 5,000 gpd each; total number 14	100
Flowing wells	300
Industrial wells	30
Domestic and stock wells, pumps of 3 hp or less, generally less than 1 hp; total number about 2,000	1,000
Total (rounded)	5,500

Pumpage from a group of wells known as the Suscol wells is one of the largest single elements of the total withdrawal. The water is derived entirely from the Sonoma volcanics. Figures for the pumpage for the years ending March 31, 1946–52, assembled by the Geological Survey, were obtained from estimates made by Mr. W. A. Forbes and from records of water metered and sold to the Napa Housing Authority, the Basalt Co., and the California Pacific Utilities Co. Table 4 shows this pumpage for the 7 years, April 1, 1945, to March 31, 1952. The figures are totaled by years ending March 31, so as to keep them comparable to the figures based on Pacific Gas & Electric Co. power records. The method of estimation is described below.

TABLE 4.—*Pumpage from the Suscol wells, Napa Valley, for years ending March 31, 1946–52*

Year	Gallons	Acre-feet	Year	Gallons	Acre-feet
1945–46	62, 300, 000	191	1949–50	238, 000, 000	730
1946–47	70, 200, 000	215	1950–51	49, 700, 000	153
1947–48	63, 200, 000	194	1951–52	53, 400, 000	164
1948–49	191, 000, 000	586			

The methods used for estimating the quantity of unmetered water pumped from wells are indirect. All wells to be known of 5 horsepower or more and a representative group of wells of less than 5 horsepower were examined. The owners for most wells did not know the quantity of water pumped. However, nearly all the wells in Napa Valley are electrically operated. Thus, it is possible to estimate the pumpage by calculating, for each electrically operated pump, the number of kilowatthours required to pump 1 acre-foot of water, and dividing the average value, or energy factor, so obtained into yearly totals of kilowatthours consumed. The Pacific Gas & Electric Co. kindly furnished data on 41 pump-efficiency tests and yearly totals of kilowatthours consumed in the valley by irrigation pumps of 5 horsepower or more for the years ending March 31, 1946–50. The valley was divided into three subareas to allow for differences in energy factors due to differences in pumping lift. The average energy factors derived are 204 kilowatthours per acre-foot for the southern half of Napa Valley, 201 for the northern half, and 253 for the Milliken-Tulucay Creeks area.

The yearly quantity of water pumped, in acre-feet, was determined by dividing the total yearly kilowatthours consumed in each of the 3 subareas by the appropriate energy factor and adding the 3 quantities. Table 5 shows this pumpage for the years ending March 31, 1946–50. In Napa Valley little water is pumped for irrigation from

December through May because of heavy winter and spring rains. Therefore, most of the pumpage listed for a given water year occurred in the previous calendar year. The estimates of pumping may involve some energy consumed for purposes other than irrigation, but the amount is probably less than 5 percent of the total. Pumpage for irrigation by pumps of less than 5 horsepower is small and is included in the estimate for domestic use.

TABLE 5.—*Estimates of pumpage from wells in Napa Valley for irrigation for the years ending March 31, 1946–50*

Year	Kilowatt-hours	Acre-feet	Year	Kilowatt-hours	Acre-feet
1945–46	299, 808	1, 400	1948–49	499, 500	2, 200
1946–47	295, 400	1, 400	1949–50	623, 771	2, 900
1947–48	377, 565	1, 800			

Table 5 shows that the use of ground water for irrigation has more than doubled since 1947. However, this increase may be a little less than it appears. In tabulating the kilowatthours consumed in the early years, 1946 and 1947, some energy consumption for irrigation may have been omitted because some of the irrigation accounts could not be identified owing to changes in meters or ownership.

Other estimates of annual pumpage shown in table 3 were derived as follows: Pumpage from ground water for the Napa State Hospital was estimated by Mr. Sibsee, Napa State Hospital engineer, as about 500 acre-feet. Fourteen wells used largely for washing and cleaning in dairies were assumed to pump at least 5,000 gpd each, for a total estimated as 100 acre-feet. The discharge of all flowing wells was measured or estimated by the Geological Survey and was estimated as about 300 acre-feet. Pumpage for 2 tanneries was estimated as 30 acre-feet. On the basis of the canvass of wells in Napa Valley it was estimated that there were about 2,000 domestic and stock wells with pumps of 3 horsepower or less, most of which are 1 horsepower or less. Total pumpage from these wells is estimated as about 1,000 acre-feet.

FLUCTUATIONS OF WATER LEVELS

All known measurements of water levels in wells in Napa Valley were collected by the Geological Survey. These include measurements by well drillers, well owners, and pump men, by Clark (1919) and Bryan (1932), and by other interested persons. Between September 1949 and March 1952 the Geological Survey made about 1,000 water-level measurements in about 550 wells, made periodic measurements in 44 wells, and operated continuous water-level recorders on 4 wells.

These records show that water levels in wells in Napa Valley are highest in the winter or spring, decline during the summer and fall, and rise sharply during the next winter and spring rains. This cycle is similar, but not identical, for all wells in Napa Valley. It also varies slightly from year to year in the same well. In areas where there is little pumping effect, the records show (wells 7/5–5H1 and 7/5–36N1) that the seasonal fluctuations may be less than 3 feet a year; whereas in some wells affected by pumping (fig. 3) the seasonal fluctuation may be as much as 40 feet in a year. This large range doubtless partly results from the low specific yield and permeability of many of the deposits, and does not mean that a large volume of storage space is created each summer.

For any one well the low point of the seasonal cycle may be so affected by pumping from nearby wells that little information of value can be gained from a fall or low-water measurement. However, a measurement of the spring, or high-water, level may give a true indication of long-term trends of the water body or of annual changes in ground-water storage.

The records collected show that water levels in the younger and older alluvium of Napa Valley have been virtually the same every spring. The longest continuous record is for well 6/4–22P2, which was measured by Mr. Pinkham, the former owner, at the end of every month for 17 years, ending in September 1942. The hydrograph for this well (fig. 2) shows an annual fluctuation in the range between 5 and 21 feet below the land surface, evidently related directly to the rainfall. Rainfall was below normal in the years 1933 and 1934, and in these years the water level showed only a small spring rise. The year of least rainfall for the period of record was 1939. In this year there was no spring rise of water level, but a continuation of the previous year. Early in 1940, a year of more than average rainfall, the water level rose to its highest recorded level. The fluctuation of the water level in the period between November 1949 and March 1952 (table 14 and fig. 2) was within the range of earlier fluctuations.

Comparison of 1949 water levels in 82 wells with earlier water levels in the same wells or comparable wells indicate no significant change since 1918. There may have been some lowering of the pumping levels of wells of large production, but these water levels still recover to their original positions each spring, as indicated by the hydrographs of wells 7/5–16B1 and 8/6–10Q1 (fig. 3).

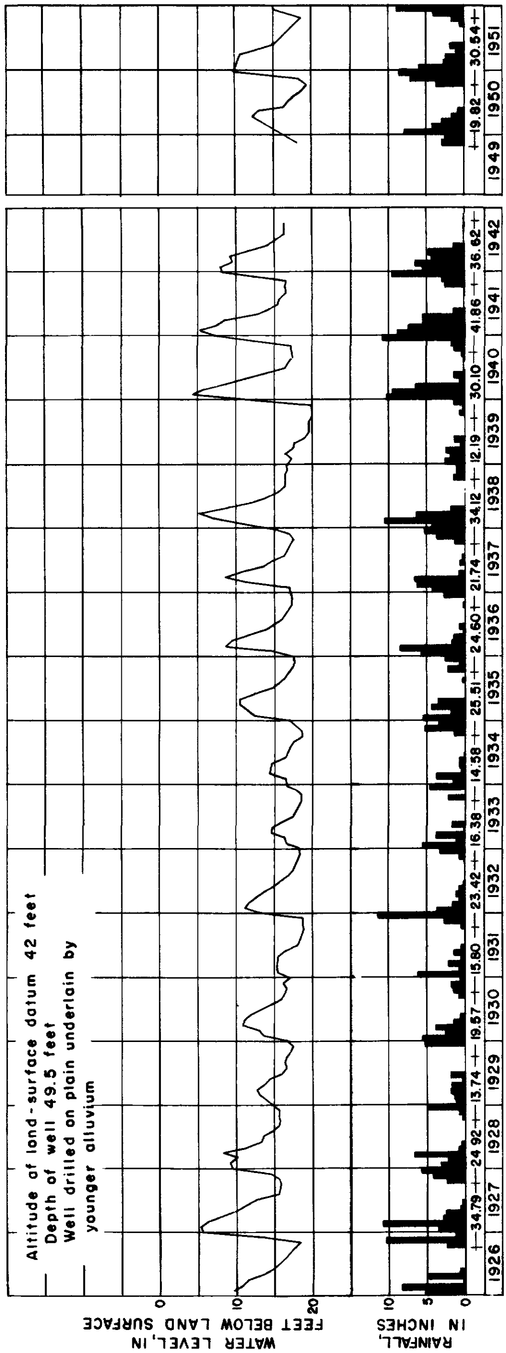

FIGURE 2.—Hydrograph of well 6/4–22P2 in Napa Valley and rainfall at the Napa State Hospital.

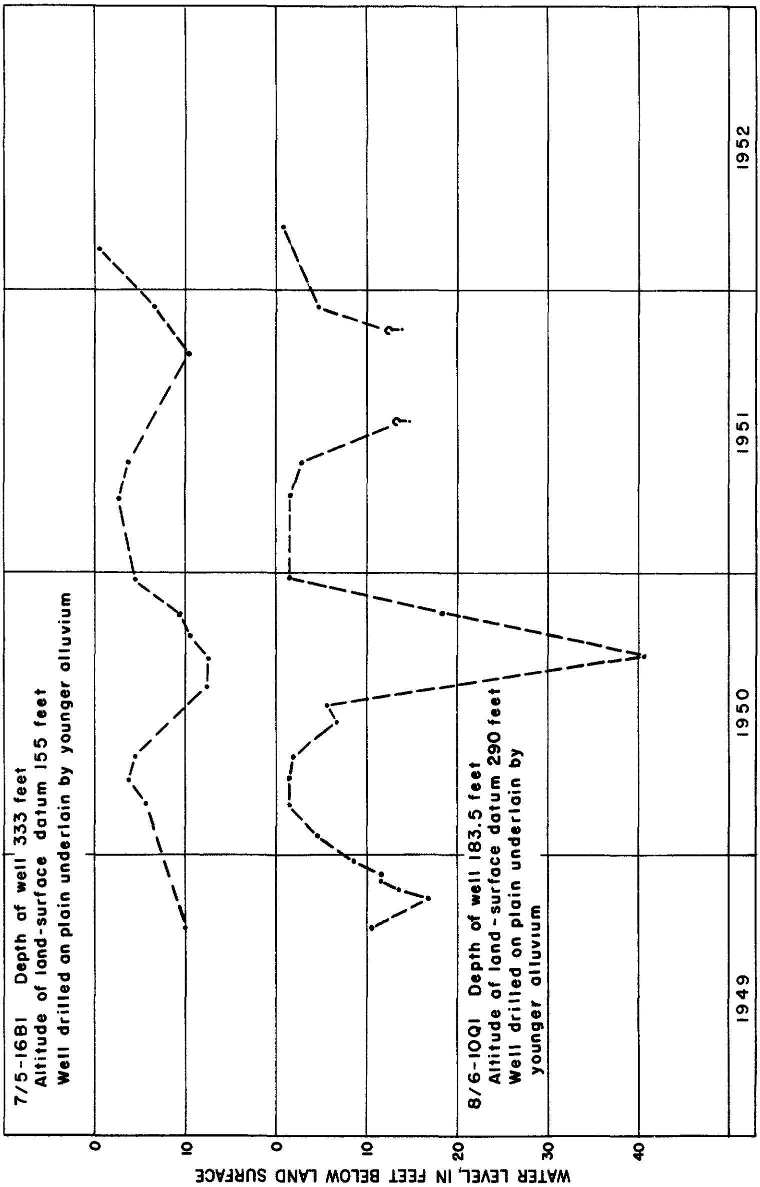

FIGURE 3.—Hydrographs of wells 7/5-16B1 and 8/6-10Q1 in Napa Valley.

In the Sonoma volcanics in the Milliken-Tulucay Creeks area the head of wells has declined since 1918. Few measurements of water levels are available, but reports indicate that the net decline has been generally less than 30 feet. Also there is an annual cycle, the decline being greatest in the summer and fall when the pumping is greatest. No wells in the area now flow all year, as some of them did in 1918; but most of the wells that originally flowed still recover sufficiently in the winter and spring to flow part of the year.

In the Suscol area, water levels in the Sonoma volcanics were originally at, or slightly above, the land surface, but heavy pumping between 1920 and 1937 caused a considerable decline. Bryan (1932) reports the water level of well 5/4–23C2 on April 17, 1930, at 8.63 feet below the land surface or 3.63 feet below sea level, and on September 12, 1931, as 108.85 feet below sea level. The water-level contour map (pl. 4) shows the extent of this "pumping hole" during the winter of 1949–50. The water level in well 5/4–23C2 on December 16, 1949, was 59.65 feet below sea level. In April 1950 the draft on the Suscol wells was greatly reduced (table 4), and by March 1952 the water level in well 5/4–23C2 had risen to 32.82 feet below sea level, a rise of 26.83 feet. During this time the water levels in other wells in the Sonoma volcanics in this area rose between 2 and 23 feet, according to their position in the pumping hole. The water level in well 5/4–16K1, the well farthest from the center, rose least (table 13).

Records of water levels in the Sonoma volcanics in the Calistoga area are few and show no appreciable long-term changes. There has been a reported decline in the temperature of the water from "geyser" wells, and some of the earliest "geyser" wells are reported to have ceased erupting. However, this may be due to a cooling of the volcanic rocks by induced circulation of shallow water to greater depths and may not be significant with respect to water levels.

Pumpage from the Huichica formation has been small and has not affected natural water levels. However, the formation generally has a low permeability, and any pumped well has a large drawdown and slow recovery. For example, on January 26, 1950, the water level in well 5/4–29N2 was 0.9 foot below the land surface, but the owner reported that this well was unused because the drawdown was so great and the recovery so slow that it could not supply domestic needs. The water level in well 5/4–31N2, several hours after pumping on March 27, 1952, was 59.50 feet below the land surface. After 20 hours of recovery the water level was 21.96 feet below the surface.

QUALITY OF WATER

During the fieldwork for this investigation, the Geological Survey collected samples of water for chemical analysis from more than 200

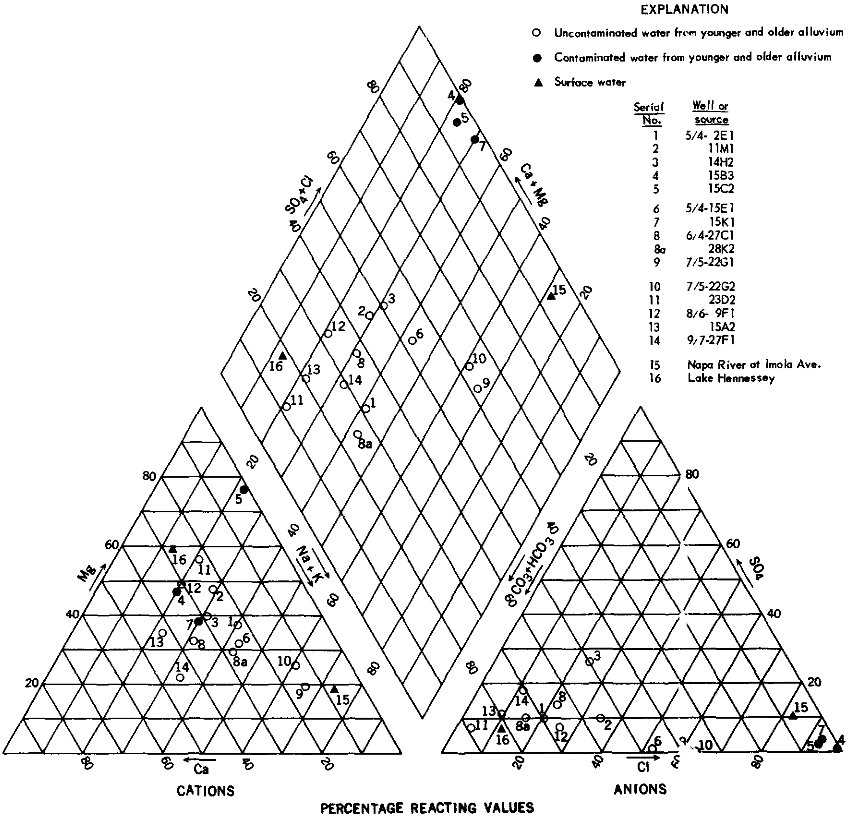

FIGURE 4.—Water-analysis diagram of surface water and water from younger and older alluvium in Napa Valley.

wells and surface sources. Of these, 18 were analyzed for 14 constituents (table 15); the remainder were analyzed only for chloride concentration, hardness, and specific electrical conductance. This last affords an approximate measure of the dissolved solids. Other agencies, provided additional analyses of water from wells and surface sources.

The results of the more complete analyses of 14 samples from the younger and older alluvium, and 2 surface-water samples, are given graphically in figure 4. Figure 5 similarly shows information on 12 samples of ground water from the Sonoma volcanics. These diagrams were prepared by the method described by Palmer (1911) and Piper (1944). Most of this water is of satisfactory quality for most uses. However, the water from several sources differs somewhat, and locally is of poor quality. Some of the differences, together with the information on water of poor quality, are discussed in following sections and are taken up by sources.

YOUNGER AND OLDER ALLUVIUM

Most of the water from the younger and older alluvium is apparently of satisfactory quality—generally good for most uses. Most of the samples analyzed are from the part of the valley north of Napa. These show that the water is somewhat hard and of the bicarbonate type. It has small concentrations of sulfate, chloride, and dissolved solids. Figure 4 shows these features. Older alluvium is included with the younger alluvium here because many wells in the Napa Valley may pass through younger alluvium and enter the older alluvium at depth and obtain water from both. However, wells, such as 5/4–29H1 on the west side of the valley and 5/4–14H2 on the east side, that begin in older alluvium obtain no water from younger alluvium. Here the water of the older alluvium alone apparently is of good quality. At least it only has a small chloride concentration.

In one small area north of Napa, and in a somewhat larger area including part of the city of Napa and a part of the younger alluvial plain to the south, the ground water from these deposits, mostly the younger alluvium, is of poor quality.

At a locality northeast of Oakville, wells 7/5–22G1 and 7/5–22G2 are reported by the owner to be drilled for their entire depth in alluvium. These wells are 56 and 40 feet deep, respectively, and are 40 feet apart. The analyses of water from these wells (table 15) show chloride concentrations of 270 and 30 ppm and boron concentrations of 14 and 15 ppm. Not only is the chloride content unusually large, but the boron content also is so great that the water would be unfit for irrigation of most crops. Two other wells in this same general area, 7/5–9M1 and 7/5–26D1, have chloride concentrations of 57 and 40 ppm, respectively. These concentrations, though moderate, are somewhat higher than usual for water from the younger alluvium.

Water from well 7/5–22P1 about 1 mile to the southwest, at Oakville, had 8.5 ppm of boron, according to an analysis by the University of California in January 1942. This was an irrigation well, reported to be 510 feet deep, but is now unused because of the boron. No log is available for this well, and the source of the boron-bearing water is not known. A reasonable explanation would be that the water comes from some depth, in the underlying volcanic rocks, and that this deep water is moving upward into the alluvium in the area.

At several other localities farther north in Napa Valley water having a relatively large chloride content occurs in the alluvium. In the area just northwest of Calistoga, water from well 9/7–25M1, 149 feet deep, had 190 ppm of chloride. Water from well 9/7–26P1, 17.5 feet deep, had 37 ppm of chloride in May 1951. According to University of California analyses in 1948 and 1949 (table 15), water from this well had 115 and 135 ppm of chloride, respectively. The reason for the difference between 1951 and the earlier years is not known. However, adjoining deeper wells (9/7–2R2 and 2R3) that penetrate the Sonoma volcanics also had high chloride concentrations. Well 26R3 is a flowing well, and the discharge may have leaked into the shallow aquifer at times so as to increase the chloride content of the water.

In the tidal marsh area south of Napa and in the alluvial plain along the Napa River in and south of Napa—both areas underlain mostly by younger alluvium—the chloride content of the water is relatively high under what apparently are two sets of conditions.

First, analyses of water from 11 wells that penetrate the younger alluvium in T. 4 N., R. 4 W., and T. 5 N., R. 4 W., have chloride concentrations ranging from 28 to 166 ppm. Plotting this concentration against depth indicates a rough correlation. For example, well 5/4–2M1, yielding water having 28 ppm of chloride, is 25 feet deep, and well 4/4–16E1, having 145 ppm, is 306 feet deep. Well 4/4–9C2, whose water has 166 ppm of chloride, is deeper than 200 feet by an unknown amount. Water in 2 wells, 5/4–15C1 and 15C2, reportedly taken from depths of about 80 and 66 feet, has 174 and 158 ppm of chloride, respectively. These 2 wells, however, were originally somewhat deeper, and reportedly yielded saltier water from the greater depths. An explanation for this fact is offered below.

One possible reason for the apparent general increase in chloride concentration down to depths of at least 306 feet is that the younger alluvium in this area was deposited in brackish water of San Pablo Bay, which originally may have extended north to, and perhaps beyond, Napa, and the salty water is at least partly connate. As the deposits were built up above bay level, continuing and subsequent infiltration of rainfall caused the uppermost layers to become saturated with comparatively fresh water. This is particularly true in the northern part of the reach where the Napa River is now entrenched as much as 10 or 20 feet into the alluvium. In that way a transition zone would be formed from fresh water at the top to saltier water below.

One exception seems to exist. Well 4/4–7A1 is reported to be 54 feet deep, and the water had a chloride concentration in March 1951 of 2,020 ppm (see table 16, p. 158).

The second set of conditions is that involving wells of noticeably high chloride concentration in Napa and along the Napa River. The wells, chloride concentrations, and depths are listed below.

Well	Chloride (ppm)	Depth (feet)	Remarks
5/4-15B2	2,440	125	
15B3	1,700	50	
15C1	2,840	100	When drilled.
15K1	3,680	1,168	
27Q1	2,620	600	Salt reported to be within top 115 ft. Drilled in 1920.

Four of these wells are in sec. 15, T. 5 N., R. 4 W., near the south edge of the Napa city limits. Three of them are 125 feet deep or less, and one is 1,168 feet deep. Well 5/4-27Q1 also is deep. However, it is reported that, when the well was drilled in 1920, the water in the top 115 feet of deposits was salty. Thus, it is possible that the casing is rusted through and the salty water is now coming from shallow depth. It seems possible that the salty water in well 5/4-15K1 also may be coming similarly from shallow depth through faulty casing. Well 27Q1 is just adjacent to the brackish reach of Napa River, and well 15K1 is not far away. That salty water may come from the nearby Napa River under present conditions is exemplified by well 5/4-22B1. This well, 13 feet deep, is about 125 feet from the river. The well draws on the ground-water body, but when the pumping level is lowered sufficiently, water is also drawn into the well from the Napa River. Therefore, in the spring of the year when the fresh ground-water head is high, and the water in the Napa River has little chloride, this well is used for irrigation. Later in the year the fresh water is depleted by pumping, and, as the flow of the Napa River decreases, brackish water backs up from San Pablo Bay. Consequently, by midsummer the water in this well becomes too brackish for irrigation.

The other wells may be drawing salty connate water that was trapped in the sediments, as postulated for the area farther south, but simply has been diluted less by subsequent rainfall. However, the analyses for wells 5/4-15B3 and 15K1, when plotted on the trilinear graph of figure 4, do not appear near the right-hand corner of the central diamond, which is where the analyses for sea water would plot. Therefore, the contaminant probably is not sea water, or at least not unmodified sea water. Five abandoned wells at 5/4-10P1-5, which were respectively 147, 198, 193, 300, and 293 feet deep, and were drilled sometime before 1918, are known to have produced as much as 1,000 gpm of fresh water. This was the original supply for the city of Napa. Between 1918 and 1930 these wells were abandoned and destroyed because the water became too salty to use. This salty water was drawn in either from the Napa River or from deeper zones of salty water, and evidently created a zone of contamination in the deposits.

In 1949, well 5/4–15C2 was drilled to a depth of 86½ feet, and in 1950 well 5/4–15C1 was drilled to 100 feet. Salty water was found in both wells. When the lower parts of the holes were sealed off to present depths of 66 and 80 feet, respectively, the wells yielded water of usable quality, but apparently still of considerable chloride content. (See analysis in table 15.) Wells 5/4–10P1–5 just to the north had not been pumped for more than 20 years; therefore, the comparative freshness of the water (174 and 158 ppm of chloride) may result from flushing and dilution by rainfall infiltration since 1930. On the other hand, the area on the trilinear graph in which the analyses for wells 5/4–15B3, and 15C2, and 15K1 plot is about the same as that in which the analyses for well 5/3–6J1 plot on figure 5. This well seems to obtain water from diatomaceous "tule mud" in the Sonoma volcanics, which may be old connate water. Thus, the contaminated water in sec. 15, T. 5 N., R. 4 W., pumped by wells 15C1 and 15C2, may be connate water from the Sonoma volcanics brought up from below and not from the Napa River or from the alluvial deposits.

To summarize what seems to be the quality of water in the younger alluvium, good water can be obtained in most parts of the area, particularly in the part of the valley north of Napa. However, even in that area there are local areas of chloride-bearing water (perhaps with boron) that probably originates from beneath the Sonoma volcanics and rises along faults or joints. Not enough information is available to provide any systematic explanation for the occurrences.

In and south of the city of Napa, water of moderate chloride concentration occurs down to depths of at least 300 feet. There is some suggestion that the water of least chloride content is shallowest; however, wells situated close to tidal sloughs may yield water containing as much as 2,000 to 3,000 ppm of chloride if they are pumped heavily, particularly at times of low fresh-water flow in the Napa River.

Finally, in an area in secs. 10 and 15, T. 5 N., R. 4 W., in Napa, a zone between about 80 and 300 feet has been contaminated by water having a chloride concentration between 1,000 and 3,000 ppm; this water may have originated as connate water in the Sonoma volcanics. Here, water of usable quality apparently occurs above a depth of about 65 feet. Probably heavy withdrawal in this area would produce water higher in chloride, however.

SONOMA VOLCANICS

Ground water in the Sonoma volcanics is of good quality at most places. Complete chemical analyses (table 15) of uncontaminated

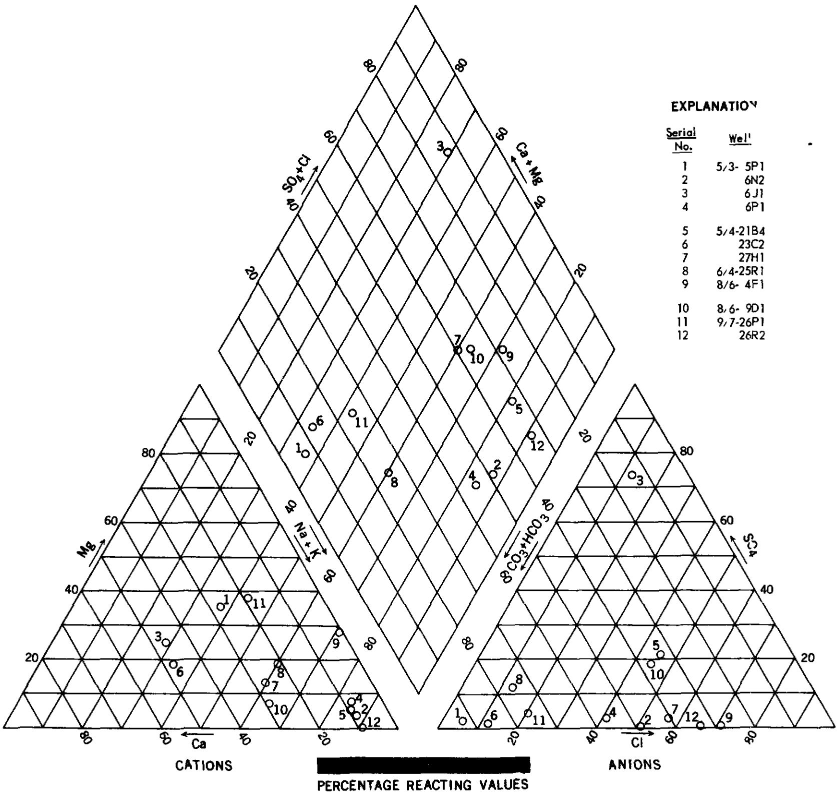

FIGURE 5.—Water-analysis diagram of water from the Sonoma volcanics in Napa Valley.

waters indicate that they are relatively low in sulfate (SO_4), calcium (Ca), and magnesium (Mg) and are satisfactory for most uses. Analyses for wells 5/3–5P1, 5/4–23C2, 6/4–25R1, and 9/7–26P1, plotted on figure 5, are typical. The partial analyses given in table 16 for water from the Sonoma volcanics indicate that the normal chloride concentration is not more than about 40 ppm. In general, dissolved solids and the percent sodium (Scofield, 1933) are higher in this water than in that from the younger and older alluvium. Nevertheless, it is satisfactory for irrigation and domestic use.

In three areas, water from the Sonoma volcanics is contaminated, or of poor quality for one reason or another. These areas are (a) in the drainage basin of Tulucay Creek east of Napa, (b) in the vicinity of Suscol south of Napa, and (c) in the northern part of Napa Valley near Calistoga.

Tulucay Creek.—In secs. 5 and 6, T. 5 N., R. 3 W., and in sec. 13, T. 5 N., R. 4 W., several wells have produced water of poor quality. Wells 5/3–5M2, 5N2, 5N3, 6M2, 6N1, and 6N2 produce water reported to have a high iron content or a strong "sulfur" odor or taste, or both iron and "sulfur." These wells range from 65 to 205 feet in depth, and, according to drillers' logs, they obtain water from beneath diatomaceous beds of the Sonoma volcanics. Water from wells 5/3–6N2 and 6P1 had 18 and 8 ppm of boron, respectively; water from wells 5/3–6H1, 6J1, and 5/4–13G2 had 301, 25, and 140 ppm of chloride, when analyzed after 1948.

The details of well construction, material penetrated, and conditions under which samples were taken are not sufficiently well known to permit a sure identification of the source of the poor-quality water or even to be certain of the number of kinds of water involved. Based on the water-analysis diagram (fig. 5), the water from wells 5/3–6N2 and 6P1 appear to be of the same kind. Most of the others may be the same. But the analysis of water from well 5/3–6J1 plots in an entirely different area. Also, although the water is of poor quality because of high sulfate, its chloride content is low.

The owner of well 5/3–6H1 reports that the quality of the water was satisfactory after the well was deepened from 150 to 280 feet and the upper 150 feet of material was sealed off. The chloride concentration changed from 301 to 25 ppm. No log of this well is available, but it starts in diatomite. The log of well 5/3–6J1 (table 17), a short distance to the southeast, shows that in the top 85 feet this well penetrated soil, diatomite, and "tule mud." The material from 85 to 150 feet is undescribed but probably is tuff. Water from well 5/3–6J1 has a large sulfate content and appreciable chloride; at times, both waters have a low pH. Thus, it is suggested that the water of poor quality occurs in the diatomite and "tule mud," and that the quality is related to conditions under which the material was laid down and to later chemical interactions.

Note that water from wells 5/3–6N1 and 6N2, which are drilled into and below diatomite, has an appreciable chloride content, as does that from wells 5/3–7L1 and 7M1, also in the diatomite area.

Many property owners report that water from wells along Milliken and Tulucay Creeks has a large iron content which causes excessive discoloration of plumbing fixtures and laundry. The "tule mud," reported in some areas, seems to impart an odor and taste of decaying vegetation to the water.

Suscol area.—In this area, most of the deep wells that pass through the alluvium and obtain water in the Sonoma volcanics produce good water. For example, water from well 5/4–26B1, 1,440 feet deep, had 32 and 19 ppm of chloride on different dates. Wells 5/4–26E1 and 27A1, 806 and 795 feet deep, respectively, also produce good water. The casings of these wells are set in cement or concrete to a depth of more than 300 feet, and the wells draw water only from the

Sonoma volcanics. Well 5/4–27H2, 860 feet deep, produced water having reportedly (table 16) 88 ppm of chloride in July 1949 and 26 ppm in January 1950. This well is adjacent to the Napa River. The variation in chloride content may indicate that salty water from either the river or the alluvial deposits occasionally leaks into the well through breaks in the casing. Water from well 5/4–15K1, 1,168 feet deep, had 3,650 ppm of chloride in September 1946 and 3,680 ppm in February 1951 (table 15). These high concentrations may result from the introduction of salty water from the shallow deposits in the alluvium, or possibly from salty water that has leaked into the volcanic rocks through other wells whose casings are not tight where they pass through shallow deposits.

On the other hand, this explanation may not account for the quality of the water in well 5/4–27H1. The analysis of this water plots on figure 5 in the same general area as the analyses for water from wells 8/6–4F1 and 9D1, which are in the northern part of Napa Valley, a long distance from the present bay. Thus, there is a strong likelihood that some zones of water having appreciable chloride content normally occur deep within the volcanic rocks in the Suscol area. If the analyses for wells 5/3–5P1, 5/4–23C2, and 9/7–26P1 (Nos. 1, 6, and 11 in fig. 5) represent uncontaminated water of the Sonoma volcanics, then the analyses for wells 5/4–27H1, 8/6–4F1, and 8/6–9D1 (Nos. 7, 9, and 10 in fig. 5) plot, on the trilinear graph, about on a line between the area of this uncontaminated water and the place where sea water would plot. Thus, these waters having a few hundred parts per million of chloride may be mixtures of fresh water and unmodified connate water in certain zones in the volcanics. (See Piper and others, 1953, fig. 18 and related text discussion, p. 135–138.) They may not result from contamination from the present bay.

A few wells that penetrate the Sonoma volcanics on higher ground west and northwest of Suscol also produce water somewhat high in chloride. These wells are: 5/4–16K1, 5/4–21B3, 21B4, 21B6, and 21K1. They are all at the western side of the valley, east of a body of Tertiary sedimentary rocks which yield salty water to wells. The logs of several of these wells, such as 5/4–21K1, suggest that they penetrate marine sedimentary rocks of Tertiary age in the lower few feet or tens of feet. The salty water probably originates from connate water in these marine rocks.

Water from certain other wells in this area, for example 5/4–12J1 and 13G2, has shown chloride concentrations somewhat higher than most water in the Sonoma volcanics, at least at times. Well 5/4–12J1 penetrates "tule clay" between 82 and 111 feet and may obtain connate salty water from those beds. These data lend further support to the possibility that there may be zones of unusually saline water deep within the Sonoma volcanics.

Calistoga area.—Wells drilled into the Sonoma volcanics in the Calistoga area are generally satisfactory for domestic use and irrigation. However, water from a few wells is unsatisfactory for irrigation. The analysis (table 15) of water from well 9/7–26R2, 320 feet deep, northwest of Calistoga, shows a boron concentration of 11 ppm, enough to be toxic to most plants if used for irrigation. Water from this well also has about 190 ppm of chloride, as does that from well 9/7–26R3. Likewise, water from wells 9/7–25N1, 26G1, and 26K1 has chloride concentrations ranging from 190 to 226 ppm, and may also contain boron. The water in many of these wells is hot and flows, or erupts as from geysers. It seems likely that the chloride- and boron-bearing water comes up from considerable depths, perhaps from rocks even deeper than the Sonoma volcanics.

Boron is present in water from wells 8/6–9D1 and 9/7–26P1 (table 15), southeast of Calistoga, but in amounts small enough that the water is usable for irrigation. Boron probably is present, but undetected, in water from other wells. The chloride concentration of water from wells 9/6–4F1 and 9/6–9D1 was 270 and 95 ppm, respectively.

HUICHICA FORMATION

Water in the Huichica formation generally is usable for domestic purposes and for irrigation but is not so good as most water from the younger and older alluvium. Comprehensive analyses have been made for water from wells 4/4–5C1 and 6/4–25F1, and chloride determinations have been made for water from these wells and from six others. Most of the wells are in the area southwest of Napa, but two are between Sarco and Milliken Creeks northeast of Napa.

The chloride concentration is less than 80 ppm in all but 1 sample. Water from well 5/4–31N1 had 161 ppm of chloride, which is unusual, but not too high for most uses. The source is unknown. Water from well 4/4–5C1 had 185 ppm of nitrate. This water is satisfactory for irrigation but is undesirable for domestic use. The nitrate in this water may be derived either from a zone of "tule mud" or from surface contamination.

MARINE FORMATIONS

At appreciable depths, water obtained from the pre-Sonoma rocks is ordinarily of poor quality. For example, water from well 5/4–5Q1, which penetrates shale of Cretaceous or Jurassic age, has 2,800 to 3,200 ppm of chloride and 11 of boron; from well 5/4–17F1, which penetrates the Capay shale, 3,970 ppm of chloride and 31 of boron; and from wells 5/4–30B2 and 30R1, which penetrate the Neroly sandstone, appreciable chloride. In shallow wells, such as 5/4–19J2 and 5/4–19L1, which penetrate the older Tertiary marine sandstones, the salty water has evidently been flushed out. (See table 16.) However, in wells that penetrate the same rocks to greater depths (5/4–30B2, 570 feet, and 30R1, 1,400 feet in the Neroly sandstone), the chloride concentration increases with depth—254 and 559 ppm, respectively.

As has been discussed, a few wells, such as 5/4–21B4 and 21K1, penetrate shale of Tertiary age beneath the Sonoma volcanics and obtain water of appreciable chloride concentration.

GROUND-WATER STORAGE CAPACITY

One of the objectives of the Napa Valley investigation was to estimate the ground-water storage capacity of the area. Although the prealluvial formations underlie a large area outside the main valley plain, the estimate of storage was made only for the area underlain by the younger and older alluvium (pl. 2). The alluvial deposits of tributary streams were omitted because they are thin and do not store appreciable quantities of water. Storage capacity was not calculated for the Huichica and Glen Ellen formations because these formations are composed predominantly of fine-grained material of low specific yield, and most wells tapping them have small yields. Some of the wells in the tuff and pumice of the Sonoma volcanics have large yields, but the water in these materials is generally confined and little storage capacity is available until they are dewatered. Storage capacity was not calculated for formations older than the Sonoma volcanics because these formations are generally non-water-bearing or contain connate sea water. Also, no storage capacity was calculated for the area of the tidal sloughs, because the water in these areas is brackish or subject to salt-water contamination.

In general, storage was computed for the volume between the average depth to water of 10 feet (15 feet in Sonoma Valley) to 200 feet below the land surface. Beneath most of Napa Valley this zone was divided into 3 depth zones, as follows: 10 to 50, 50 to 100, and 100 to 200 feet below the land surface. These depth zones correspond to those used by the Geological Survey for computing storage capacity in other northern California valleys that contain thick bodies of water-bearing alluvial deposits.

Some cyclic dewatering of deposits within the zone above a depth of 50 feet takes place by pumping from wells under the present development. Part of the zone from 50 to 100 feet probably could be dewatered under present economic conditions. The zone from 100 to 200 feet represents the deepest storage space whose utilization under conditions of full development might be considered.

METHODS OF COMPUTATION

Ground-water storage capacity depends on two factors: volume of material that is or can be saturated and the specific yield of the material. Fundamentally, the method of determining storage capacity is to multiply the volume of saturated material by the estimated specific yield.[3] The same basic method was used to estimate the ground-water storage capacity of the San Joaquin Valley, Calif. (Davis and others, 1959).

Estimates of the volume of saturated material and its specific yield are based on a field study of the water-bearing deposits (the geology), a study of about 500 drillers' logs, and measurements of water level in several hundred wells. The actual calculation of storage capacity was based on 190 logs drilled in the younger and older alluvium of Napa Valley (table 17).

Volume.—For volume approximations, contour lines within the younger and older alluvium were drawn at 10, 50, 100, and 200 feet below the land surface to outline the 3 depth zones. The volume of each depth zone was calculated at the product of the thickness of the zone and the average of the areas of the top and bottom of the zone. This assumes an even slope for the edges of each depth zone. Actually the slopes may not be uniform, but in Napa Valley the logs are insufficient in number to determine the true slope. The assumption is considered to afford a fair approximation of the true slope, and the best one possible.

Where the younger and older alluvium is more than 200 feet thick, storage is computed for all 3 depth zones—10 to 50, 50 to 100, and 100 to 200 feet below the land surface. In unit 3 of Napa Valley on plate 5, the storage is estimated only for the 10 to 50-foot zone, because of the lack of logged wells deeper than 50 feet. Also, from geologic considerations, it is believed that the depth to bedrock is not more than 50 feet in most of the unit.

The alluvial plain of Napa Valley was divided into five areas called ground-water storage units in order to apply specific-yield factors. These areas are shown on plate 5. These subdivisions are

[3] Meinzer (1923b, p. 28) defines specific yield as follows: "The specific yield of a rock or soil, with respect to water, is the ratio of (1) the volume of water which, after being saturated, it will yield by gravity to (2) its own volume. This ratio is stated as a percentage and may be expressed by the formula $Y = 100\ (y/V)$, in which Y is the specific yield, and y is the volume of gravity ground water in the rock or soil, and V is the volume of the rock or soil."

based on the similarity of geology, physiography, soils, and distribution of wells.

Ground-water storage unit 1 comprises the alluvial deposits north of Napa Creek and south of Yountville. Calculations of specific yield (table 8) were made on the basis of 93 (or fewer)[4] well logs. This is the area of best control.

Ground-water storage unit 2 comprises the large alluvial area from Yountville to the north edge of St. Helena; the average specific yield was estimated from 28 (or fewer) well logs. The figure is not considered so accurate as that for unit 1.

Ground-water storage unit 3 comprises the alluvial area north of St. Helena. Calculations of average specific yield values for this unit were made on the basis of 6 well logs. At best, the results for this area are only crude approximations.

Ground-water storage unit 4 comprises the area from Napa Creek south to a line north of but parallel to Imola Avenue. It includes a part of the tidal area along the Napa River extending northward a quarter of a mile beyond Trancas Avenue. Most of this area is free of chloride contamination, but any intensive development of ground water in this area presumably would eventually lower the water table sufficiently to induce infiltration of the brackish water from the Napa River.

Unit 4 is relatively small, so that the specific-yield values, based on 39 well logs, are believed by the writers to be reasonably correct. Of the 39 (or fewer) logs used, 14 are from wells in ground-water storage unit 1. Using these logs for ground-water storage, unit 4 is justified, because the wells are on the same alluvial fan that extends into unit 4, and the logs indicate similar material. This unit is similar to unit 1, but is differentiated because of the possibility of chloride contamination.

Ground-water storage unit 5 extends south of unit 4 to the bedrock narrows at Suscol. Numerous wells in this unit pump water contaminated by the brackish water from the Napa River. Continued development of ground water is already impractical, unless all the contaminated water is cased off and fresh water withdrawn from the underlying formations. The relationships are still imperfectly understood, but connate sea water may, in part, be the source of some of the chloride. The source of the chloride contamination must be considered in any further use of water in this area. The average specific-yield figures for this area are based on information from 28 (or fewer) logs. The detail of the material logged in some of these

[4] Table 8 shows 93 well logs in the 10- to 50-foot zone, 87 well logs in the 50- to 100-foot zone, and 55 well logs in the 100- to 200-foot zone. The reason for the decrease in number of logs with depth is that not all wells in the upper zones penetrate the underlying ones. Conversely, all wells in the deeper zones do penetrate the overlying ones.

wells is poor; the results for this area, therefore, are not considered very accurate.

The volume for each of the storage units in Napa Valley was calculated for each depth zone by multiplying the average area of each by its thickness. Table 6 shows the area of the alluvium at various depths below the land surface, and table 7 shows the volume for the three depth zones.

TABLE 6.—*Area of younger and older alluvium in Napa Valley, in acres, at 0, 10, 50, and 100 feet below land surface*

[Results rounded to two significant figures]

Storage unit	Area at—				
	Outcrop	10 feet	50 feet	100 feet	200 feet
1	15, 000	14, 000	11, 000	10, 000	9, 500
2	17, 000	14, 000	12, 000	10, 000	7, 700
3	8, 000	5, 700	(1)	(1)	(1)
4	3, 000	2, 600	2, 400	2, 200	1, 700
5	4, 000	3, 400	3, 000	2, 600	1, 800
Total 47,000		39, 000	28, 000	25, 000	21, 000

[1] Area very small or lacking entirely.

TABLE 7.—*Estimated volume of younger and older alluvium in Napa Valley, in acre-feet, for depth zones of 10–50, 50–100, and 100–200 feet*

[Results rounded to two significant figures]

Storage unit	10–50 feet	50–100 feet	100–200 feet
1	500, 000	520, 000	970, 000
2	520, 000	550, 000	880, 000
3	200, 000		
4	100, 000	110, 000	190, 000
5	130, 000	140, 000	220, 000

Specific yield.—Estimates of specific yield were made by classifying the materials in the younger and older alluvium, as reported in drillers' logs, into groups, and assigning a specific-yield value to the material in each group. In the drillers' logs, gravel, sand, clay, and volcanic rocks are usually identified. The more complete logs mention the color, coarseness of grain, hardness, degree of cementation, and other characteristics readily related to the formations or lithologic types. The drillers' terms were grouped into five general classes of material of similar water-bearing properties, as follows: (a) Gravel; (b) sand, including sand and boulders; sand and gravel; and sand, gravel, and boulders; (c) clay and gravel, including sand and clay; clay, sand, and gravel; and similar material; (d) clay with gravel, clay and boulders, cemented gravel or sand, and similar material, (e) clay, and other material of low yield.

It was not feasible in this investigation to attempt to make field determinations of the specific yield of the different types of water-bearing material. Therefore, an estimated specific-yield value was assigned to each of the five general classes of material on the basis of available data. These values are the same as were applied in the Sacramento Valley investigation (Poland and others, 1951, p. 625) on the basis of the work of Eckis (1934) and Piper and others (1939), and are applied to the same classes of material as nearly as could be determined from the drillers' logs. The names of the materials included in each group are those commonly used and listed by drillers in the area.

Class of material	*Specific yield (percent)*
Gravel, boulders, gravel and boulders	25
Sand; sand and boulders; sand and gravel; sand, gravel, and boulders; water	20
Clay and gravel alternating; clay, gravel, and water; clay and sand; clay, sand, and gravel; clay and gravel, sandy; clay, sandy, and boulders; gravel and sandstone; sandy loam; sand, gravel, boulders, and clay mixture; sand, gravel, boulders, and some clay; sand and hard gravel; sand and rock; some water	10
Clay with gravel; cemented conglomerate; cemented gravel; cemented sand, gravel, and clay; cemented sand and boulders; clay and boulders; clay, gravel, no water; clay and gravel; clay with gravel; clay and rock; sandy clay; clay with sand; gravel, boulders, and clay; hard gravel [cementing assumed]; dry gravel [cementing assumed]; hardpan and boulders; loam; dry sand [cementing assumed]; sandrock; sandstone	5
Clay; clay and soil; hardpan; hardpan and clay; broken rocks; rocks; rock(s), water; soil; surface; tule mud	3

To determine the average specific yield for each depth zone in each ground-water storage unit, the thickness, in feet, of each class of material in each depth zone was totaled. These thicknesses were converted to percentages of total thickness of all the materials in each zone; and these percentages were multiplied by the specific-yield value assigned to the particular class of material. The sum of these products is the average specific yield for each depth zone. In other words, the various specific yields are prorated according to the relative thickness of the material that has each specific-yield value.

Table 8 shows the number of well logs used in the calculation of average specific yield, the amount of material classified in each depth zone, and the average specific yield for each depth zone. If future work makes possible a more accurate determination of specific yield for the different classes of material, the average specific yield can be recalculated readily.

Storage capacity.—The ground-water storage capacity of each storage unit is computed by multiplying the volume in each depth zone (table 7) by the average specific yield determined for that depth zone (table 8). Table 9 summarizes the ground-water storage for each of the depth zones for all units.

TABLE 8.—*Average specific yield of depth zones and ground-water storage units, Napa Valley*

[Italic numerals in first column give the depth zones, in feet]

	Class of material according to specific yield, in percent, assigned						Number of logs in zone [1]
	25	20	10	5	3	Total	
Ground-water storage unit 1							
10–50							
Thickness feet	269	74	208	1,108	1,731	3,390	93
Percent of total thickness	7.9	2.2	6.1	32.7	51.1	100.0	
Portion of average specific yield	1.98	0.44	0.61	1.64	1.53	6.2	
50–100							
Thickness feet	317	80	238	1,110	2,029	3,774	87
Percent of total thickness	8.4	2.1	6.3	29.4	53.8	100.0	
Portion of average specific yield	2.10	0.42	0.63	1.47	1.61	6.2	
100–200							
Thickness feet	240	25	305	1,379	1,554	3,505	55
Percent of total thickness	6.8	0.7	8.7	39.4	44.4	100.0	
Portion of average specific yield	1.70	0.14	0.87	1.97	1.33	6.0	
Ground-water storage unit 2							
10–50							
Thickness feet	98	37	45	392	455	1,027	28
Percent of total thickness	9.5	3.6	4.4	38.2	44.3	100.0	
Portion of average specific yield	2.38	0.72	0.44	1.91	1.33	6.8	
50–100							
Thickness feet	43	41	26	472	374	956	22
Percent of total thickness	4.5	4.3	2.7	49.4	39.1	100.0	
Portion of average specific yield	1.12	0.86	0.27	2.47	1.17	5.9	
100–200							
Thickness feet	19	0	65	298	295	1,307	17
Percent of total thickness	1.4	0	5.0	71.0	22.6	100.0	
Portion of average specific yield	0.35	0	0.50	3.55	0.68	5.1	
Ground-water storage unit 3							
10–50							
Thickness feet	16	5	0	105	79	205	6
Percent of total thickness	7.8	2.4	0	51.2	38.6	100.0	
Portion of average specific yield	1.95	0.48	0	2.56	1.16	6.1	

See footnote at end of table.

TABLE 8.—*Average specific yield of depth zones and ground-water storage units, Napa Valley*—Continued

	Class of material according to specific yield, in percent, assigned						Number of logs in zone [1]
	25	20	10	5	3	Total	
Ground-water storage unit 4							
10–50							
Thickness feet	57	34	79	307	969	1,446	39
Percent of total thickness	3.9	2.4	5.5	21.2	67.0	100.0	
Portion of average specific yield	0.98	0.48	0.55	1.06	2.01	5.1	
50–100							
Thickness feet	250	20	80	390	843	1,583	36
Percent of total thickness	15.8	1.3	5.1	24.6	53.2	100.0	
Portion of average specific yield	3.95	0.26	0.51	1.23	1.60	7.5	
100–200							
Thickness feet	225	33	71	351	951	1,631	23
Percent of total thickness	13.8	2.0	4.4	21.5	58.3	100.0	
Portion of average specific yield	3.45	0.40	0.44	1.08	1.75	7.1	
Ground-water storage unit 5							
10–50							
Thickness feet	69	39	49	499	432	1,088	28
Percent of total thickness	6.3	3.6	4.5	45.9	39.7	100.0	
Portion of average specific yield	1.58	0.72	0.45	2.30	1.19	6.2	
50–100							
Thickness feet	263	14	8	554	466	1,305	28
Percent of total thickness	20.1	1.1	1.3	41.8	35.7	100.0	
Portion of average specific yield	5.02	0.22	0.13	2.09	1.07	8.5	
100–200							
Thickness feet	102	10	216	721	560	1,609	23
Percent of total thickness	6.4	0.6	13.4	44.8	34.8	100.0	
Portion of average specific yield	1.60	0.12	1.34	2.24	1.04	6.3	

[1] In each ground-water storage unit the number of logs in each zone decreases with depth because not all wells penetrate all the zones, but they all enter the uppermost zone.

LIMITATIONS OF THE METHODS

Calculations of ground-water storage is a straightforward procedure, but the data used are not precise. In the first place, all the calculations are based on drillers' logs. Most of these were copied from drillers' record books and are reliable so far as they indicate what the driller saw, but the entries give only generalized statements as to grain size, sorting, and slight changes in lithology. Second, computation of the volume of the alluvium is based on the average area of the depth zones, which in turn is based on a contour map of the prealluvial surface constructed from drillers' logs and geologic mapping. Bedrock is usually correctly identified and reported in the logs by drillers, but the number of logs may be few or their distribution erratic in any one area. The result is a generalized bedrock-contour map which may be incorrect in detail. In general, the fewer the logs in a unit the greater is the possibility of error in the volume of that unit.

TABLE 9.—*Estimated gross ground-water storage capacity of the younger and older alluvium in Napa Valley, in acre-feet*

[All data rounded to two significant figures]

Ground-water storage unit	Storage capacity for indicated depth zones									Gross storage (acre-feet)
	10–50 feet			50–100 feet			100–200 feet			
	Volume (acre-feet)	Average specific yield (percent)	Storage (acre-feet)	Volume (acre-feet)	Average specific yield (percent)	Storage (acre-feet)	Volume (acre-feet)	Average specific yield (percent)	Storage (acre-feet)	
1	500,000	6.2	31,000	520,000	6.2	32,000	970,000	6.0	58,000	120,000
2	520,000	6.8	35,000	550,000	5.9	32,000	880,000	5.1	45,000	110,000
3	200,000	6.1	12,000							12,000
Subtotal			78,000			64,000			100,000	240,000
4	100,000	5.1	5,000	110,000	7.5	8,000	190,000	7.1	13,000	26,000
5	130,000	6.2	8,000	140,000	8.5	12,000	220,000	6.3	14,000	34,000
Subtotal			13,000			20,000			27,000	60,000
Gross storage			91,000			84,000			130,000	300,000

Third, the greatest single source of error in the calculations lies in the interpretation of classes of material from the drillers' logs, and the application thereto of values for specific yield. Different drillers attach different meanings to the various terms used for identifying material penetrated in drilling. To minimize this source of error, drilling methods were observed in the field, and where possible the material penetrated in wells was compared to the log at the time of drilling, and the drillers' terms were interpreted. However, the terms "clay," "clay and boulders," and "clay with boulders," cover about 50 percent of all the material logged. Consequently, inaccurate logs and small errors in the specific-yield values assigned to the classes of material would have a large effect on the computed storage. For all logs, whenever a material of doubtful character was assigned to a class, an attempt was made to be conservative.

Therefore, the values used are not to be taken as precise; they are a conservative estimate of the gross ground-water storage capacity in the younger and older alluvial deposits.

LIMITATIONS ON USABILITY OF GROUND-WATER STORAGE CAPACITY

In Napa Valley the ground-water storage capacity of the younger and older alluvium to a depth of 200 feet is estimated at 300,000 acre-feet (table 9). This amount is gross storage, and does not represent usable ground-water storage capacity.[5] Usable ground-water storage capacity in Napa Valley is largely confined to ground-water storage units 1, 2, and 3 (pl. 5). The usable storage of these units is somewhat less than the 240,000 acre-feet of gross ground-water storage, because it is probably both physically and economically impractical to dewater the alluvium to a depth of 200 feet. To estimate such items as the amount of lowering of water level that would be practicable in the year or in several years requires data and analyses beyond the scope of this report. Certainly water levels have not declined greatly in any large part of the area under present withdrawals.

Under present conditions, ground-water storage units 4 and 5 (pl. 5) have little usable storage capacity. Parts of these units have been contaminated with brackish water from the Napa River, and further lowering of the water levels in the area would cause the migration of more brackish water into these deposits. Also, in the

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[5] Poland and others (1951, p. 621) state that usable storage capacity "is that reservoir capacity that can be shown to be economically capable of being dewatered during periods of deficient surface supply and capable of being resaturated, either naturally or artificially, during periods of excess surface supply. Obviously it must contain usable water, which may be defined as that having a satisfactory quality for irrigation and occurring in sufficient quantity in the underground reservoir to be available without uneconomic yield or drawdown."

future, if water levels are lowered appreciably in ground-water storage unit 1, it would be necessary to keep the fresh-water levels high in ground-water storage unit 4 to act as a barrier to the migration of salty water northward into ground-water storage unit 1.

For any future development and utilization of ground water in the southern part of Napa Valley, salty water must be kept out. To do so, local interests have discussed building a dam or ground-water barrier to bedrock across the narrows at Suscol. If such a structure were built it would keep the water in the Napa River fresh: it would keep brackish water from coming up the river, and it might eventually allow the ground water of high chloride content now in the younger and older alluvium to be flushed out of the area. However, the altitude of the land surface in much of the area is low, and it may be impossible to build up a fresh-water head sufficient to flush out the salty water already in the younger and older alluvium, to say nothing of that which may be present deep in the Sonoma volcanics.

SONOMA VALLEY

Ground water in Sonoma Valley occurs in several of the described formations and perhaps in several hydrologically distinct bodies. In this report two water bodies are recognized. One of these is a main body, chiefly in the younger and older alluvium; the water is mostly unconfined, but that in the lower part is semiconfined in some areas. The other is in the Huichica and Glen Ellen formations and in the Sonoma volcanics and the water is mainly confined.

WATER IN THE YOUNGER AND OLDER ALLUVIUM

In the younger and older alluvium, the water constitutes a continuous body lying beneath the alluvial plain and extending northward from San Pablo Bay to the northern edge of the plain, about 1 mile south of Glen Ellen. (See pl. 2.) This water is mostly unconfined, but locally the water at depth has a head higher than the water table, probably because of the interfingering of the water-yielding lenses with beds of clay. For example, well 5/6–25P1, 168 feet deep, has a small flow. Also, semiconfined water occurs elsewhere in beds thought to be older alluvium. For example, the water in well 5/6–25P1 (table 22) rises with sufficient head to flow from sand that underlies several thick lenses of clay. Nearby wells do not flow, but they are shallow. Wells 5/5–30E1 and 5/5–31A1 also flow, but they are much deeper, are more than 1 mile away, and therefore may tap a different water body. However, the drillers' logs indicate that these wells tap the older alluvium, which thus appears to contain a body of semiconfined water. The extent of this semiconfined water cannot be adequately determined from the existing data, but it may lie beneath much of the west side of Sonoma Valley. In general, however, the water in the alluvium is unconfined, and the body is known here as the main unconfined water body.

The bottom of this water body in the younger and older alluvium is poorly defined and varies in depth. At most places it is at solid bedrock or at the top of the first extensive zone of impermeable material at depth. The depth to it ranges from a few feet to many tens of feet. At well 5/5–8E1, as indicated by the log, the bottom of this water body is at the top of a lava flow at 116 feet. Well 5/6–14B2, 200 feet deep, is apparently all in this main water body; and well 5/5–21R1 apparently reaches unconfined water which stands below the alluvium to a depth of 242 feet in the upper part of the Huichica formation.

The static water level in wells in the unconfined water generally ranges between 5 and 25 feet below the land surface and averages about 15 feet below. Beneath higher ground the depth to water may be as much as 60 feet.

The water-level contour lines on plate 4 indicate the general direction of movement of the main body of unconfined ground water in the Sonoma Valley. The contour lines based on measurements made in April and May 1950 when there was little or no pumping, show that the unconfined water moves southward from the north end of the valley, and inward from the sides. The ground water discharges into Sonoma Creek and into the tidal sloughs tributary to San Pablo Bay. The source of the water is seepage from small streams draining the surrounding hilly areas, and infiltration of rainfall on the outcrop area of the water-bearing deposits. Some water probably enters the unconfined water body by upward movement from deeper confined water where the confinement is not complete.

The water-level altitudes are determined by interpolation from the 25-foot contours on topographic maps and are not precise. However, the static level of the unconfined water south of Schellville can hardly be more than 1 or 2 feet above sea level, and perhaps is less.

Also, within and near the tidal marshlands below Schellville, the shallow water would be expected to be brackish or salty, from the land surface down to considerable depths. See wells 4/5–3C1, 3C2, and 34D1, 5/5–31A2 and A3, and 31H1, table 18.)

WATER IN THE HUICHICA AND GLEN ELLEN FORMATIONS AND SONOMA VOLCANICS

Water in the Huichica and Glen Ellen formations and the Sonoma volcanics occurs as a body more or less coextensive with these deposits. It thus occupies a large area, including that adjacent to the alluvial plain and that within the plain, where it underlies the unconfined water. The semiconfined water extends to depths of several hundred feet, and beneath the main part of the valley and the tidal marshes it may extend to depths of more than 1,000 feet. Within the area of the younger and older alluvium it underlies the unconfined water without any clear-cut separation.

The water levels in wells in the older unconsolidated deposits range from a few feet above the land surface to about 15 feet below. Many wells along the margins of Sonoma Valley, such as 5/5–9E1, 5/5–9L2, 5/5–9N1, 5/5–20R1, 5/5–22L1, 5/5–22L2, 5/5–22Q1, 5/5–27H1, and others, that are drilled into the older unconsolidated deposits at depth yield flowing artesian water. In most wells drilled into these deposits, however, the head of the water is only a little higher than that of water in the younger and older alluvium. The altitude of the land surface at most wells is not determined accurately enough to show significant differences in water levels, and the difference in level usually is observed only during the drilling of wells, the water level generally rising as the well is drilled deeper.

The temperature of water from wells drilled in the Huichica and Glen Ellen formations ranges from about 62° to 65°F, which is in the normal range. The temperature of water from wells known to be drilled in the Sonoma volcanics ranges from 65° to more than 110°F, the maximum of the thermometer used. The temperature of water from well 5/6–2A3, drilled in the Sonoma volcanics, is reported to be 140°F.

The source of water in the Huichica and Glen Ellen formations and the Sonoma volcanics is precipitation on the outcrop area; infiltration of water from streams that flow over the outcrop area; and probably, in some places where the head is low and confinement is not complete, downward seepage of water from the overlying formations.

The water in these deposits moves inward from the intake area in the hills adjoining the valley to the area of semiconfinement beneath the alluvial plain. Because these deposits are generally of low permeability, the water-level gradient is steep. Semiconfined water probably tends to move upward and discharge into the tidal marshes, or into San Pablo Bay farther south. If upward leakage through the confining beds did not occur, the head of water in deep wells, such as 4/5–14D1, 4/5–14D2, and 5/4–14L1, probably would be substantially higher, unless—as is not likely—these wells happen to be on the downgradient side of a barrier that prevents the transmission of water from the hills and mountains on the northeast.

PUMPAGE

No records of pumpage are available for Sonoma Valley. However, according to information reported by the Pacific Gas & Electric Co., well drillers, and residents, the average annual pumpage before 1945 is estimated at less than 800 acre-feet, divided about equally between domestic and irrigation use.

During this investigation an estimate of ground-water pumpage in Sonoma Valley was made for each year during the 5-year period from April 1, 1945, to March 31, 1950. For this period the Pacific Gas & Electric Co. furnished figures for the total kilowatthours consumed each year by all well pumps of 5 horsepower or more in Sonoma Valley and also results of efficiency tests on 21 wells.

From the efficiency tests it was determined that an average of 404 kilowatthours of electric energy was consumed for each acre-foot of water pumped. This factor was consistent for the 5-year period considered and for all parts of Sonoma Valley. Therefore, the quantity of water pumped each year was determined by dividing the total kilowatthours of electric energy consumed by well pumps for each year by the average energy factor of 404 (table 10). This pumpage includes virtually all the ground water used for irrigation, plus the water pumped for the city of Sonoma, for various local water companies, for the Sonoma golf course, for all dairies, and for a few other uses.

TABLE 10.—*Water pumped in Sonoma Valley, from wells equipped with pumps of 5 horsepower or more, for the years ending March 31, 1946–50*

Year	Kilowatt-hours	Acre-feet	Year	Kilowatt-hours	Acre-feet
1945–46	197, 000	490	1948–49	539, 000	1, 300
1946–47	367, 000	910	1949–50	780, 000	1, 900
1947–48	393, 000	970			

The figures given in table 10 do not include water pumped for domestic use by small wells of less than 5 horsepower. Nearly all these pumps are of less than 1 horsepower and are connected to the same electric meter as the owner's house current. Therefore, the electric energy used for pumping water cannot be separated from other uses. There are about 1,000 wells of this type to serve about 3,000 persons. The amount pumped is estimated to be 500 acre-feet. The total of the domestic and irrigation pumpage in Sonoma Valley for the year ending March 31, 1950, thus is estimated to have been 2,400 acre-feet.

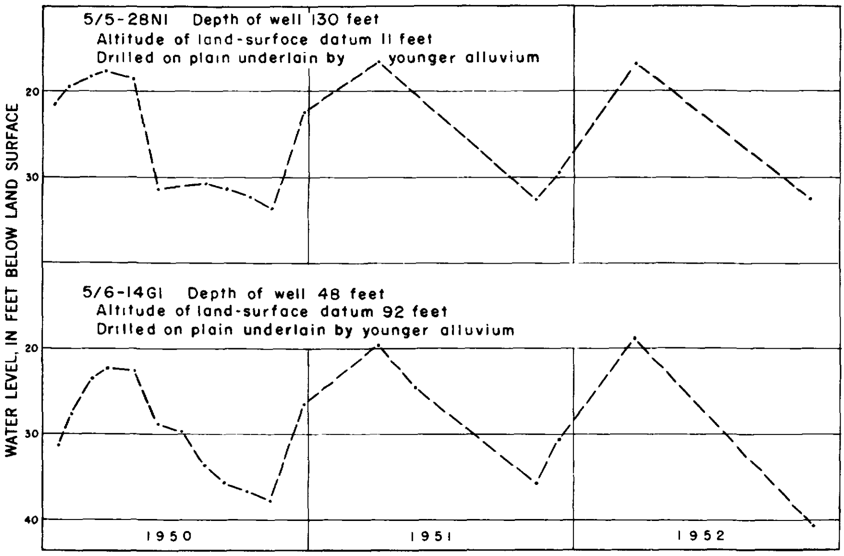

FIGURE 6.—Hydrographs of wells 5/5–28N1 and 5/6–14G1 in Sonoma Valley.

FLUCTUATIONS OF WATER LEVELS

Between January 1950 and March 1952 the Geological Survey made more than 200 measurements of water levels in about 175 wells, made periodic measurements in 6 wells, and operated a continuous water-level recorder in 1 well (table 19). In addition, Mr. J. Larbre, a drilling contractor in Sonoma Valley, furnished more than 200 measurements of water levels that he made at the time wells were drilled, and individual well owners also furnished data.

These records indicate that water levels in wells in Sonoma Valley are highest in the spring, decline during the summer and fall, and rise during the winter or spring rains. The average annual range of water-level fluctuations in wells that are not pumped is about 20 feet. The hydrograph of well 5/6–14G1 (fig. 6), which taps the main unconfined water body, is typical.

The hydrograph of well 5/5–28N1 (fig. 6) shows the fluctuation of the static water level in a heavily pumped well during the same period. The pumping levels in this well are about 20 feet below the static levels. In this particular well the seasonal range in static level is about the same as that in the nonpumped well. Each spring during the period of record, the static water levels have risen to or above the spring level of each preceding year.

The water-level measurements from all sources indicate no appreciable net change in water levels in the period of record. The spring levels in nearly all wells seem to have recovered to the same or a higher level each year. Hence, there is no critical overdraft on the ground-water bodies at the current rate of withdrawal.

QUALITY OF WATER

During the field canvass of wells, the Geological Survey collected 43 samples of water from wells for chemical analysis. Fourteen of these samples were analyzed for the principal constituents (table 20), and 29 were analyzed for chloride concentration and hardness, and for specific electrical conductance, an indication of the relative amount of dissolved solids (table 21). In addition, analyses of water were furnished by other agencies or individuals.

The results of 22 analyses are plotted on figure 7, which shows the characteristics of ground waters from the water-bearing deposits.

UNCONFINED WATER IN THE YOUNGER AND OLDER ALLUVIUM

In Sonoma Valley, the water in the unconfined water body in the younger and older alluvium, generally north of the zero water-level contour (pl. 4), is hard bicarbonate water, low in sulfate, chloride, and dissolved solids. The water is generally satisfactory for irrigation and, except for hardness, for domestic uses. One exception is the water from well 5/6–13K1, which has a boron concentration of 4.4 ppm, an amount harmful to most plants. The character of the unconfined water is shown in figure 7 from the analyses of water from wells 5/5–19L1, 5/5–20C1, 5/6–13K1, 6/6–10M1, and 6/6–35M3. The analyses (table 20) indicate that the sulfate content is 15 ppm or less, the chloride, 20 ppm or less, and the sum of the determined constituents, less than 250 ppm.

South of the zero water-level contour (pl. 4) shallow water of the unconfined water body is generally salty. When irrigation wells 4/5–3C1 and 4/5–3C2, in the Huichica formation, and 5/5–28N1 and 5/5–31A3, in the alluvium, were drilled they yielded water of satisfactory quality, but heavy summer pumping has caused some inflow of brackish water from the tidal sloughs into these wells. The chloride content in water from wells 4/5–3C1, 5/5–31A2, and 5/5–31A3 (pl. 4) is at times greater than the acceptable limit for irrigation. (See tables 18, 20.)

Successive samples were taken from well 5/5–31A3 over a period of several years. Three of the chloride determinations are given in tables 20 and 21; two determinations were made in more recent years. All are listed below:

Chloride concentrations in water from well 5/5–31A3

Date	Chloride (ppm)
Sept. 20, 1951	1,480
Apr. 8, 1952	111
June 10, 1952	1,350
Apr. 8, 1954	502
Aug. 22, 1954	1,360

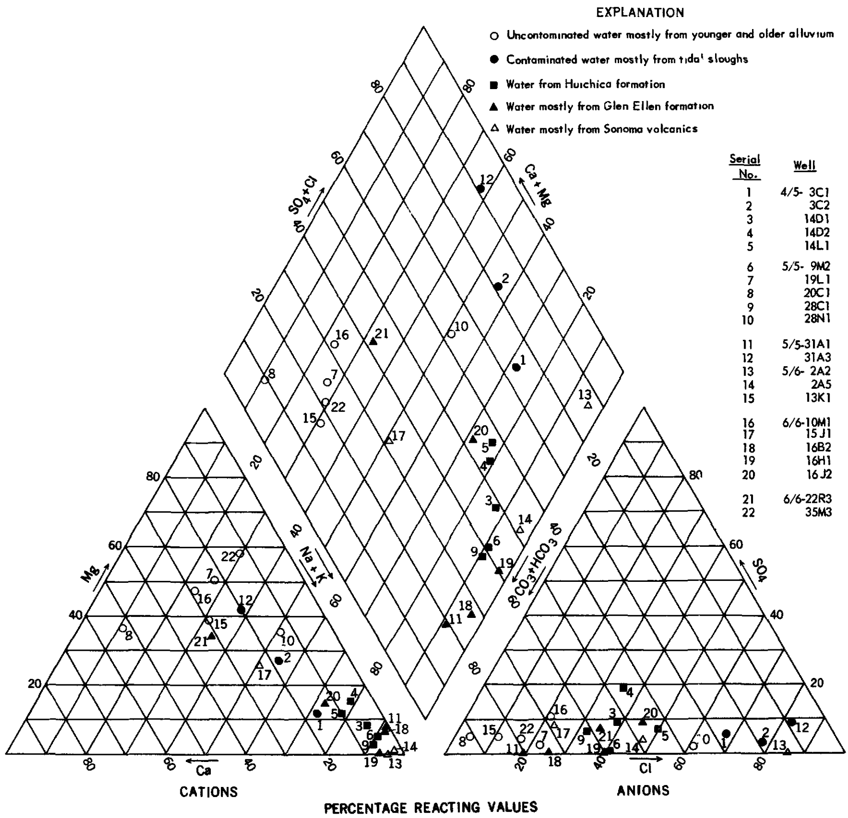

FIGURE 7.—Water-analysis diagram of ground water from Sonoma Valley.

The well is 56 feet deep and is near Sonoma Creek in or near the salt-marsh area. These determinations suggest that replenishment of fresh water during the winter is enough to drive back or to flush out salty water that comes in during the summer irrigation season. The increase in concentration of chloride from April 1952 to April 1954 may indicate, however, that any flushing action is incomplete, and that the concentration of chloride can be expected to increase. Or it may be that the time of sampling was on a different part of the cyclic fluctuation because of difference in season in the 2 years.

In nearby areas, as in secs. 30 and 33, T. 5 N., R. 5 W., well owners report that the quality of water from wells is satisfactory. However, if pumping is too heavy and prolonged, salty water probably will be drawn in, and the chloride content of the water from these wells probably will increase.

CONFINED WATER

The confined water in Sonoma Valley occurs mostly in the older consolidated deposits. In general these waters are soft and of the bicarbonate type, low in sulfate, and generally higher in dissolved solids than the unconfined water in the younger and older alluvium. Detailed analyses (table 20) indicate that the sulfate is generally less than 50 ppm, the sum of the determined constituents less than 850 ppm, and the percent sodium (Scofield, 1933) generally more than 50. In general, these waters are less desirable for irrigation than waters from the unconfined water body.

Huichica and Glen Ellen formations.—Water in the Huichica and Glen Ellen formations at most places is usable for domestic needs and irrigation but may be unsatisfactory locally. Water from some wells has a chloride concentration as high as 400 ppm, which is generally above acceptable limits for irrigation and domestic use in Napa and Sonoma Valleys. Water from other wells has a boron concentration as high as 7.7 ppm, which makes it unsuitable for irrigation of all but very tolerant plants.

Detailed and partial chemical analyses of water (tables 20, 21) from wells 4/5–14D1, 4/5–14D2, 4/5–14L1, 5/5–16E1, 5/5–20A2, 5/5–31A1, 6/6–16B2, 6/6–16H1, 6/6–16J2, and 6/6–22R1 show a chloride concentration that ranges from 60 to 400 ppm. These wells may draw some water from the older alluvium, but most of the water is drawn from either the underlying Huichica or Glen Ellen formation. The water is mostly soft and relatively high in bicarbonate, and some samples contain considerable carbonate. Most of the analyses plot toward the right-hand side of the trilinear diagram (fig. 7), suggesting some similarity to the higher chloride water from the Sonoma volcanics (fig. 5). Water from the Glen Ellen formation pumped by well 6/6–22R3 (fig. 7) is similar to water from the younger and older alluvium.

Analyses of water (table 20) from wells 6/6–16B2, 6/6–16H1, and 6/6–16J2 show boron concentrations of 7.7, 6.2, and 7.7 ppm. These concentrations of boron make the water unsuitable for irrigation of all but the most tolerant plants. The Glen Ellen formation has been folded and faulted and the boron may be associated with the fault zones.

Sonoma volcanics.—Few analyses of water from the Sonoma volcanics in Sonoma Valley are available, but water from these rocks is generally reported to be satisfactory for all uses. Four wells at Boyes Springs, 5/6–2A2, 5/6–2A3, 5/6–2A4, and 5/6–2A5, which are 350, 450, 128, and 80 feet deep, yield water whose chloride concentration (table 21) is 378, 273, 208, and 132 ppm, respectively. The two deeper wells (2A2, 2A3) yield the water of highest chloride concentration. With the possible exception of 5/6–2A5, all four wells are drilled for much of their depth in the Sonoma volcanics, which probably are the source of the chloride in the water. Well 6/6–10G1, also drilled in the Sonoma volcanics, has an appreciable chloride content.

GROUND-WATER STORAGE CAPACITY

The ground-water storage capacity of Sonoma Valley was estimated to a depth of 200 feet by virtually the same method as was used to estimate the ground-water storage capacity of Napa Valley. The extent of the storage area, as shown on plate 5, is the same as that of the younger and older alluvium in the central lowland part of the valley (pl. 2), except that the area south of the zero water-level contour (pl. 4) is excluded. South of the zero water-level contour the deposits down to a depth of 200 feet contain salty water and therefore have no usable storage capacity as that term is defined in this report. The adjoining foothills and mountains also are excluded because they are underlain only in part by water-bearing material, and the yields of the few existing wells are low.

The younger and older alluvium overlies clay, sand, and gravel of the Glen Ellen and Huichica formations, or tuff, agglomerate, and flow rocks of the Sonoma volcanics. All these deposits are generally water bearing, and above a depth of 200 feet the water is ordinarily unconfined. Also, sufficient logs are available for a reasonable good estimate of the specific yield of these rocks. Therefore, in Sonoma Valley the volume of water-storing material is estimated to a vertical depth of 200 feet within the entire storage area. The area for which ground-water storage capacity is estimated is subdivided into 14 ground-water storage units in each of which the geologic and hydrologic conditions and distribution of wells are reasonably uniform. These units are shown on plate 5.

METHODS OF COMPUTATION

Volume.—Because vertical boundaries are assumed for the ground-water storage units in Sonoma Valley, the volume of each storage unit is equal to the area of the unit multiplied by its thickness. The effective thickness of the uppermost zone is measured from the average spring water level, which in Sonoma Valley is about 15 feet below the land surface. As in the Napa Valley, the storage is computed for three depth zones. Storage capacity is estimated for depth zones of 15 to 50, 50 to 100, and 100 to 200 feet. (See tables 11 and 12.)

Specific yield.—The specific yield of the younger and older alluvium is estimated on the basis of drillers' logs, as for Napa Valley. The calculation is based on 251 drillers' logs. (See table 22 for selected well logs.)

Because the ground-water storage capacity of Sonoma Valley was estimated to a depth of 200 feet, some volcanic material beneath the older alluvium at the edges of the plain was included in the estimate and in the classification of materials. In general, the pumice and tuff are assumed to be comparable in specific yield to sandy clay and gravel, the agglomerate to clay and gravel, and clayey volcanic rocks to clay. The flow rocks yield practically no water; therefore, in Sonoma Valley a sixth class of material, "rock," is added. These classes and their specific-yield values are as follows:

Class of material	*Specific yield (percent)*
Gravel, boulders, gravel and boulders	25
Sand; sand and boulders; sand and gravel; sand, gravel, and boulders; water	20
Clay and gravel alternating; clay, gravel, and water; clay and sand; clay, sand, gravel; clay and gravel, sandy; sandy clay, and boulders; gravel and sandstone; sandy loam; sand and clay; sand, gravel, boulders, and clay mixture; sand, gravel, boulders, and some clay; sand and hard gravel; sand and rock; some water; volcanic ash; tuff; pumice; tuff and gravel; tuff and boulders	10
Clay with gravel; cemented conglomerate; cemented gravel; cemented sand, gravel, and clay; cemented sand and boulders; clay and boulders; clay, gravel, no water; clay and gravel; clay with gravel; clay and rock; sandy clay; clay with sand; gravel, boulders, and clay; hard gravel [cementing assumed]; dry gravel [cementing assumed]; hardpan and boulders, loam and dry sand [cementing assumed]; sandrock; sandstone; boulders and red clay; volcanic rocks and rocks [agglomerate]	5
Clay; clay and soil; hardpan; hardpan and clay; broken rocks; rocks; rock(s), water; soil; surface; tule mud; red volcanic rocks; soft rock; red rock; some water; porous rock	3
Rock; hard rock; solid rock; basalt; granite	0

The following table gives the average specific yield for each depth zone in each ground-water storage unit in Sonoma Valley. The method of calculation is the same as that described for Napa Valley.

TABLE 11.—*Average specific yield of depth zones and ground-water storage units, Sonoma Valley*

[Italic numerals in first column give the depth zones, in feet]

	Class of material according to specific yield, in percent, assigned							Number of logs in zone [1]
	25	20	10	5	3	0	Total	
Ground-water storage unit 1								
15–50								
Thickness feet	92	2	34	366	444	25	963	28
Percent of total thickness	9.6	0.2	3.5	38.0	46.1	2.6	100.0	
Portion of average specific yield	2.40	0.04	0.35	1.90	1.38	0	6.1	
50–100								
Thickness feet	15	0	22	385	559	107	1,088	25
Percent of total thickness	1.4	0	2.0	35.4	51.4	9.8	100.0	
Portion of average specific yield	0.35	0	0.20	1.77	1.54	0	3.9	
100–200								
Thickness feet	10	10	167	404	449	29	1,064	17
Percent of total thickness	0.9	0.9	15.7	38.0	42.2	2.3	100.0	
Portion of average specific yield	0.22	0.18	1.57	1.90	1.27	0	5.1	

See footnotes at end of table.

TABLE 11.—*Average specific yield of depth zones and ground-water storage units, Sonoma Valley*—Continued

	Class of material according to specific yield, in percent, assigned							Number of logs in zone [1]
	25	20	10	5	3	0	Total	
Ground-water storage unit 2								
15–50								
Thickness feet	33	19	116	218	132	35	553	17
Percent of total thickness	6.0	3.4	21.0	39.4	23.9	6.3	100.0	
Portion of average specific yield	1.50	0.68	2.10	1.97	0.72	0	7.0	
50–100								
Thickness feet	44	13	66	272	122	50	567	14
Percent of total thickness	7.8	2.3	11.6	48.0	21.5	8.8	100.0	
Portion of average specific yield	1.95	0.46	1.16	2.40	0.64	0	6.6	
100–200								
Thickness feet	48	4	71	236	132	39	530	10
Percent of total thickness	9.0	0.8	13.4	44.5	24.9	7.4	100.0	
Portion of average specific yield	2.25	0.16	1.34	2.22	0.75	0	6.7	
Ground-water storage units 3 and 4 [Wells in units 3 and 4 used in common for all zones]								
15–50								
Thickness feet	106	11	3	340	33	0	493	15
Percent of total thickness	21.5	2.2	0.6	69.0	6.7	--------	100.0	
Portion of average specific yield	5.38	0.44	0.06	3.45	0.20	--------	9.5	
50–100								
Thickness feet	69	8	48	174	69	0	368	11
Percent of total thickness	18.7	2.2	13.0	47.3	18.8	--------	100.0	
Portion of average specific yield	4.68	0.44	1.30	2.36	0.56	--------	9.3	
100–200								
Thickness feet	9	12	97	105	294	0	517	12
Percent of total thickness	1.7	2.3	18.8	20.3	56.9	--------	100.0	
Portion of average specific yield	0.42	0.46	1.88	1.02	1.71	--------	5.5	
Ground-water storage unit 5								
15–50								
Thickness feet	97	12	84	236	347	0	776	23
Percent of total thickness	12.5	1.6	10.8	30.4	49.7	--------	100.0	
Portion of average specific yield	3.12	0.32	1.08	1.52	1.34	--------	7.4	
50–100								
Thickness feet	30	25	79	65	371	0	570	17
Percent of total thickness	5.3	4.4	13.8	11.4	65.1	--------	100.0	
Portion of average specific yield	1.32	0.88	1.38	0.57	1.95	--------	6.1	
100–200								
Thickness feet	0	14	150	0	270	0	434	9
Percent of total thickness	--------	3.2	34.6	--------	62.2	--------	100.0	
Portion of average specific yield	--------	6.4	3.46	--------	1.87	--------	6.0	
Ground-water storage unit 6								
15–50								
Thickness feet	14	0	103	98	120	10	345	10
Percent of total thickness	4.1	--------	29.8	28.9	34.8	2.9	100.0	
Portion of average specific yield	1.02	--------	2.98	1.42	1.04	0	6.5	
50–100								
Thickness feet	5	0	133	50	190	39	417	9
Percent of total thickness	1.2	--------	31.9	12.0	45.6	9.3	100.0	
Portion of average specific yield	0.30	--------	3.19	0.60	1.37	0	5.5	
100–200								
Thickness feet	10	0	171	69	76	122	448	6
Percent of total thickness	2.2	--------	38.2	15.4	17.0	27.2	100.0	
Portion of average specific yield	0.55	--------	3.82	0.77	0.51	0	5.6	

See footnotes at end of table.

TABLE 11.—*Average specific yield of depth zones and ground-water storage units, Sonoma Valley*—Continued

	Class of material according to specific yield, in percent, assigned							Number of logs in zone [1]
	25	20	10	5	3	0	Total	
Ground-water storage unit 7								
15-50								
Thickness feet	16	0	13	300	882	0	1,121	36
Percent of total thickness	1.3	0	1.1	24.8	72.8		100.0	
Portion of average specific yield	0.32	0	0.11	1.24	2.18		3.8	
50-100								
Thickness feet	4	18	40	158	1,053	0	1,273	31
Percent of total thickness	0.3	1.4	3.2	12.4	82.7		100.0	
Portion of average specific yield	0.08	0.28	0.32	0.62	2.48		3.8	
100-200								
Thickness feet	2	47	195	205	862	89	1,400	18
Percent of total thickness	0.1	3.4	13.9	14.6	61.6	6.4	100.0	
Portion of average specific yield	0.02	0.68	1.39	0.73	1.85	0	4.7	
Ground-water storage unit 8								
15-50								
Thickness feet	28	27	26	319	135	0	535	16
Percent of total thickness	5.2	5.0	5.0	59.6	25.2		100.0	
Portion of average specific yield	1.30	1.00	0.50	2.98	0.76		6.5	
50-100								
Thickness feet	68	8	0	150	30	0	256	11
Percent of total thickness	26.6	3.1		58.6	11.7		100.0	
Portion of average specific yield	6.65	0.62		2.93	0.35		10.6	
100-200								
Thickness feet	9	30	169	47	303	0	558	[2] 13
Percent of total thickness	1.6	5.4	30.3	8.4	54.3		100.0	
Portion of average specific yield	0.40	1.08	3.03	0.42	1.63		6 6	
Ground-water storage uuit 9								
15-50								
Thickness feet	86	66	44	192	272	0	660	21
Percent of total thickness	13.0	10.0	6.7	29.1	41.2		100.0	
Portion of average specific yield	3.25	2.00	0.67	1.46	1.24		8.6	
50-100								
Thickness feet	28	27	65	23	403	0	546	15
Percent of total thickness	5.1	5.0	11.9	4.2	73.8		100.0	
Portion of average specific yield	1.28	1.00	1.19	0.21	2.21		5.9	
100-200								
Thickness feet	0	20	23	5	133	0	181	6
Percent of total thickness		11.0	12.7	2.8	73.5		100.0	
Portion of average specific yield		2.20	1.27	0.14	2.20		5.8	
Ground-water storage unit 10								
15-50								
Thickness feet	11	14	56	190	213	0	484	14
Percent of total thickness	2.3	2.9	11.6	39.2	44.0		100.0	
Portion of average specific yield	0.58	0.58	1.16	1.96	1.32		5.6	
50-100								
Thickness feet	1	0	55	56	319	0	431	13
Percent of total thickness	0.2		12.8	13.0	74.0		100.0	
Portion of average specific yield	0.05		1.28	0.65	2.22		4.2	
100-200								
Thickness feet	0	0	65	6	436	0	507	6
Percent of total thickness			12.8	1.2	86.0		100.0	
Portion of average specific yield			1.28	0.06	2.58		3.9	

See footnotes at end of table.

TABLE 11.—*Average specific yield of depth zones and ground-water storage units, Sonoma Valley*—Continued

	Class of material according to specific yield, in percent, assigned							Number of logs in zone [1]
	25	20	10	5	3	0	Total	
Ground-water storage unit 11								
15–50								
Thickness feet	107	45	39	155	127	0	473	14
Percent of total thickness	22.6	9.5	8.2	32.8	26.9		100.0	
Portion of average specific yield	5.65	1.90	0.82	1.64	0.81		10.8	
50–100								
Thickness feet	54	29	46	23	86	0	238	10
Percent of total thickness	22.7	12.7	19.3	9.7	36.1		100.0	
Portion of average specific yield	5.68	2.44	1.93	0.48	1.08		11.6	
100–200								
Thickness feet	44	18	151	6	340	0	559	[3] 12
Percent of total thickness	7.9	3.2	27.0	1.1	60.8		100.0	
Portion of average specific yield	1.98	0.64	2.70	0.06	1.82		7.2	
Ground-water storage unit 12								
15–50								
Thickness feet	32	9	39	63	309	0	452	14
Percent of total thickness	7.1	2.0	8.6	13.9	68.4		100.0	
Portion of average specific yield	1.78	0.40	0.86	0.70	2.05		5.8	
50–100								
Thickness feet	7	7	14	47	302	0	377	11
Percent of total thickness	1.85	1.85	3.7	12.5	80.1		100.0	
Portion of average specific yield	0.46	0.37	0.37	0.62	2.40		4.2	
100–200								
Thickness feet	44	18	151	6	340	0	559	[4] 12
Percent of total thickness	7.9	3.2	27.0	1.1	60.8		100.0	
Portion of average specific yield	1.98	0.64	2.70	0.06	1.82		7.2	
Ground-water storage unit 13								
15–50								
Thickness feet	7	33	189	169	606	0	1,004	30
Percent of total thickness	0.7	3.3	18.8	16.8	60.4		100.0	
Portion of average specific yield	0.18	0.66	1.88	0.84	1.81		5.4	
50–100								
Thickness feet	5	36	118	186	865	0	1,210	26
Percent of total thickness	0.4	3.0	9.7	15.4	71.5		100.0	
Portion of average specific yield	0.10	0.60	0.97	0.77	2.14		4.6	
100–200								
Thickness feet	0	17	140	312	1,152	45	1,666	22
Percent of total thickness		1.0	8.4	18.7	69.2	2.7	100.0	
Portion of average specific yield		0.20	0.84	0.94	2.07	0	4.0	
Ground-water storage unit 14								
15–50								
Thickness feet	88	10	19	74	223	0	414	13
Percent of total thickness	21.2	2.4	4.6	17.9	53.9		100.0	
Portion of average specific yield	5.30	0.48	0.46	0.90	1.62		8.8	
50–100								
Thickness feet	23	3	50	77	246	0	399	9
Percent of total thickness	5.8	0.8	12.5	19.3	61.6		100.0	
Portion of average specific yield	1.45	0.16	1.25	0.96	1.85		5.7	
100–200								
Thickness feet	0	3	74	90	346	0	513	7
Percent of total thickness		0.6	14.4	17.5	67.5		100.0	
Portion of average specific yield		0.12	1.44	0.88	2.02		4.5	

[1] In each ground-water storage unit the number of logs in each zone decreases with depth because not all wells penetrate all the zones, but they all enter the uppermost zone.
[2] 11 well logs in 100- to 200-foot zone used from adjacent units.
[3] 10 well logs in 100- to 200-foot zone used from adjacent units.
[4] 6 well logs in 100- to 200-foot zone used from adjacent units.

TABLE 12.—*Estimated gross ground-water storage capcaity in Sonoma Valley, in acre-feet*

[Results rounded to two significant figures]

Ground-water storage unit	Area (acres)	Storage capacity for indicated depth zones								
		15–50 feet			50–100 feet			100–200 feet		
		Volume (acre-feet)	Average specific yield (percent)	Storage (acre-feet)	Volume (acre-feet)	Average specific yield (percent)	Storage (acre-feet)	Volume (acre-feet)	Average specific yield (percent)	Storage (acre-feet)
1	1,800	63,000	6.1	3,800	90,000	3.9	3,500	180,000	5.1	9,200
2	1,100	38,000	7.0	2,700	55,000	6.6	3,600	110,000	6.7	7,400
3	800	28,000	9.5	2,700	40,000	9.3	3,700	80,000	5.5	4,400
4	1,500	52,000	9.5	4,900	75,000	9.3	7,000	150,000	5.5	8,200
5	820	29,000	7.4	2,100	41,000	6.1	2,500	82,000	6.0	4,900
6	590	21,000	6.5	1,400	30,000	5.5	1,600	59,000	5.6	3,300
7	790	28,000	3.8	1,100	40,000	3.8	1,500	79,000	4.7	3,700
8	700	24,000	6.5	1,600	35,000	10.6	3,700	70,000	6.6	4,600
9	680	24,000	8.6	2,100	34,000	5.9	2,000	68,000	5.8	3,900
10	670	23,000	5.6	1,300	34,000	4.2	1,400	67,000	3.9	2,600
11	1,400	49,000	10.8	5,300	70,000	11.6	8,100	140,000	7.2	10,000
12	870	30,000	5.8	1,700	44,000	4.2	1,800	87,000	4.3	3,700
13	1,300	45,000	5.4	2.400	65,000	4.6	3,000	130,000	4.0	5,200
14	340	120,000	8.8	11,000	170,000	5.7	9,700	340,000	4.5	15,000
Totals				44,000			53,000			86,000
Gross storage										180,000

Ground-water storage capacity.—The ground-water storage capacity for each ground-water storage unit in Sonoma Valley is computed by multiplying the volume of each depth zone (table 12) by the average specific yield of that depth zone (table 11).

LIMITATIONS ON USABILITY OF GROUND-WATER STORAGE CAPACITY

In Sonoma Valley the estimated gross ground-water storage capacity in the younger and older alluvium to a depth of 200 feet below the land surface is on the order of 180,000 acre-feet. Because Sonoma Valley at its broad southern end is in contact with the tidal marshes and brackish water in the sloughs tributary to San Pablo Bay, any appreciable lowering of the water table in that part of the area will result in the encroachment of brackish water.

In parts of the valley that are distant from the bay, it is likely that some dewatering could be accomplished, and storage space created and maintained over a period of as much as several years, without appreciable migration of the brackish water. However, with present knowledge of the water-bearing deposits, particularly their specific yield and permeability at different places and depths, and the details of ground-water movement in the valley, quantitative estimates cannot be made. North of the 90-foot water-level contour, in units 1 to 3 (pl. 5), the full volume to 200 feet may be usable if it could be dewatered and replenished economically. Among the factors to be considered is whether the dewatering and replenishment could be done rapidly enough to be practical.

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TABLES OF BASIC DATA

Tables 13 through 22 present tabulated descriptions of water wells in Napa and Sonoma Valleys, Calif. These tables give the location of the wells (see "Well-numbering system"), water levels, chemical analyses, and drillers' logs.

The name of the property owner is listed where known; otherwise, the tenant on the land.

Altitudes given to feet and tenths were determined by spirit level, generally by the well owner. Altitudes given in whole feet are estimated from topographic maps.

Depths of wells in whole feet are reported or are from drillers' logs; those given in feet and tenths were measured by the Geological Survey.

Land-surface datum is an arbitrary precise datum approximating the land surface at the well. Water-level measurements are in feet below land-surface datum except for well 5/4-27H1, table 14. The distance between measuring point and land-surface datum has been subtracted from all field measurements. Descriptions of measuring points are in the files of the Geological Survey.

Measurements between September 1949 and March 1952 were made by the Geological Survey unless otherwise indicated. Measurements of June 1918 were made by Clark (1919). Miscellaneous records of water levels totaling more than 6 measurements per well are listed in table 14 for Napa Valley and table 19 for Sonoma Valley. Periodic measurements in 85 wells in Napa Valley have been published by the California Division of Water Resources (Bryan, 1932). Of these the only measurements included in table 14 are for those wells in which the Geological Survey has made measurements more than 5 times.

Table 13.—*Description of water wells in Napa Valley, Calif.*

Other numbers are those assigned to wells by public agencies or appear in previous reports. Those preceded by "C" are assigned by Clark (1919); those preceded by "W" are the same wells renumbered by Weaver (1949, p. 192–195); those preceded by "DWR" are numbers assigned to observation wells by Bryan (1932); by "Napa" are city of Napa observation wells; and by "USN" are numbers assigned by the Mare Island Navy Yard.

Type of well is indicated by symbol as follows: Du, dug; Dr, drilled. For dug wells the diameter or dimensions are given in feet.

Type of pump is indicated by letter symbol as follows: A, airlift; C, centrifugal; J, jet; L, lift; S, suction; T, turbine; Ts, turbine submersible.

Horsepower is the rated power of the motor if electric. Wind and hand power are shown by words.

Use of well is shown by symbol as follows: A, abandoned and destroyed; D, domestic; Dy, dairy; Ind, industrial; Irr, irrigation, more than 5 acres; irr, irrigation less than 5 acres; PS, public supply; RR, railroad; S, stock; U, unused. A few other uses are indicated by footnotes.

Other data available are factual information in the files of the Geological Survey, much of which is cited in this report; C, chemical analysis; Cp, partial chemical analysis; L, log; W, record of water-level fluctuations.

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
							T. 3 N., R. 4 W.						
3/4- 3P1	....	Irvine Estate...	....	0	29.0	Dr, 6	Nov. 8, 1949	1.86	....	....	U	....	Water reported to be salty.
3P2	....	.....do............	1947	4	120	Dr, 8	.....do..........	4.38	....	L	S	....	Do.
4L1	....	.....do............	....	0	300	Dr, 6	.....do..........	3.07	....	C	S	Cp	Water salty.
6H1	....	.....do............	....	0	53.0	Dr, 6	.....do..........	2.77	....	....	U	....	Water reported to be salty.
6J1	....	.....do............	1947	4	111.5	Dr, 8	.....do..........	3.60	....	....	U	....	Do.
9D1	....	.....do............	1945	0	300	Dr, 8	.....do..........	1.48	....	C	S	....	Do.

T. 4 N., R. 3 W.

4/3-30E1	....	H. H. Mitchell..	1944	75	60.0	Dr, 6	Mar.10, 1950	8.55	....	J 3/4	D	....	

T. 4 N., R. 4 W.

4/4- 2J1	DWR 75	Greenwood......	....	....	30	Dr	....	....	....	L, Wind	S	....	
2P	DWR 76	Napa County Airport.	....	....	....	....	....	....	....	....	A	....	
2Q1	....	.....do..........	1946	31	120	Dr, 12	Mar.10, 1950	8.25	....	J 1 1/2	D	Cp	
							Mar.28, 1950	6.04	....	....	......	....	
3J1	....	M. C. Almada ..	1944	30	110	Dr	Feb.15, 1950	27.27	....	L, Wind	D	....	
4C1	....	Norman's Resort.	1935	12	80	Dr, 8	Jan. 11, 1950	16.41	....	L	D	Cp, L	
4E1	DWR 47	A. Acquistapace	....	10	67.0	Dr, 6	Dec. 20, 1949	7.79	....	C	U	W	
4E2	....	.....do..........	....	10	20.5	Dr	.....do.........	8.08	....	L, Wind	S	....	
4L1	....	Norman's Resort.	1949	6	455	Dr, 12	Jan. 11, 1950	3.46	....	....	U	....	Water reported to be very salty.
							Dec. 27, 1950	2.34	....	....	......	....	
5A1	W 78 C 92	P. Headly........	....	25	51	Du	June 1918	37.9	....	....	A	....	
5C1	....	P. C. Lund......	1947	30	155	Dr, 12	....	....	....	J 2 1/2	D	L, Cp, C	
5D1	....	Christenson.....	....	20	60	Dr	Mar.13, 1951	2.94	....	J 1	D	Cp	
5D2	....	T. Raven.........	....	22	60	Dr	.....do.........	4.85	....	J 1 1/2	D	Cp	
							Mar.28, 1952	7.03	....	J 1 1/2	D	Cp	
6N1	....	J. P Cabral.....	....	18	....	Dr, 6	Mar.16, 1950	18.56	....	J 2	Dy	Cp, L	
							Mar.28, 1952	18.90	....	....	......	....	
7A1	....	Press Wireless	....	3	54	Dr, 8	Jan. 31, 1950	2.20	....	J 1	D	L, Cp	Water salty.
							Mar.13, 1951	1.70	....	....	......	....	
8M1	DWR 49	J. A. Pritchett..	....	1	175	Dr, 6	Dec. 21, 1949	.00	....	J 1 1/2	D	Cp	
9C1	W 79 C 93	Wm. Stewart ...	....	1	143	Dr, 7	June 1918	.3	....	....	......	....	
9C2	....	Wm. Stewart ...	1949	1	200+	Dr, 7	Dec. 20, 1949	2.00	....	L, Wind	S	Cp	
12B1	DWR 77	M. C. Almada..	....	74	38.5	Du	Dec. 9, 1949	34.38	....	L	S		
12C1	....	Kelly Estate	1875	70	24.5	Du	Nov. 8, 1949	23.77	....	L, Wind	D	....	Reported maximum yield about 200 gpd.
12C2	....	....	....	60	....	Dr	....	....	....	L, Wind	S	....	
12F1	....	Kelly Estate	1875	70	26.5	Du	Nov. 8, 1949	Dry	....	....	U	....	
12M1	DWR 78	P. Rodgers......	....	48	26.5	Du	Dec. 21, 1949	23.48	....	L, Wind	D, S	....	

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 4 N., R. 4 W.—Continued							
4/4-13B1	W 80	......	......	65	75.0	Dr, 8	June 1918	Flowing	......			L	
	C 94	......	......	......	......	......	Dec. 9, 1949	4.08	......	T, 2	S	......	
13E1	DWR 79	George Lawrence.	......	41.17	98	Dr, 8	Dec. 21, 1949	15.54	62	L, 1 1/2	S	W, Cp	
14C1	......	W. M. Souza....	......	35	20	Dr	Jan. 13, 1950	Dry	......	L, Wind	S	......	
14F1	......	.....do......	......	25	63.0	Dr, 8	.....do......	25.76	......	L, 3/4	D, S	......	
16D1	......	James Pritchett	1947	0	231	Dr, 6	Jan. 11, 1950	.42	......	C, 2	D, S	L, Cp	
16E1	......	Ernest Nelson..	1950	0	306	Dr, 10	......	......	......	J 1 1/2	D	L, Cp, C	
25J	DWR 80	B. H. Lewallen.	......	......	......	......	......	......	......	......	A	......	
25K1	......	H. Mini......	......	57	13.5	Du, 3	Nov. 8, 1949	10.37	......	L, Wind	D	......	
32R1	......	Irvine Estate...	1947	0	120	Dr, 8	Mar. 10, 1950	1.01	......	L	S	......	Water reported to be salty.
						T. 5 N., R 3 W.							
5/3- 5M1	......	L. Magris......	1946	255	117	Dr	June 1949	[1]70	......	J 1 1/2	D, irr	L, Cp	
							Jan. 11, 1950	50	......	......	......	......	
5M2	......	L. Allen......	1948	240	135	Dr, 8	......	......	......	J 1	D, irr	L	Water reported to have high iron content.
5N1	......	W. M. Paige.....	1948	240	135	Dr, 8	......	......	......	J 2	D, irr	L, Cp	
5N2	......	H. O. Stoddard..	1941	225	115	Dr	Sept. 23, 1947	43	......	J 1/4	D	L, Cp	Do.
5N3	......	C. Trouslot.....	1950	450	192	Dr, 8	June 1, 1951	81.80	......	J 1 1/2	D	L	Do.
5P1	......	M. Stanton......	1941	500	450	Dr	......	......	......	T, 5	D, Irr	L, Cp, C	
6H1	......	N. Coombs......	1949	220	280	Dr, 8	Apr. 3, 1951	13.50	......	J 1 1/2	D	Cp	
6J1	......	L. A. Kech......	1951	200	290	Dr, 10	May 22, 1951	27.36	......	......	......	L, C	
6M1	......	H. Denny......	1930	125	295	Dr, 8				J 2	D, S	L	

6M2	...	J. C. Beatty	1938	135	65	Dr, 6	Jan. 30, 1950	48.52	...	J 3/4	D	L, Cp	Water reported to have strong "sulfur" taste.
6N1	...	A. L. Simkins	1939	120	120	Dr, 6	Jan. 11, 1950	52.84	66	J 1 1/2	Dy, D	L, Cp	
6N2	...	L. V. Evans	1945	155	205	Dr, 8	Dec. 1945	[1]21	64	J 1 1/2	D	L, Cp, C	Yield reported by owner to be 18 gpm in December 1945. Water reported to have high iron content and "sulfur" odor.
6N3	...	T. B. Wright	1934	120	146	[2]Dr	Feb. 9, 1950	2.32	...	J 3/4	D	L	
6P1	...	W.N.Wingstrom	...	150	285	Dr, 8	...	...	...	J 1/2	D	C	
6Q	W 60 C 71	...	...	...	75	...	June 1918	20	...	...	...	...	
6Q1	...	Don Searl	1950	163	228	Dr, 8	...	...	...	J 1	D	L	
7C	W 61 C 72	George Stephens	...	...	95	Dr, 6	June 1918	18	...	...	A	L	
7C1	...	B. Ruddle	1948	135	200	Dr, 6	...	...	...	J 1/2	D	...	
7C2	...	do	1948	140	232	Dr, 8	...	...	...	J 1	D	L	
7D1	...	George Kucek	1950	125	145	Dr, 10	...	...	...	J	D	L	
7D2	...	T. Ontis	1950	125	125	Dr, 6	June 1, 1951	33.34	...	J 1	D	L	
7E1	...	W. Forsythe	1949	94	104	Dr, 10	...	...	...	C 1/4	D, irr	L	
7E2	...	W.L. Jackson	1947	120	135	Dr, 8	...	...	63	J	D	L, Cp	
7E3	...	Mount George Union School.	...	118	478	Dr, 12	July 1, 1949	[1]50	...	J 3	D	L	Reported to pump 35 gpm with 17-ft draw-down.
							Aug. 16, 1949	[1]30	...	...	...	...	
							Jan. 30, 1950	[1]23.74	...	...	...	...	High iron and H_2S reported.
7G	W 64 C 75	George Lubben	...	...	178	Dr, 8	1917	[1]18	...	...	A	...	
7H	W 63 C 74	Lief Wahlburg	...	...	175	Dr, 8	June 1918	9	...	...	A	...	
7H1	...	M.W.Eichmann	...	170	40	Dr	...	...	...	J 1	D	L, Cp	High iron content reported.
7H2	...	L. L. Hubbard	...	160	65	Dr, 6	...	...	...	J 2	D, irr	L	Do.
7L1	...	G. J. Speas	...	69	120	Dr	...	...	...	J 1	D, irr	L, Cp	
7L2	...	Mrs. W. Malcom.	1937	62	147	Dr, 6	Feb. 7, 1950	20.32	...	J 1/2	D, irr	L	
7M1	...	B. Stoddard	1948	90	98	Dr, 8	...	...	60	J 1	D	L, Cp	

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 5 N., R. 3 W.—Continued							
5/3- 7M2	...	W. E. Thorburn	1940	78	22	Dr, 8	Jan. 26, 1950	8.45	...	J 1/2	D	L	
7M3	...	B. A. Trotter	1950	100	105	Dr, 8	...	...	...	J 1	D	L	
7N1	...	T. Lundberg	...	95	172	Dr, 8	May 21, 1951	Flowing	68	J 1/2	D, S	Cp	
8C	W 62 C 73	John Lubben	...	...	207	Dr, 8	June 1918	2	...	...	A	...	
8C1	...	B. A. Johnson	1940	290	95	Dr, 6	Feb. 15, 1950 Feb. 22, 1950	Flowing Flowing	... 69	J 1 ...	D ...	L, Cp ...	
8D1	...	Murray	1951	200	120	Dr, 6	June 1, 1951	21.40	...	L 1	D	L	
8L1	...	G. W. Clark	1949	370	195	Dr	...	...	...	J 2	U	L	
8M1	...	L. C. Smith	1947	280	201	Dr	...	...	...	L 2	D	L	
17C1	...	E. F. Lazarus	1948	600	261	Dr	Fall 1948	[1]100	...	L	D	L	
						T. 5 N., R. 4 W.							
5/4- 1F1	...	W. J. Hughes	1944	140	80	Dr, 8	...	...	...	J 1/4	D	L, Cp	Reported to flow in wet weather.
1G1	...	A. Marshall	1944	142	78	Dr, 8	...	...	...	L 1	D	L	
1R1	...	A. C. Buchta	1946	130	369	Dr, 6	...	...	...	C 1	D	L	
2B1	...	R. I. Parrish	...	70	202	Dr	...	...	...	J 1	D	L	
2B2	...	Wyckoff	1946	140	200	Dr, 8	...	...	...	L 1	D	L	
2C	...	R. Reininghaus	1927	...	226	Dr	...	...	...	...	A	L	
2E1	...	G. Pistone	1934	20	112.5	Dr, 8	Mar. 10, 1950	15.79	...	L 5	D, irr	C	Reported to pump 35 gpm with 35-ft draw-down.
2M1	...	O. E. Dean	...	18	25.0	Du	Nov. 18, 1949 Mar. 28, 1952	6.53 0	... ...	J 1/2 ...	D ...	Cp ...	

2P1	...	Ted Marion ...	1948	75	195	Dr, 8	Spring 1948	[1]17	...	J 1	D	L	
2R1	...	M. P. Monez ...	...	160	189	Dr	Feb. 2, 1952	76.19	...	L	D	L	
2R2	...	Max Wiloth ...	1946	150	160	Dr, 8	...do...	72.70	...	L 2	D	L	
3C	W 48	D. E. Beard ...	...	...	77	Dr	June 1918	33.8	...	...	A	...	
	C 57A												
3C	W 49	A. Gasling ...	...	...	68	Dr, 6	June 1918	19.2	...	...	A	...	
	C 58												
3C1	...	E. Smith ...	...	36	42.5	Du	Dec. 14, 1949	27.08	...	L 1	D	...	
3D1	...	Maple ...	1924	41	60	Dr	...	...	...	...	D	L	
3F1	...	H. N. Webb ...	1950	36	98	Dr, 6	...	...	...	J 1	D	L	
3G1	...	J. M. Gardner ..	1939	18	81	Dr, 8	Feb. 14, 1950	7.84	...	J 1	D	L	
3H1	...	H. Widger ...	...	15	155	Dr, 12	Mar. 28, 1952	7.21	...	T 7 1/2	Irr	L	
3H2	...	...do...	...	15	83	Dr, 12	Feb. 15, 1950	10.34	...	T 7 1/2	Irr	L	
							Mar. 28, 1952	5.81	...	...	...	...	
3L1	...	Myles Archer ..	1935	28	82	Dr	Feb. 13, 1950	19.22	...	J 3/4	irr	L	
3M1	W 51	Mrs. J. Hartley.	...	...	865	Dr	...	...	...	...	A	L	
	C 60												
3N1	...	George Ball ...	1947	37	80	Dr, 6	...	...	...	J 1/2	irr	L	
3Q1	...	C. Dagalia ...	1935	22	316	Dr, 8	Feb. 14, 1950	30.37	...	J 2	irr	L, Cp	
4F1	...	J. G. Trethewey	1946	72	130	Dr, 6	...	...	...	J 1/3	D	L	
4G1	...	A. C. Swanson ..	1935	63	190	Dr, 6	Feb. 10, 1950	37.3	...	J 1/2	D	L	
4H	W 50	Egbert Smith ...	...	...	68	Dr, 6	June 1918	50	...	...	A	...	
	C 59												
4K1	...	Sherwood Munk	1928	62	72.0	Dr, 8	Feb. 15, 1950	3.17	...	L 1	D	L	
4K2	...	Jim Towey ...	1948	64	100	Dr, 8	Dec. 18, 1948	[1]20	...	J 3/4	D	L	Reported to pump 24 gpm with 21-ft draw-down.
4N1	...	Fanslon ...	1951	77	66	Dr	...	...	...	...	...	L	Test well.
4N	...	...	...	...	280	Dr	...	...	...	...	A	L	
4Q	W 53	Joe Brownley ...	1918	...	36	Dr, 10	June 1918	21	...	...	A	L	
	C 62												
4Q1	...	T. M. Morris ...	1938	57	100	Dr	Feb. 14, 1951	1.64	...	J 1/2	D	L	
5H1	...	T. E. Rudech ...	1947	95	132	Dr, 6	...	...	...	J 1/2	D	L, Cp	
5H2	...	D. Collins ...	1948	95	90	Dr, 6	...	...	...	J	D	L	
5H3	...	...do...	1948	95	90	Dr, 6	...	...	...	J	D	L	
5H4	...	C. M. Wigington	1946	93	75	Dr	...	...	...	J 1/2	D	L	
5K	W 52	E. C. Hillman ..	...	...	...	Du	June 1918	13.0	...	...	A	...	
	C 61												

See footnote at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 5 N., R. 4 W.—Continued							
5/4- 5Q1	......	Martin Gozza	1948	117	140	Dr, 6	Mar. 16, 1951	31.71	......	......	U	C	
5Q2	......	A. L. Southgate	1950	117	150	Dr, 8	....do	6.94	......	J 1	D	Cp, L	Reported to pump 5 gpm.
5R1	......	C. L. Dunkin	1951	97	70	Dr, 8	June 1, 1951	10.04	......	J 1	D	L	
6	......	W. C. Joens	1931	......	102	Dr	......	......	......	......	A	L	
6A1	......	L. Cotter	1948	150	72	Dr	......	......	......	J 1/2	D	L	
6K1	......	J. Capatani	1929	175	60	Dr, 10	Feb. 3, 1950	14.12	......	L 3/4	D	L, Cp	Water reported to have high iron content.
7R	......	J. R. Davisson	1931	......	102	Dr	......	......	......	......	......	L	
8G1	......	Richardson	1948	310	220	Dr, 6	Apr. 12, 1950	31.72	......	L, Hand	U	......	
8K1	......	......	......	230	19.5	Du, 3 1/2	....do	1.43	......	J 1/3	S	......	
8P1	......	......	......	173	24.5	Du	....do	6.97	......	L 1/4	D	......	
9A1	......	A. D. Storck	1939	45	80	Dr	......	......	......	J 3/4	D	L	
9A2	......	R. D. Pittsley	......	46	71	Dr, 6	Jan. 26, 1950	9.91	......	......	U	L	
9B1	......	Leonard	1947	62	127	Dr, 8	Nov. 1947	[1]23	......	J 1	D	L	
9C1	......	Formerly H. C. Bryan.	1923	......	400	Dr	......	......	......	......	A	L	Reported to have been a dry hole.
9D	W 54 C 64	H. C. Bryan	......	......	133	Dr, 10	June 1918	20	......	......	A	L	
9D1	......	W. A. Hawes	......	120	135	Dr, 6	Feb. 2, 1950	25.32	......	......	D	L	
9E1	......	H. C. Bryan	1923	160	330	Dr, 12	......	[1]40	68	T, 10	D, Irr	L, Cp	Reported to pump 150 gpm with 140-ft draw-down. Water reported to have high iron content.

9K1	W 56 C 66	E. Veinop	...	45	85	Dr, 6	June 1918	15	...	L, Wind	D	Cp	
9K2	...	M. H. Manassee	1947	42	108	Dr, 108	Feb. 16, 1950	5.30	...	L 1	Irr	L	
9L	W 55 C 65	Mrs. D. Jesperson.	...	...	42	Du	June 1918	31	...	...	A	...	
9L1	...	H. Reames	1929	80	258	Dr	...	...	...	...	D	L	
9L2	...	B. Robinson	...	85	26.5	Du, 4	Feb. 14, 1950	2.50	...	L	D	...	
9L3	...	....do	...	110	96	Dr, 8	....do	15.28	...	L 3	S, Irr	L	
9Q1	...	A. E. Shroyer	1946	35	178	Dr, 6	...	...	...	J 1	D	L	
9Q2	...	M. L. George	1946	33	147	Dr, 6	...	...	...	J 1	D	L, Cp	
9Q3	...	E. J. Barnett	1926	32	140	Dr, 6	...	...	...	J 1/2	D	L	
9Q4	...	J. B. Critchley	...	30	80	Dr, 8	Feb. 3, 1950 Mar. 28, 1952	17.86 9.26	...	J 1/2	D	L	
10B	W 57 C 68	Napa Steam Laundry.	...	...	120	Dr, 6	June 1918	[1]20	...	...	A	...	
10E1	...	E. Riordan	...	37	96	Dr, 6	Feb. 14, 1950	5.32	...	L 3/4	irr	L	
10F1	...	Bridges	1937	30	100	Dr, 8	...	...	...	J 1 1/2	irr	L, Cp	
10F2	...	S. K. Parker	1947	32	117	Dr, 8	Feb. 15, 1950	6.70	...	...	U	L	
10G1	...	K. K. Priest	1946	22	160	Dr	...	...	...	J 1	irr	L	
10G2	...	R. V. Wigger	1937	23	72	Dr	...	...	...	J	irr	L	
10P1	DWR 57 C 82 (1)	City of Napa	...	25	147	Dr	...	...	...	...	A	L	
10P2	C 82 (2)	....do	...	25	198	Dr	...	...	...	...	A	L	
10P3	C 82 (3)	....do	...	25	193	Dr	...	...	...	...	A	L	
10P4	W 70a C 82 (4)	....do	...	25	300	Dr	...	...	...	...	A	L	
10P5	C 82 (5)	....do	...	25	239	Dr	...	...	...	...	A	L	
11A1	...	James Brown	1950	120	235	Dr, 8	June 1, 1951	97.50	...	...	U	L	
11E1	W 58 C 69	A. Zellar	1914	...	700	...	June 1918	Flowing	...	...	A	L	
11F1	DWR 58	Silverado Motor Court.	...	18	75	[2]Dr	Nov. 18, 1949 Mar. 28, 1952	12.50 6.14	...	L 3/4	D	Cp	
11F2	...	Harry Stover	...	18	110	Dr	Feb. 13, 1950	16.56	...	J 1	D	L	
11F3	...	Silverado Motor Court.	...	16	165	Dr, 8	Feb. 13, 1951 Mar. 28, 1952	32.70 19.77	...	L 1 1/2	D	Cp, C	
11G1	...	W. E. Swenson	1933	40	184	Dr	Feb. 2, 1950	23.16	...	L	D	L	
11H1	...	Don Imbodin	1947	100	150	Dr, 6	Apr. 23, 1948 Jan. 24, 1950	[1]40 30.57	...	J 1	D	L, Cp	Reported to pump 11 gpm with 15-ft drawdown.

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 5 N., R. 4 W.—Continued							
5/4-11L1	....	B. Bellew	....	25	92.5	Dr, 8	Oct. 15, 1949	[1]44	....	J 1	D	Cp	
							Nov. 18, 1949	30.69	....	....	....	....	
11L2	DWR 59	.....do	....	25	35.5	Du	.....do	29.86	....	....	U	....	
11L3	....	L. F. Barnes	1950	25	69	Dr, 8	June 1, 1951	27.19	....	J 1/2	D	L	
11M1	....	DeWitt Machine Shop.	1938	13	58.5	Dr, 8	Feb. 3, 1950	6.40	65	....	U	L, Cp, W, C	
11P1	DWR 72	P. A. Gasser, Dairy.	....	15	77	Dr	....	....	....	....	A	....	
11R1	....	J. Marshall	1947	37	105	Dr, 6	....	....	....	L, Wind	D	L	
11R2	....	Wm. A. Young	1946	40	198	Dr, 8	Mar.11, 1946	[1]25	....	L, Hand	U	L	
12B	W 59 C 70	Mary D. Hendricks.	....	....	61	Du	....	....	....	....	A	L	
12B1	....	H. Park	1947	120	150	Dr, 6	Mar.10, 1948	[1]29.3	....	J 1	D	L	
							Mar.17, 1950	28.27	....	....	....	....	
12B2	....	D. Sanders	....	95	....	Dr, 8	Apr. 4, 1951	4.85	....	J 1	D	Cp	
12E1	....	Robert Jacks	1937	120	255	Dr, 8	Dec. 30, 1949	30	....	L 1	D	L	
12F1	....	R. McMurtry	1945	130	203	Dr, 8	Jan. 30, 1950	62.09	....	L 1	D	L, Cp	
12J1	....	John Carbone	1937	78	303	Dr, 8	Jan. 13, 1950	31.97	....	J 1	D	L, Cp	
12M1	....	Paul Lewis	1933	45	115	Dr	....	....	66	J 3	Dy	L, Cp	
13E1	....	F. Summers	1928	60	153	Dr	Feb. 2, 1950	35.20	....	L 1 1/2	D	L	
13F1	....	H. Nelson	1939	105	160	Dr, 8	Jan. 12, 1950	39.72	....	J 3/4	D	Cp	
13G1	....	Spractic	1949	110	180	Dr, 6	.....do	53.59	....	J 1	D	L, Cp	
13G2	....	E. Mees	1948	110	120	Dr, 6	.....do	20.56	....	....	U	L, Cp	
13G3	....	.....do	1949	105	345	Dr, 8	.....do	64.09	....	....	D	Cp	
13L1	....	Napa State Hospital.	....	83	906	Dr, 15	Oct. 17, 1942	[1]123.4	....	T 60	Irr	L, C	Pumped 225 gpm, drawdown 40 ft on test
							June 18, 1945	[1]135.6	....	....	....	....	

							Jan. 4, 1950	[1]133.3	......	......	......	......	June 1945. Pumped 190 gpm on test in January 1950.
							Mar.28, 1952	71.18	......	......	......	......	
14A1	......	Mrs. G. W. Swift	1931	58	225	Dr, 8	......	......	......	J 1 1/2	D	L	
14C1	......	P. A. Gasser, Dairy.	......	17	220	Dr	Dec. 2, 1949	12.86	......	J 1	D, Dy	L, Cp	
14G1	......	H. H. Dykes......	1938	46	110	Dr	Feb. 2, 1950	49.72	......	J 1	D	L	
14H1	......	C. Julian......	1949	64	150	Dr, 8	......	......	......	J 1	D	L	
14H2	......	Jack Boeris......	1949	64	150	Dr, 8	......	......	......	J 1	D	L, Cp	
14H3	......	A.B. Coronado...	1934	56	240	Dr, 8	Feb. 2, 1950	57.83	......	J 3	PS	L, Cp	
14J1	DWR 81 W 65 C 77	Napa State Hospital.	......	74.46	486	Dr, 8	1917	30	......	......	U	L	
							Oct. 17, 1942	101.4	......	......	......	......	
							Dec. 16, 1949	124.43	......	......	......	......	
							Mar.27, 1952	107.06	......	......	......	......	
14J2	DWR 82 W 66 C 78	.....do......	......	74.69	......	Dr, 10	1912	[1]56	......	......	U	......	
							Dec. 16, 1949	110.95	......	......	......	......	
							Mar.27, 1952	56.00	......	......	......	......	
14J3	DWR 83	.....do......	......	75.72	399	Dr, 12	Dec. 16, 1949	115.79	......	......	U	W, L	
14L1	DWR 85	.....do......	......	14.51	525	Dr, 20	Oct. 17, 1942	[1]56.8	......	T 20	PS, Irr	L	Pumped 410 gpm with 45-ft drawdown on test in June 1945
							June 18, 1945	[1]67.5					
							Dec. 16, 1949	73.80					Pumped 300 gpm with 40-ft drawdown in January 1950.
							Jan. 4, 1950	[1]73.2					
							Mar.28, 1952	48.00					
14L2	W 67 C 79	.....do......	......	16	325	Dr, 8	June 1918	Flowing	......	......	A	L	
							Oct. 17, 1942	[1]17					
14P1	......	.....do......	1947	10	600	Dr, 14	Jan. 4, 1950	[1]65.0	80	T 30	PS, Irr	L, Cp	Pumped 430 gpm with 11-ft drawdown on test in January 1950.
15B	......	Sawyer Tannery	......	10	445	Dr	......	......	......	......	A	L	
15B1	......	.....do......	......	8	80	Dr	Dec. 22, 1949	16.30	......	T 7 1/2	Ind	......	
15B2	......	.....do......	......	8	125	Dr, 10	......	......	62	T 7 1/2	Ind	Cp	
15B3	......	Cal-Nap. Tannery	......	8	50	Dr	Jan. 25, 1950	15.14	......	T 3	Ind	W, Cp, C	
15C1	......	Louis Avelar	......	23	80	Dr	Feb. 2, 1951	16.09	......	J	irr	Cp	
15C2	......	C. W. Johnson....	......	22	66	Dr, 8	.....do......	16.02	......	J 3/4	irr	Cp, W	Reported to pump 15 gpm on 24-hr test.

See footnote at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 5 N., R. 4 W.—Continued							
5/4-15C3	....	Cudabacks Nursery.	....	23	75.5	Dr, 8	Feb. 2, 1951	18.83	....	....	irr	....	
15E1	USN W-21	William Bohen..	....	21	158.0	Dr, 10	....	[1]64	....	....	D,irr	Cp	
							Dec. 20, 1949	26.80					
							Mar. 28, 1952	22.95					
15E2	W 69 C 81 USN W-20	....do........	....	19	29.5	Dr, 4	June 1918	28	....	....	U	....	
							Dec. 20, 1949	25.60					
15K1	....	A. Sheveland....	....	6	1,168	Dr, 12	Dec. 21, 1949	48.31	....	....	U	C, Cp, L	
							Feb. 14, 1951	28.74	63				
							Mar. 28, 1952	22.28					
15M	W 68 C 80	....do........	....	....	....	Dr, 12	....	....	....	....	A	....	
15M1	DWR 51	....do........	....	21	750	Dr	Dec. 21, 1949	45.24	....	Ts 5	D, S	Cp	
								40.60					
15N1	....	J. Ghisletta	....	8	200+	Dr, 8	Dec. 1, 1949	25.03	....	....	U	....	
							Mar. 28, 1952	12.15					
15P1	....	A. Sheveland....	....	15	137.5	Dr, 8	Dec. 22, 1949	27.86	....	....	U	....	
							Feb. 14, 1951	28.31					
							Mar. 28, 1952	26.35					
15P2	....	J. Ghisletta	1926	10	1,214	Dr	....	....	....	....	U	L	
16A	W 72 C 85	Mrs. George Bevenne.	....	....	163	....	June 1918	21	....	....	A	....	
16E1	....	J. Ghisletta	1939	170	55	Dr, 12	Apr. 12, 1950	10.82	....	L, Wind	D, S	L	

16G1	...	I. Nelson...	...	55	121.0	Dr, 3	Jan. 12, 1950	27.14	...	J 1	D	...	
							Mar. 28, 1952	21					
16H1	W 71	A. Gruenhagen..	...	26	74	Dr	June 1918	37.9	...	...	A	...	
	C 84												
16H2	...	Drive-in	1949	24	240	Dr	...	...	...	J 1 1/2	PS	L, Cp	
		Theater.											
16J	...	A. Sheveland...	...	...	38	Du	June 1918	33	...	...	A	...	
16K1	W 73	Horseman's	...	55	136	Dr, 9	...do...	65	...	J 1/2	D, S	L, Cp	
	C 86	Assoc.					Dec. 20, 1949	70.36	62				
							Mar. 28, 1952	68.00					
16K2	...	...do...	...	55	280	...	June 1918	48	...	...	D	L	
17D1	...	Sisson...	1920	168	34.5	Du, 3	August 1949	[1]Dry	...	L 1	D		
							Feb. 14, 1950	10.81	...	...	...	...	
17E1	...	B. G. Baker...	1947	125	260	Dr, 6	Feb. 2, 1950	10.43	...	...	D	Cp, C,	
							Feb. 15, 1951	7.62	...	...		L	
17F1	...	E. A. Peters...	1938	...	160	Dr, 6	...	...	...	...	D	L	
19J1	...	J. Zweifel...	1946	105	100	Dr, 6	Jan. 31, 1950	2.44	...	J 1	D	L	
19J2	...	Tom Donahue...	1948	100	108	Dr, 8	...do...	+2.64	...	L 3	D	Cp, L	
							Mar. 21, 1950	+3.20					
							Mar. 13, 1951	+2.00					
19K1	...	H. Day...	1947	140	100	Dr, 8	...	...	...	...	D	L	
19K2	...	E. L. Schauman..	1947	110	90	Dr	...	...	...	J	D, S	L	
19K3	...	M. Cooper...	1946	140	50	Dr, 6	...	...	...	J 3/4	D	L	
19L1	...	R. C. Potter...	1946	130	95	Dr, 8	Jan. 27, 1950	7.44	...	L 3/4	S	Cp, L	Reported to pump 10 gpm.
19Q1	...	...do...	1945	100	170	Dr, 8	...do...	16.46	...	...	U	L	
19R1	...	A. M. Ross...	1948	125	135	Dr	Jan. 31, 1950	.00	...	...	U	L	
20D1	...	J. H. Bentley...	1916	113	28	Du	Feb. 9, 1950	7.49	...	C	D	L	
21A1	...	J. Ghiseletta...	...	35	545	Dr, 12	...	...	...	T 25	S, Irr	Cp, L	Reported to pump 400 gpm.
21B1	...	D. E. Douglass..	1948	75	140	Dr, 8	Mar. 9, 1951	11.68	...	J 1	D	Cp, L	
21B2	...	Paul Watson...	1948	155	200	Dr, 8	...do...	50.38	...	...	D	L	
21B3	...	Milton Munger..	1948	100	200	Dr, 8	...do...	11.56	...	J 1	D	Cp, L, W	Reported to pump 5 gpm.
21B4	...	R. O. Baldwin...	1948	102	208	Dr	...do...	6.16	...	J 1	D	C, L	
21B5	...	...do...	1948	125	150	Dr	...do...	50.45	...	...	U	...	
21B6	...	George Hilde-	1950	105	200	Dr	July 25, 1951	43.14	...	J 1	D	Cp, L	
		brant.					Oct. 7, 1951	[1]48.40					
							Mar. 28, 1952	24.90					

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 5 N., R. 4 W.—Continued							
5/4-21D1	....	....	....	118	8.5	Du	Apr. 11, 1950	2.06	....	....	U	....	
21E1	....	Stewart's Dairy	....	113	44.5	Du	.....do........	10.78	....	L, Hand	S	....	
21J1	W 74	.....do........	....	60	28.0	Dr, 6	June 1918	16.1	....	J 1	D, S	L	
	C 87					(2)	Dec. 20, 1949	23.09					
							Mar. 27, 1952	5.22					
21K	W 75	.....do........	....	....	63	Dr, 8	June 1918	11.6	....	....	A	L	
	C 88												
21K1	....	.....do........	1949	47	113.0	Dr, 8	Dec. 20, 1949	13.20	....	J	S	Cp	
21P1	....	J. G. Carr........	....	25	178	Dr, 6	1915	[1]35	....	....	U	....	
							Mar. 26, 1952	6.93					
21P2	....	.....do........	1951	25	235	Dr, 8	.....do........	15.67	....	J 1-1/2	D	C, Cp, L	
22B1	....	J. Ghiseletta........	....	10	13	Du	Dec. 23, 1949	4.78	....	C 15	Irr	....	Large sump along river bank.
22M1	....	Stewart's Dairy	....	12	99.0	[2]Dr	Nov. 1, 1949	64.06	....	L, Wind	S	Cp, W	
23B	W 76	....	....	....	....	....	June 1918	Flowing	....	....	A	....	
	C 89												
23C1	....	Napa State Hospital Smith Brown well 2	....	5	200+	Dr, 12	Oct. 17, 1942	[1]48.7	....	....	U	....	
							Dec. 16, 1949	57.84					
							Mar. 27, 1952	31.22					
							Mar. 28, 1952	31.10					
23C2	DWR 84	Napa State Hospital Smith Brown well 1	....	5	323	Dr, 12	Oct. 17, 1942	[1]49.0	....	T 40	D, Irr	....	Pumped 400 gpm with 88-ft drawdown on test.
							June 18, 1945	[1]48.0					
							Dec. 16, 1949	64.65					
							Jan. 4, 1950	[1]64.2					
							Mar. 28, 1952	37.82					

26B1	....	Adams and Forbes No. 8.	1933	20	1,440	Dr, 20	Jan. 24, 1950	72.74	92	T 30	PS	Cp, L, W	
26E1	....	Adams and Forbes No. 7 formerly C & H No. 7.	1932	8	806	Dr, 15 1/2	.....do..........	[3] 62.52	82	T 25	PS	Cp, W, L.	
26M1	....	Adams and Forbes No. 6 formerly C & H No. 6.	1931	7.42	939	Dr, 15 1/2	Mar. 23, 1942 Oct. 16, 1942 Jan. 24, 1950 Mar. 28, 1952	[1] 35.3 [1] 43.9 58.84 35.69	....	....	U	L	
26M2	....	Adams and Forbes formerly C & H No. 2.	1931	3.27	682	Dr, 20	Jan. 24, 1950	2.17	....	....	U	L	Well probably plugged.
26N1	....	Adams and Forbes formerly C & H No. 1.	1930	8	450	Dr, 20	.....do......... Mar. 28, 1952	40.5 25.8	....	....	U	L	
27A1	....	Adams and Forbes No. 3 formerly McKee No. 3.	1920	7.37	795	Dr, 12	Fall 1920 Jan. 24, 1950 Mar. 28, 1952	Flowing 68.16 46.79	....	....	U	L	
27H1	....	Adams and Forbes No. 4 formerly McKee No. 4.	1923	8	1,226	Dr, 16	....	....	....	....	U	L, W, C	
27H2	....	Adams and Forbes No. 5 formerly McKee No. 5.	1923	8	860	Dr, 12	Jan. 24, 1950	64.13	68	T 25	PS	L, Cp, W	
27K1	....	Adams and Forbes formerly McKee No. 1.	1919	8	276	Dr, 12	1919	Flowing	....	....	A	L	
27K2	....	Adams and Forbes formerly McKee No. 2.	1919	8	456	Dr, 12	Sept. 5, 1919	Flowing	....	....	A	L	

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
							T. 5 N., R. 4 W.—Continued						
5/4-27M1	USN W-57	G. H. McFarland	....	5	....	Du, 20	Oct. 22, 1949	Dry	....	....	U	....	
27M2	USN W-58	.....do............	....	5	....	Du, 23	.....do..........	Dry	....	....	U	....	
27Q1	....	G.H. McFarland formerly Stanley No. 1.	1920	6.61	600	Dr, 8	Dec. 21, 1949	18.51	....	....	U	L, Cp	
27R1	....	G.H. McFarland formerly Stanley No. 3.	1931	3.16	485	Dr, 20	....	....	....	....	U	L	Pumped 270 gpm on test on May 17, 1931.
27R2	....	G.H. McFarland formerly Stanley No. 2	1930	5	331.5	Dr, 10	....	....	....	....	U	L	
28R1	DWR 45 W 77 C 90 USN W-56	.....do............	....	37	51	Dr, 8	June 20, 1918 Feb. 25, 1930 Dec. 20, 1949 Mar. 28, 1952	28.2 [4]11.1 36.20 [5]30	....	J 1	D	L	
29C1	....	E. Lewis.........	1938	107	160	Dr, 8	Jan. 26, 1950	8.21	....	....	U	L	
29C2	....	.....do............	1938	105	1,010	Dr, 10	....	....	....	....	A	L	
29C3	....	.....do............	1939	99	175	Dr, 8	....	....	....	....	A	L	
29E1	....	Bert De Vita....	1943	103	148	Dr	Feb. 9, 1951	14.30	....	J 3/4	D, S	L	
29E2	....	McMillin.........	1939	118	110	Dr, 8	Feb. 15, 1951	40.70	....	J 1	D	L	
29E3	....	.....do............	....	112	....	Dr, 8	.....do.........	.68	....	L, Wind	D	....	
29F1	....	E. Chase.........	1938	93	106	Dr, 8	Feb. 2, 1951	58.72	....	L 1	D	L, Cp	

29H1	DWR 46	J. Flanagan.....	1890	77	44.5	Du	Dec. 21, 1949	36.34	....	J 1/4	D	Cp	
							Mar. 9, 1951	23.30					
							Mar. 28, 1952	19.17					
29K1	....	J. Patek.........	1939	80	105	Dr	....	....	....	....	A	L	
29N1	....	J. L. Hansen....	....	72	33.0	Du	Jan. 26, 1950	13.91	....	S 1/4	D	....	
29N2	....	McEllerin.......	....	69	310	Dr, 6	.....do.........	.90	....	....	......	L	
29Q1	....	H. Morkt........	1946	77	170	Dr	....	....	....	....	A	L	
29Q2	....	.....do...........	1946	70	149	Dr, 8	....	....	....	J 3	D	L	
30A1	....	L. L. Day.......	....	133	80	Dr, 6	Jan. 31, 1951	42.48	....	....	D	....	
30A2	....	.....do...........	1948	133	200	Dr, 8	....	....	....	J 1	D	L	Reported to pump 1 gpm.
30B1	....	R. C. Potter....	....	110	55	Dr, 8	Jan. 27, 1950	15.28	....	....	U	L	
30B2	....	.....do...........	1948	110	570	Dr, 12	Jan. 10, 1947	Flowing	73	J 2	D, Dy, S	Cp, L	Reported to pump 30 gpm.
							Jan. 27, 1950	1.71					
							Mar. 21, 1950	Flowing					
30B3	....	.....do...........	....	110	86.0	Dr, 8	Jan. 26, 1950	14.64	....	....	U	....	
30P1	....	L. Longhurst...	....	118	347	Dr, 10	.....do.........	10.25	....	....	U	L	
30R1	....	C. Stornetta....	....	70	1,400	Dr, 12	.....do.........	Flowing	68	....	U	Cp, L	
							Mar. 21, 1950	Flowing					
31C1	....	L. Longhurst...	1947	95	344	Dr, 6	Mar. 16, 1950	6.96	....	....	U	L	
31N1	....	F. Martinez.....	1890	55	180	Dr, 3	....	....	66	P 3/4	S	Cp	
31N2	....	.....do...........	1948	90	180	Dr, 10	Mar. 16, 1950	21.77	62	[6]L	D, S	Cp	
							Mar. 9, 1951	22.34					
							Mar. 27, 1952	[3]59.50					
							Mar. 28, 1952	21.96					
32J1	DWR 48	R. Huntoon......	1916	31.25	29.0	Du	Dec. 21, 1949	20.17	....	J 1	D	C	
32R1	....	J. Matheson....	....	20	....	Dr	....	....	....	J 1/2	S	Cp	
32R2	....	.....do...........	1949	50	150	Dr, 8	Mar. 13, 1951	47.10	....	L 1/2	D, S	Cp, L	
							Mar. 28, 1952	47.07					
33N1	DWR 50	A. V. Long......	....	23	60.5	Dr, 12	Dec. 21, 1949	23.18	....	J 1/2	D	L	
34A1	DWR 61	Suscol Dairy Ranch.	....	16	131.0	Dr, 10	.....do.........	69.56	....	....	U	....	
							Mar. 27, 1952	45.45					
34R1	DWR 63	T. T. Somkey...	....	5	51.0	Dr, 6	Aug. 3, 1948	[1]15	....	J 1/3	S	....	
							Dec. 21, 1949	8.84					
35B1	DWR 60	John Gaines.....	....	75	25	Du	....	....	....	....	A	....	
35B2	....	.....do...........	....	75	112.5	Dr	Dec. 9, 1949	19.13	....	J 3/4	D	....	

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 5 N., R. 4 W.—Continued							
5/4-35E	DWR 64	John Gaines.....	....	....	12	Du	....	....	....	....	A	....	
35G1	....	Reimel's Restaurant.	1950	68	302	Dr, 12	May 5, 1950	32.65	68	....	U	L	Reported to pump 2 gpm.
							May 3, 1951	10.70					
							Mar. 28, 1952	8.14					
35G2	....	.....do............	1948	68	185	Dr, 8	.....do..........	16.15	....	L 3	D	Cp	
35L1	DWR 62	T. T. Somkey...	....	25	31.0	Du	Dec. 21, 1949	Dry	....	....	U	....	
35R1	DWR 74	A. Kurts	....	39	....	Du	.....do..........	27.9	....	....	U	....	
35R2	DWR 73	.....do............	....	42	60	Dr, 6	....	....	....	L, Wind	D	....	
35R3	....	.....do............	1946	37	70	Dr, 6	....	....	....	L	D	L	
35R4	....	.....do............	1948	23	1,208	Dr	....	....	....	....	U	L	
36C1	....	E. J. Devlin.....	1930	160	150	Dr, 8	Mar. 23, 1951	Flowing	68	....	U	Cp	
36C2	....	.....do............	1930	160	150	Dr, 8	.....do.........	Flowing	....	....	S	....	Reported to pump 500 gpm.
36N1	....	....	....	56	....	Dr, 6	Mar. 9, 1950	16.46	....	J 1/2	D	....	
						T. 5 N., R. 5 W.							
5/5- 2A1	....	O. C. Struve.....	....	750	64	Dr	....	....	....	....	D	L	
23R1	....	L. Longhurst....	1940	155	480	Dr, 12	1940	[1]Flowing	....	....	D, S	Cp	Reported to pump 350 gpm.
							Jan. 26, 1950	6.34	....	....	......	....	Piped to dwelling by siphon.
24J1	....	....	....	180	10.0	Du	Apr. 13, 1950	2.75	....	Wind	S	....	
26G1	....	Stornetta's Dairy.	....	285	410	Dr, 6	Jan. 26, 1950	57.40	....	J 1	S	Cp, L	

T. 6 N., R. 3 W.

6/3-19M1	...	J. E. Wilson	1949	540	190	Dr, 8	Apr. 25, 1949 Apr. 29, 1949 Feb. 6, 1951	[1]20 [1]23 118.4	...	L 1	D	Cp, L	Reported to pump 10 gpm with 127-ft drawdown.
30K1	...	Vic Mugsek	1949	270	102	Dr, 8	...	...	...	...	...	L	
30M1	...	F. T. Hermes	1948	160	228	Dr, 6	Feb. 1, 1950	33.53	70	J 3/4	D, S	Cp, L	
30N1	...	M. E. Benson	1910	115	380	Dr, 10	Mar. 22, 1950	Flowing	75	...	D	Cp	Flowing 60 gpm Mar. 22, 1950.
30Q1	...	E. L. Bess	1948	195	272	Dr, 10	Apr. 25, 1950	35.38	...	J 1	D	...	
31B1	W 45 C 55	N. K. Davis	...	240	315	Dr, 12	June 1918 Dec. 15, 1949	6.0 68.98	...	...	U	L	Reported to pump 120 gpm.
31G1	...	Mrs. Buehler	1948	145	465	Dr, 10	....do....	1.98	68	...	U	Cp, L, W	Flowing 24 gpm Dec. 15, 1949.
31H1	...	N. K. Davis	1948	180	330	Dr, 12	....do....	26.52	67	T 25	Irr	Cp, L, W	
31K1	...	Napa Country Club.	1929	150	348	Dr, 8	Dec. 14, 1949 Mar. 22, 1950	Flowing Flowing	68	C 2	D, Irr	Cp, L	Water reported to have high iron content. Reported to pump 160 gpm.
31M1	...	...	...	115	298	Dr, 18 1/2	June 1918	Flowing	...	...	D	...	
31N1	...	Conley Bros	...	170	240	Dr, 12	Nov. 15, 1937	[1]16.7	...	T 7 1/2	D, Irr, S	...	
32E1	...	N. K. Davis	1948	225	380	Dr, 12	Dec. 15, 1949	74.22	...	...	U	L	
33J1	...	J. H. Acheson	1948	1,430	...	Dr, 12	Apr. 4, 1952	84.71	...	T 25	Irr	...	

T. 6 N., R. 4 W.

6/4- 4E1	...	J. G. Regusci	...	110	600	Dr, 16	Dec. 6, 1949	12.04	...	...	U	L	Reported to be a dry hole.
4N1	...	....do....	...	67	320	Dr, 12	Feb. 15, 1950	11.80	...	L 5	D, S	...	
5A1	C 22B	Parker Ranch	1916	107	127.0	Dr, 16	Dec. 16, 1949	7.23	...	L 3	D	L	
5B1	C 22A	....do....	1916	...	58	Dr	...	...	...	...	A	L	
5B2	C 22	....do....	1916	...	28	Dr	...	...	...	...	A	L	
5J1	C 21	J. G. Regusci	1916	...	292	Dr	...	...	...	...	A	L	
5L1	...	F. Zwissig	...	69	58	Dr, 8	Dec. 6, 1949	6.94	...	L, Wind	U	...	

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
							T. 6 N., R. 4 W.—Continued						
6/4- 5Q1	C 23	F. Zwissig......	1916	65	99	Dr	Dec. 6, 1949	8.38	....	L	U	L	
6B1	DWR 2	C. L. Land......	....	80	26	Du	Nov. 30, 1949	13.82	....	C 1	D	....	
6L1	DWR 3	C. E. Herrick...	....	82	40.0	Du	.....do.........	14.50	....	J 1/2	D	....	
6P1	....	P. R. Allen......	1949	75	120	Dr, 12	Dec. 1949 Apr. 19, 1950	[1]12 6.65	63	T 10	Irr	Cp, L	Pumped 400 gpm with 26-ft drawdown. Measured by USGS.
6R1	W 17 C 20	Frank Zwissig.	1916	100	66.6	Dr, 26	July 27, 1948	[1]32	....	T 7 1/2	D, Dy, S	L	Reported to pump 15 gpm with 15-ft drawdown.
6R2	....	.....do............	1948	100	220	Dr, 12	Dec. 6, 1950	16.90	....	T 40	D, Dy, Irr, S	L	Reported to pump 400 gpm.
7A1	DWR 24	C. Prelli.........	....	70	35.0	Dr, 10	Nov. 30, 1949	17.62	....	....	U	....	
7A2	....	.....do............	1935	70	122.0	Dr, 8	.....do.........	16.26	....	J 3	D, Irr	....	Reported to test pump 400 gpm with 20-ft drawdown.
7D1	....	Mrs. Z. D. Page..	1905	77	25.0	Du, 6	Dec. 21, 1949	7.82	....	L 1/4	D	....	
7E1	....	A. Ghiorso......	1946	75	120	Dr, 6	Dec. 22, 1949	14.01	....	J 1	D, S	Cp	
7E2	....	R. G. Gentry....	1949	74	120	Dr, 8	.....do.........	9.3	....	J 1	D	....	
7N1	....	W. M. Reese....	1949	140	90	Dr, 8	July 1949	[1]15	....	J 1	D, irr, S	....	
8E1	....	L. M. Ragatz...	1947	70	32	Dr, 6	Nov. 30, 1949	14.73	....	J 1	D, S	W	Reported to pump 300 gpm.
8E2	....	.....do............	1947	70	100	Dr, 10	....	....	62	T 7 1/2	Irr	Cp, L	
8M1	....	H. L. Page......	1905	70	80	Dr, 6	Dec. 22, 1949	13.10	59	L	D, irr, S	Cp	
8P1	....	H. T. Hoffman..	1873	72	18.0	Du, 6	.....do.........	13.84	....	J 1/2	D	....	

10R1	....	Ed Conrado	1948	170	100	Dr, 8	Jan. 31, 1950	4.81	....	J 1	D	L	
15A1	....	G. L. Caveney..	1944	220	121	Dr, 8	Feb. 8, 1950	66.30	....	J 1/2	D	L	
15E1	W 26	P. A. Gasser ...	....	61	102	Dr, 6	June 1918	1.5	....	....	S	L	
	C 34												
15J1	....	H. A. McColley .	1948	105	127	Dr, 6	Feb. 8, 1950	1.79	....	J 1	D	L	
15L1	....	Mrs. Shreeve...	1945	74	125	Dr, 8	Jan. 31, 1950	1.72	....	J 1	D	L	Reported to pump 25 gpm with 27-ft drawdown.
15M1	....	W. L. Carpenter	1948	66	75	Dr, 8	....	....	....	J 1/2	D	....	
15P1	....	E. C. Grimes...	1940	63	204	Dr	....	....	....	J 1 1/2	D, S	L	
15Q1	....	A. R. Johnston ..	1945	67	303	Dr, 8	Oct. 13, 1949	27.00	68	J 1	D, S	Cp, L, W	
15Q2	....	.....do...........	1945	50	90	Dr, 8	.....do.........	18.08	....	....	U	L, W	
15Q3	....	G. Jepson........	....	65	327	Dr, 8	May 22, 1948	[1]12	....	....	D	L	
15Q4	W 30	T. J. Olivera....	....	74	280	Dr, 8	July 1918	[1]60	....	J 3	D, S	L	
	C 38												
15R1	W 31	Christopherson Bros.	....	60	96	[2]Dr, 6	June 1918	3.0	....	C	U	....	
	C 39						Dec. 9, 1949	8.71					
16B	W 18	....	....	....	42	Dr, 6	June 1918	9.0	....	....	......	....	
	C 24												
16E1	W 19	T. H. Townsend.	....	71	26	Du, 4	.....do.........	20.0	....	T 5	Irr	L	
	C 25						Dec. 8, 1949	23.02					
16E2	....	.....do...........	1908	71	27.0	Du, 4	Dec. 6, 1949	24.88	....	....	U	....	
16H1	....	....	1949	57	98.0	Dr, 6	Oct. 5, 1949	8.20	....	J 1	D	....	
16M1	....	D. Wheatley.....	1930	67	100	....	Nov. 30, 1949	20.38	....	J 1	D	....	
16N1	....	V. P. Turner	....	68	100.5	Dr	Nov. 10, 1949	17.75	....	J 1	D	....	
16N2	W 25	.....do...........	....	68	59.0	Dr, 6	June 1918	7.0	....	....	U	....	
	C 33						Dec. 8, 1949	9.50					
16N3	DWR 26	John Hartley....	....	67	20.0	Du, 5	Nov. 22, 1949	15.20	....	....	U	....	
16P1	DWR 1	L. Avanzino.....	....	62	76	Dr	June 1918	16.3	....	J 1	......	....	
	W 27						Nov. 22, 1949	17.30					
	C 35												
17A1	....	Richard Ohlandt.	1948	67	250	Dr, 12	Oct. 13, 1949	16.62	....	T 10	Irr	W	Reported to pump 250 gpm.
17F1	W 20	R. J. Deese	....	33	....	Dr, 13	1913	[1]8.0	....	....	U	....	
	C 27						Mar. 27, 1952	5.77					
17F2	....	.....do...........	1946	83	....	Dr, 10	.....do.........	6.38	....	J 3	D, Irr	....	

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 6 N., R. 4 W.—Continued							
6/4-17G1	DWR 10	D. Wheatley	1920	81	252	Dr	Nov. 23, 1949	27.60	...	L	D	...	Reported to pump 300 gpm.
17G2	...	do	1930	82	192	Dr	May 17, 1939	[1]22.9	65	T 5	Irr	Cp, L	Reported to pump 150 gpm.
17G3	W 21 C 28	do	...	81	175	Dr, 8	June 1918 Dec. 1, 1936	23.0 [1]28.0	...	...	A	...	
17H1	...	Richard Ohlandt.	1946	78	206	Dr	...	...	...	T 25	Irr	L	Reported to pump 300 gpm.
17H2	...	G. M. Nowell	...	75	104	Dr	Dec. 8, 1949	24.89	...	T 7 1/2	Irr	...	Reported to pump 200 gpm.
17H3	...	do	1895	74	86	Dr	...	...	...	J 1 1/2	D	L	
17J1	...	D. Wheatley	1938	75	190	Dr	Nov. 23, 1949	22.20	...	...	U	...	
17K1	...	do	1930	86	160	Dr, 12	do	23.68	...	T	Irr	...	
17K2	...	do	...	86	25	Du	do	22.38	...	...	U	...	
18A1	...	J. M. Rodgers Dairy.	...	87	250	Dr	1948	[1]10	...	T 15	D, Irr, S	Cp	
18A2	DWR 12	do	...	85	105.5	Dr	Nov. 29, 1949 Mar. 27, 1952	30.00 17.34	...	T 3	D, S	Cp	
18A3	...	do	1950	82	755+	Dr, 12	do	12.15	66 1/2	T	Irr	Cp, L	
19B1	...	Oak Knoll Ranch.	1950	125	125	Dr, 12	do	20.68	...	T 20	...	L	
19R1	W 23 C 30	Louis Wurz	...	120	56.0	Du	June 1918 Dec. 8, 1949	42.0 33.54	...	J 1	D	...	
20E1	W 22 C 29	...	...	110	115	Dr, 8	June 1918	19.7	...	...	A	...	
20L1	DWR 11	V. H. Thomas	...	107	44.0	Du, 5	Nov. 23, 1949	21.74	...	...	U	...	

20L2	......	.....do......	......	107	97.5	Dr, 12	.....do......	22.00	......	L 1	D	......	
20M1	......	......	......	114	......	Du	Dec. 6, 1949	18.00	......	L	Irr	......	
20P1	W 24	F. M. Milton.....	......	102	90	[2]Dr	June 1918	30.0	......	J 3/4	D	......	
	C 32						Dec. 8, 1949	17.66					
21B1	W 28	Jordan......	......	62	67.0	Dr, 6	June 1918	10.1	......	C 2	D	......	
	C 36						Dec. 9, 1949	11.37					
21G1	DWR 21	M. Wiloth......	......	61	21.0	Du	Nov. 22, 1949	4.72	......	C	U	......	
21H1	DWR 13	H. Boudier......	......	56	80	Dr, 6	......	......	......	L 3/4	D	......	
21J1	......	L. L. Thoreson.	1949	50	86	Dr, 8	Aug. 1943	[1]7	......	J 1	D	L	
							.....do......	[1]12					
							Apr. 14, 1950	6.14					
21P1	DWR 17	Jack Dukes......	......	67	48	Dr	......	......	......	J	D	Cp	
21P2	......	.....do......	......	67	91.8	Dr, 6	Nov. 23, 1949	20.80	......	......	U	W	
21Q1	W 29	J. Gonnders.....	......	66	110	Dr, 8	June 1918	13.4	......	......	A	L	
	C 37												
22B1	......	Guy Hartman...	1946	72	89	Dr, 8	......	......	......	......	D	L	
22B2	......	.....do......	1948	60	117	Dr, 8	......	......	......	J	D	L	
22B3	......	R. Johnson......	1948	86	237	Dr, 8	......	......	......	......	D	L	
22N1	DWR 14	Beagles' Ranch.	......	48	26	Du	......	......	......	......	A	......	
22P1	......	Wm. Fisher.....	1939	53	125	Dr, 6	July 13, 1949	[1]28.7	......	L 1	D	W	Reported to pump 15 gpm.
							Nov. 22, 1949	29.27					
							Mar. 27, 1952	18.96					
22P2	DWR 16	.....do......	......	42	49.5	Dr, 8	Nov. 22, 1949	18.10	......	J 2	D	Cp, W	
23F1	......	G. Brown......	1946	75	220	Dr	Feb. 1, 1950	39.94	......	T 10	S	L	Reported to pump 20 gpm. Pumped dry October 1949.
23J1	......	V. Maxwell......	1947	87	700	Dr, 18	.....do......	Flowing	85	T 40	Irr	Cp, L	Reported to pump 665 gpm with 66-ft drawdown.
							Apr. 3, 1950	Flowing					Flow measured as 13 gpm Apr. 3, 1950.
23Q1	......	Fernangos......	......	82	114.3	Dr, 8	Oct. 13, 1949	36.76	......	L 1	D	......	
24M1	......	V. Maxwell......	1940	77	......	Dr, 18	July 23, 1940	Flowing	......	T 20	Irr	Cp	Reported to pump 830 gpm.
							Feb. 1, 1950	Flowing					
							Apr. 3, 1950	Flowing	75				
25B1	......	Ben McKinzey..	1948	160	129	Dr	Feb. 9, 1950	45.0	......	J 1	......	Cp, L	
25B2	......	R. K. Northrope	1946	120	185	Dr, 8	......	......	......	L 2	......	Cp, L	
25C	W 41	F. Cuthbertson	......	......	250	Dr, 10	June 1918	Flowing	......	......	A	......	
	C 51												

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
							T. 6 N., R. 4 W.—Continued						
6/4-25D1	W 39 C 49	Vichy Springs..	1917	95	305	Dr, 10	June 1918	Flowing	....	T 15	(7)	Cp, L	Flow measured as 97 gpm Mar. 23, 1950.
							Dec. 13, 1949	Flowing					
							Mar. 23, 1950	Flowing	74				
25E1	W 40 C 50	.....do............	....	90	....	Dr, 10	June 1918	Flowing	....	J 1	D	....	
							Oct. 13, 1949	2.29					
							Mar. 23, 1950	Flowing					
25E2	W 38 C 48	Lepori Estate ..	....	102	188	Dr	June 1918	Flowing	....	....	(6)	L	
25F	W 42 C 52	B. A. Burrill	....	....	132	Dr, 10	.....do.........	[1]50	....	....	A	L	
25F1	....	.....do............	1920	90	110	Dr, 10	Mar. 17, 1950	9.34	....	J	D	C	
25Q1	....	T. F. Werner...	....	70	80	Dr, 8	Feb. 17, 1950	6.07	....	J	D	L	
25R1	....	A. M. Lauritsen	....	105	409	Dr	March 1950	Flowing	....	T 5	(7)	....	
26F1	....	D. Daniels......	1944	62	204	Dr, 6	....	....	....	J 1	D	L	
26H1	....	Hedgeside distillery.	1934	85	643	Dr	Mar. 23, 1950	Flowing	75	T 5	D	L, Cp	
26L1	....	V. A. Bradley...	1946	53	249	Dr, 6	....	....	....	J 1 1/2	D	L	
26L2	....	R. R. Mohr......	1945	50	180	Dr, 6	Feb. 1, 1950	12.11	....	J 1 1/2	D, irr	Cp, L	
26N1	....	H. J. Vollmer ..	1931	32	150	Dr, 8	Jan. 12, 1950	23.47	60	L 3/4	D	Cp, L	
27C1	....	John Platt	1932	40	60	Dr, 6	....	....	....	L 1	D	C	
27C2	....	.....do............	1950	40	240	Dr	....	....	....	....	A	....	Reported to pump 1/2 gpm.
27D1	....	J. Renwick	1948	59	120	Dr	Oct. 11, 1949	26.05	....	J 2	D	....	
27E1	W 32 C 40	....	....	....	84	Dr, 6	....	....	....	....	A	....	

27L1	DWR 33	F. G. Anderson	....	51	79.0	Dr	Nov. 21, 1949	23.82	....	J 3/4	D	....
27M1	....	W. A. Bird	1948	55	108	Dr, 8	....	....	....	J 1/2	D	L
27N1	DWR 34	C. M. Ellis......	....	50	111.5	Dr. 8	Nov. 21, 1949	24.12	....	J 1	D, S	L
27N2	....	V. Parrett.......	1929	48	125	Dr, 8	Jan. 11, 1950	18.98	....	J 1	D	L
27N3	....	C. Fields	1948	52	100	Dr, 8	March 1948	[1]17	....	J 3/4	D	L
27P1	....	J. D. Canton	....	47	....	Dr	....	....	....	T 7 1/2	Irr	....
27P2	DWR 15	.....do...........	....	45	62	Dr	Nov. 21, 1949	13.20	....	J 1	D	....
28F1	DWR 22	F. E. Scott	1948	68	99	Dr, 6	Feb. 8, 1950	3.03	....	J 1	D	Cp
28G1	....	N. L. Brup-bacher.	....	65	80	Dr, 8	Nov. 22, 1949	17.24	....	J 3/4	D	....
28H1	....	D. W. Rendle-man.	1938	61	85	Dr, 6	....	....	....	L 3/4	D	L
28K1	....	A. E. Stumley ...	1944	62	90	Dr, 6	Oct. 11, 1949	24.06	....	....	U	L, W
28K2	....	.....do...........	1950	62	155	Dr, 8	July 1950	[1]30	....	L 3	D, S	Cp, L
							Mar. 1, 1950	11.45				
28M1	DWR 31	W. P. Raymond .	1918	72	21.5	Du, 3	Nov. 22, 1949	13.29	....	1/4	D	....
28M2	DWR 32	S. Marchetti.....	....	71	71.0	[2]Dr	.....do.........	10.40	....	....	U	....
28M3	....	.....do...........	1931	71	179	Dr, 8	....	....	....	J 3	D	L
28N1	....	W. C. Jarzyna...	1948	68	85	Dr, 6	Sept. 1949	[1]14	....	J 1/4	D	L
							Jan. 25, 1950	12.43				
28Q1	....	W. H. Luhman...	1930	57	219	Dr	....	[1]20	....	L	U	L
29B1	DWR 23	J. Avery	1921	92	112	Dr, 8	Nov. 23, 1949	15.17	....	L 1	D	....
29J1	....	E. Hamblin......	....	82	120	Dr, 6	Oct. 11, 1949	12.11	....	J 1	L	....
29R	W 33 C 41	....	....	....	135	Dr, 12	June 1918	15.7	....	....	A	L
30B1	....	....	1935	128	104	Dr, 8	....	....	....	....	D	L
30C1	....	D. P. Bales......	1928	152	104	Dr, 8	1928	[1]31	....	J 1	D	Cp, L, W
							Sept. 30, 1949	45.68				
30C2	....	Love Ranch	1950	155	185	Dr, 8	June 8, 1951	28.90	....	L 2	D	L
32D1	....	R. M. Douglas ..	....	103	78.5	Dr	Nov. 10, 1949	29.54	....	L 1/3	D	Cp
32G1	....	E. Dougherty....	1947	93	115	Dr, 6	Jan. 31, 1950	5.20	....	....	U	L
32J1	....	A. McKenzie....	....	97	475	Dr, 8	Oct. 12, 1949	43.68	....	J 1/2	D	L
32J2	....	J. Cameron......	1948	95	100	Dr, 6	....	....	....	J 1	D	....
32J3	....	G. N. Wagner....	1939	94	80	Dr	....	....	....	L 1	D	L
32J4	....	P. Everett.......	1948	93	100	Dr, 6	....	....	....	J 1	D	L
32J5	....	C. B. Santini.....	1948	93	150	Dr, 8	Feb. 16, 1950	20.32	....	J 1 1/2	D	....

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

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						T. 6 N., R. 4 W.—Continued							
6/4-32J6	....	R. L. Perryhouse.	1948	95	101	Dr, 6	Feb. 16, 1950	8.60	....	J 1	D	....	
32L1	....	F. Thomas........	....	117	165	Dr, 8	Dec. 29, 1949	40.82	....	1	D	L	
32N1	....	.....do........	....	140	519	Dr, 8	Oct. 11, 1949	49.03	....	....	U	L	
32N2	....	.....do........	....	123	325	Dr, 8	.....do........	28.06	....	L 3	D, S	L	
32N3	....	.....do........	....	125	112.0	Dr, 8	Dec. 23, 1949	24.28	....	....	U	L	
32N4	....	.....do........	....	125	84.0	Dr, 8	.....do........	22.10	....	....	U	L	
32P1	....	B. R. Cester........	....	113	130	Dr	Sept. 30, 1949	38.76	....	J 1	D	....	
32P2	....	F. Thomas........	....	123	161	Dr, 6	Dec. 23, 1949	15.57	....	....	U	....	
32R1	....	George Harmon.	1929	97	134.1	Dr, 8	Feb. 9, 1950	12.13	....	L 1	D	L	
33F1	....	A. Gasser........	....	74	420	Dr, 12	Oct. 11, 1949	12.74	65	....	U	Cp, W	Pumped 60 gpm with 112-ft drawdown on test.
33H1	....	State Div. Forestry.	....	51	104	Dr, 8	Oct. 5, 1949 Mar. 28, 1952	11.68 1.18	....	J 1 1/2	D,irr	Cp	
33J1	....	C. Filippini........	....	60	42.5	Dr, 6	Oct. 13, 1949	7.36	....	....	U	W	
33L1	W 35 C 40	A. McKenzie........	....	75	138	Dr, 6	June 1918	9.7	....	....	A	L	
33L2	....	.....do........	1931	75	202	Dr, 8	....	....	....	J 1	D	L	
33M	W 34 C 42	....	....	....	87	Dr, 8	June 1918	12.0	....	....	A	L	
33M1	....	W. Gugliemetti..	1940	85	175	Dr, 8	Oct. 12, 1949	13.64	....	....	U	L	
33M2	....	E. Paniagua........	....	82	44.5	Dr, 8	Dec. 13, 1949	13.33	....	....	D		
33Q1	W 36 C 45	C. G. Langum........	....	69	114	Dr, 6	June 1918 Dec. 13, 1949	5.0 9.34	....	S 1/3	D	L	
33Q2	....	R. M. Knowlton..	1947	68	85	Dr, 6	....	....	....	J 1	D	L	

34B1	DWR 52	M. J. Ducharm ..	....	47	77	[2]Dr	Nov. 18, 1949	43.46	....	J 1/4	D	Cp	
							Mar. 28, 1952	31.97					
34D1	....	A. Gasser	1944	40	194	Dr, 8	Oct. 12, 1949	16.76	....	L 3	D, S	L	
							Mar. 27, 1952	2.90					
34D2	....	.....do........	....	43	380	Dr, 12	Oct. 12, 1949	13.72	....	....	U	L, W	
							Nov. 1, 1949	13.65					
							Nov. 10, 1949	13.24					
34D3	....	.....do........	1950	41	219	Dr, 10	Aug. 9, 1950	13.72	....	T 10	Irr	L	
							Mar. 27, 1952	3					
34G	W 37 C 46	J. S. Grum	....	....	300	Dr, 6	....	....	....	....	A	....	
34H	....	George VonUhlit	....	....	....	Dr	....	....	....	T 7-1/2	Irr	....	
34H1	....	....	....	42	60.5	Dr, 6	Mar. 17, 1950	39.13	....	L 1	S	....	
							Mar. 28, 1952	37.36					
34K1	....	A. B. Grant	1948	40	85	Dr, 6	Feb. 2, 1950	24.50	....	J 1/2	D	L	
34M1	....	Napa Valley Inn.	1931	48	202	Dr, 8	Feb. 9, 1950	9.10	....	L	D	L	
35F1	....	C. J. Sevener....	1920	55	311	Dr	....	....	....	L 5	D	L	Reported to pump more than 24 gpm.
35G1	DWR 54	N. Solari........	....	36	27.0	Du, 3	Nov. 21, 1949	24.60	....	L, Wind	U	....	
35G2	....	T. E. Longworth.	1948	37	258	Dr, 8	....	....	....	J 1-1/2	D	L	
35G3	....	L. W. Johnson....	....	38	260	Dr, 6	Jan. 31, 1950	8.11	....	J 1	D	Cp	
35G4	....	Cliff Lowe........	....	27	250	Dr, 8	Mar. 27, 1952	2.64	....	J 3	D,irr	L	Reported to pump 50 gpm with 30 ft draw-down.
35K1	DWR 56 [5]W 47 C 57	City of Napa.....	....	27	1,586	Dr, 12	June 1918	Flowing	86	T 25	U	Cp, L	Flow measured as 3 gpm March 21, 1950.
							Nov. 21, 1949	Flowing					
							Mar. 21, 1950	Flowing					
35K2	DWR 55	.....do........	....	27	27.5	Du, 10	.....do........	22.14	....	....	U	....	
35L1	DWR 53	N. Adustino	....	24	137.0	Dr	Nov. 18, 1949	5.96	....	L, Wind	D	....	
35L2	....	L. G. Wilkins....	....	25	260	Dr, 8	....	....	....	J 1	D, S	Cp, L	
35L3	....	J. A. Navoni	....	23	100	Dr, 9	Mar. 9, 1950	11.56	....	T 5	Irr	C	Reported to pump 65 gpm.
35P1	....	E. G. Van Winkle	1945	75	200	Dr, 8	Jan. 26, 1950	57.65	....	C 3/4	irr	L	
35P2	....	D. E. Barber	1950	22	105	Dr, 8	June 15, 1950	17.76	....	J 2	irr	L	
35Q1	....	G. Hewitt	1937	140	192	Dr, 8	....	....	....	J 3	D,irr	L	Reported to pump 50 gpm.

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 6 N., R. 4 W.—Continued							
6/4-35R1	....	J. L. Healey.....	....	230	382	Dr, 6	Feb. 8, 1950	[1]150	....	L 5	D	L	Reported to pump 10 gpm.
36B	W 44 C 54	W. G. Smith.....	....	....	350	Dr, 8	June 1918	Flowing	....	....	A	L	
36B1	....	F. M. French...	....	90	200+	Dr, 8	Dec. 14, 1949	20.50	....	L 1	D	....	
36B2	....	....do....	....	105	96.0	Dr, 5	.....do..........	45.10	....	....	U	....	
36C1	....	Raahauge Dairy	....	55	447	Dr, 10	April 1948 Apr. 5, 1950	[1]9.9 [1]8.9	....	T 10	Irr	L	Reported to pump 150 gpm with 113 ft drawdown.
36D1	W 43 C 53	....	....	57	230	Dr, 6	June 1918	Flowing	....	....	A	....	
36F1	....	L. Paine..........	1949	94	125	Dr, 8	....	....	....	J 3/4	D	L	
36H1	....	Conley Bros.....	....	105	525	Dr, 8	Mar. 10, 1950 Mar. 27, 1952	Flowing Flowing	....	T 5	Irr	....	
36H2	....	J. Ulrich..........	1951	100	332	Dr, 8	Nov. 5, 1951 Mar. 27, 1952	19.36 13.87	....	J 1	D	L	
36H3	....	....	1951	103	....	Dr, 12	.....do..........	Flowing	....	J 1	D	....	
36J1	....	R. Green..........	1948	130	432	Dr, 8	Feb. 2, 1950	41.85	....	L 3/4	D	Cp, L	
36K1	....	P. E. Pollock....	1948	100	87	Dr, 8	....	....	61	....	D	L	
36L1	....	E. McClendon....	1948	60	243	Dr	....	....	63	J 3/4	D	Cp, L	
36Q1	....	P. E. Pollock....	1933	130	76	Dr, 9	Jan. 12, 1950	35.24	63	L 3/4	D	Cp, L	
						T. 6 N., R. 5 W.							
6/5- 1	W 14 C 17	Veterans Home.	....	....	....	Du	June 1918	9.5	....	....	A	....	

1B	W 10	John Mount...	...	...	130	Dr, 6	...	...	...	...	A	...	
	C 11												
1B	W 11	...do...	...	...	104	Dr, 6	June 1918	16.0	...	...	A	...	
	C 12												
1B1	...	Marie Wright...	1939	105	87.0	Dr, 8	Dec. 2, 1949	17.15	53	L 1/2	D	Cp, L	
1B2	...	Marquez...	...	88	...	Dr	...	...	...	T 10	...	...	
1B3	...	Bon Argulleo...	...	105	57.0	Dr, 6	Dec. 2, 1949	14.98	...	L 1/2	D	...	
1C1	...	M. Frost...	1937	122	127	Dr, 6	Dec. 1, 1949	35.34	54	J 1	D	Cp, L, W	
1C2	...	Marie Cotta...	1939	115	104	Dr, 6	Dec. 2, 1949	26.13	54	L 1	irr	Cp, L	
1C3	...	Sarah Moore...	1939	115	125	Dr, 8	...do...	20.90	60	J 1	D	Cp, L	
1H1	W 15	Veterans Home.	1890	90	21	Du	June 1918	10	...	...	U	...	
	C 18						Nov. 30, 1949	7.25					
1J1	W 16	Napa County...	...	...	125	Dr, 12	...	...	...	...	A	...	
	C 19												
12R1	...	W. M. Reese...	...	200	74.5	Dr, 6	Dec. 22, 1949	29.30	...	...	U	...	
24R1	...	Anton Smerness	...	180	186	Dr, 6	Mar. 30, 1950	[1]15	63	L 3/4	D	Cp	
							Apr. 18, 1950	14.79					
							Mar. 27, 1952	22.42					

T. 7 N., R. 4 W.

7/4-18N1	...	A. Fagiani...	1905	575	59.5	Du, 4	June 27, 1951	18.26	...	...	D	...	
30–	W 13	...	...	...	40	Du	June 1918	17.2	...	...	A	...	
	C 14												
30L1	...	...do...	1939	112	171	Dr, 8	Dec. 20, 1949	...	62	J 1	...	Cp, L	
30M1	...	A. Braddock...	...	114	30.5	Dr, 8	...do...	2.50	...	L, Wind	S	Cp, W	
30Q1	W 12	S. S. Luiz...	...	110	21.0	Du, 4	June 1918	Flowing	...	J 1/2	D	...	
	C 13						Dec. 2, 1949	8.22					
30Q2	...	H. D. McCreary.	1939	115	126	Dr, 8	...	...	64	L 1	D, S	Cp, L	
31A1	...	Dan Fumasi...	...	110	72.5	Dr, 6	Dec. 21, 1949	23.97	...	J 3	D, irr	...	Reported to pump 20 gpm.
31E1	...	A. Fagiani...	...	90	272	Dr, 12	Sept. 30, 1949	9.26	...	...	U	L	
							Mar. 27, 1952	1.82					
31E2	...	Charles Hare...	1948	89	200+	Dr, 8	Dec. 20, 1949	7.31	...	...	U	...	
31H1	...	E. H. Bennett...	...	105	31.5	Du, 6	Dec. 21, 1949	15.09	...	L, Wind	D	...	
32B1	...	Dr. C. D. Hunt...	...	230	98.5	Dr, 6	...do...	7.82	...	L 3/4	D	...	
32B2	...	F. S. Grange...	1917	192	150	Dr, 12	...do...	3.53	...	T 3	D, irr, S	L	

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
							T. 7 N., R. 4 W.—Continued						
7/4-32D1	....	L. Tonnella.....	1939	125	68.5	Dr, 8	Dec. 12, 1949	11.09	....	....	U	L	
							T. 7 N., R. 5 W.						
7/5- 3E1	....	J. Gordon........	....	183	120.0	Dr, 6	Nov. 3, 1949	17.73	....	....	U	....	
3G1	DWR 7	W. W. Everett...	....	188	125	Dr, 8	Oct. 13, 1949	9.35	....	L 5	D	....	
3L1	Napa 1	Gibson Ranch...	....	174.2	35	Dr, 6	Nov. 6, 1949	[1]11.6	....	....	Obs	....	
3L2	Napa G 1	.....do..........	....	171.6	39	[2]Dr, 14	.....do..........	9.4	....	C 5	Irr	....	
3M1	....	.....do..........	1947	230	700+	Dr, 10	Feb. 1, 1950	99.79	76	Ts 5	D, Irr S	Cp	
3N1	Napa W 2	Frank Wood.....	....	161.7	16.0	Dr, 12	Nov. 3, 1949	9.3	....	....	Obs	....	
3N2	....	.....do..........	....	163	....	Dr, 6	.....do..........	9.22	63.5	J 1	S	Cp	
3N3	Napa W 3	.....do..........	....	156	....	....	Mar. 22, 1946	[1]6.6	....	....	A	....	
3P1	Napa W 1	.....do..........	....	168.65	125.0	Dr, 12	Nov. 8, 1949	[1]16.4	....	....	Obs	....	
3P2	DWR 8	W. W. Everett...	....	175	22.0	Du, 6	Nov. 18, 1949	12.03	....	C	Irr	....	
3P3	....	Gibson Ranch...	1947	185	60	Dr	....	....	....	J 5	D	L	
4B1	....	E. Werele.......	1945	215	240	Dr, 8	Nov. 4, 1949	46.26	....	....	......	L	
4B2	....	George Mardi-kian.	....	200	160.0	Dr, 8	Oct. 19, 1949	37.76	....	L 1	D, S	....	
4C1	....	.....do..........	1945	195	270	Dr, 10	.....do..........	23.92	....	T 5	Irr, S	Cp	
4C2	....	E. Werele.......	....	190	205	Dr	Nov. 4, 1949	10.32	....	J 1	D	L	
4D1	....	Wm. Wheeler...	1946	176	43	Dr, 12	Oct. 14, 1949	6.7	....	C	Irr	....	Reported to pump 800 gpm.
4D2	....	L. J. O'Conner..	1950	176	84	Dr	Aug. 11, 1950	4.92	....	J 1	D	....	
4F1	....	George Mardi-kian.	1949	170	35	Du	Oct. 16, 1950	12	....	C	Irr	....	Large sump along riverbank.

4H1	....	J. Gordon........	....	195	220	Dr, 8	Nov. 3, 1949	28.02	....	J 1	D	Cp, L	
4P1	....	Louis Edano	1914	163	19.5	Du, 5	Oct. 18, 1949	12.05	....	C 5	Irr	....	
4R1	....	H. C. Lutley	....	172	39.0	Dr	Nov. 3, 1949	14.89	....	L	U	....	
4R2	....	.....do...........	....	172	53.0	Dr, 6	.....do.........	21.16	....	L 1	D, S	....	
5A1	DWR 37	Wm. Wheeler...	....	182	38.0	Dr, 10	Oct. 14, 1949	6.04	....	C	Irr	....	Reported to pump 500 gpm.
5A2	....	L. Stice	1920	182	220	Dr, 10	.....do.........	12.85	....	....	......	....	Reported to pump 280 gpm.
5A3	....	.....do...........	1920	182	40	Dr, 12	.....do.........	8.95	....	T 7 1/2	Irr	....	Reported to pump 600 gpm.
5A4	....	.....do...........	1920	182	31.5	Dr, 12	.....do.........	8.33	....	....	U	....	
5A5	DWR 38	.....do...........	....	182	16.5	Dr, 12	Nov. 16, 1949	7.41	....	....	U	....	
5C1	....	F. H. White	....	200	57.0	Dr, 8	Oct. 18, 1949	15.73	....	J 1/2	D	....	
5C2	DWR 65	R. L. Huchison..	1920	200	28	Du	Nov. 9, 1949	18.79	....	J 1/2	D	....	
5E1	....	J. R. White......	....	212	29.5	Dr, 6	Oct. 18, 1949	23.19	....	L 3/4	U	....	
5F1	....	C. A. Volpi......	....	202	29.5	Du	.....do.........	23.99	....	J 1/4	D	....	
5H1	....	R. MacAnnan, Jr.	....	178	40.0	Dr, 8	Sept. 27, 1949	6.65	....	T 3	U	W	
5H2	....	.....do...........	....	178	21.5	Dr, 8	.....do.........	5.80	....	....	D	W	
5H3	....	L. Stice	....	179	155	Dr	Mar. 27, 1952	1.89	....	J 1	D	....	
5K1	....	R. E. Christie...	....	192	90	Dr	Oct. 14, 1949	16.11	....	J 1	D	....	
6B1	....	F. Beroldo	....	234	230	Dr, 12	Oct. 19, 1949	21.09	....	T 3	Irr	....	
							Mar. 27, 1952	9.56	....	....	......	....	
6D1	....	F. Rashe.........	1915	257	58.0	Du, 4	Nov. 6, 1949	34.74	62	J 1 1/2	D, S	Cp	
							Mar. 27, 1949	11.60					
6J1	....	A. Coombs	....	215	100	Dr, 8	Oct. 19, 1949	30.81	....	J 1	D	....	
8A1	....	Kenyon	....	175	129.0	Dr, 10	Oct. 18, 1949	18.99	....	T 5	D,Irr	....	
8B	DWR 44	Olsen	....	....	16	[2]Du	....	....	....	....	A	....	
8D1	....	S. S. Frederick .	....	190	50.0	Dr, 10	Oct. 14, 1949	14.78	....	....	U	W	
8G1	....	Chavez	1931	174	200+	Dr, 10	Sept. 30, 1949	13.67	....	T 7 1/2	U	....	
							Mar. 27, 1952	3.77					
8H1	DWR 43	Galleron.........	1880	167	24.5	Du, 3	Oct. 18, 1949	13.92	....	C	irr	....	
8K1	....	H. Pestoni.......	1939	171	250	Dr, 8	Oct. 20, 1949	20.64	....	J 5	D, S	Cp	
9E1	....	Dal Portò and Baldocchi.	....	158	226	Dr, 14	....	....	....	T 15	Irr	L	Reported to pump 700 gpm.
9M1	....	E. L. Barber ...	1918	157	15.0	Du	Oct. 18, 1949	12.00	....	S 1/3	D, S	Cp	
9M2	....	Lutley Ranch ...	1934	157	68	Dr, 12	.....do.........	7.48	....	J 1	D,irr, S	....	Reported to pump 25 gpm.

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 7 N., R. 5 W.—Continued							
7/5- 9M3	....	Lutley Ranch...	1949	157	200	Dr, 12	Nov. 5, 1951	6.45	....	T 10	Irr	....	
9Q1	....	R. Webster......	1948	152	40	Dr, 12	Dec. 7, 1949	6.76	....	C	Irr	L	
10B1	....	....	....	169	19.5	Du, 6	Nov. 4, 1949	12.91	....	S, Hand	D	....	
10C1	DWR 9 Napa C 1	W. E. Cole......	1912	162.2	30.0	Du 11 by 13	Nov. 3, 1949	12.60	....	T 15	Irr	....	Reported to pump 750–1500 gpm. Amount depends on flow of Conn Creek.
10E1	....	K. Wagner.......	1917	160	45.5	Dr, 6	Oct. 20, 1949	14.15	....	J 1/2	D	....	
10G1	Napa 3	Douglas Pringle	....	159.5	48.5	Dr, 6	Nov. 3, 1949	12.5	....	....	Obs	....	
10G2	....	.....do...........	1949	165	145	Dr, 12	Feb. 1, 1950	24.16	....	....	U	L	
10G3	....	.....do...........	1943	162	120	Dr, 8	.....do.........	24.5	....	T 7 1/2	D	....	
10K1	....	....	....	155	32	Dr, 8	Nov. 3, 1949	13.81	....	J 1/2	D	Cp	
10P1	....	Thomas Fealy..	....	158	51	Dr	Oct. 20, 1949	16.70	....	J 1/2	D, S	....	
10R1	Napa 2	Beaulieu Vineyard.	....	146.4	44.0	Dr, 6	Oct. 4, 1949	9.44	....	....	Obs	....	
11E1	....	.....do...........	....	165	110	Dr, 8	.....do.........	29.12	....	J 3/4	D	....	
11F1	....	....	....	179	....	Dr, 6	Nov. 4, 1949	34.16	....	L, Wind	S	....	
14A1	....	H. Hopman......	....	143	60	Dr, 8	Oct. 14, 1949	15.43	....	P	S	Cp, L, W	
14B1	....	W. Ponchetta....	1934	138	60.5	Dr	Dec. 13, 1949	12.07	....	J 1/2	D	....	
14E1	DWR 41	Emil Schmidt...	....	137	32	Du	....	....	....	....	A	....	
14G1	....	H. Hopman......	....	139	265	Dr	Nov. 9, 1949 Mar. 27, 1952	11.26 2.73	68.5	T 7 1/2	Irr	Cp, L	
14J1	DWR 42	C. Ramsay......	....	140	143	Dr	Nov. 18, 1949	16.15	....	J 3	D	Cp	Reported to pump 14 gpm.

14M1	....	Emil Schmidt...	....	136	29.5	Du, 4	.....do.........	9.04	....	L, Wind	D, S	....	
14R1	....	E. A. Miller	....	152	14.0	Du, 3	Dec. 12, 1949	9.94	....	J 1/2	D	....	
15A1	....	R. E. Keig.......	1928	143	355	Dr, 10	Mar. 28, 1934	[1]10.0	71	T 20	Irr	Cp, L	Estimated to pump 300 gpm.
15B1	....	....	....	147	48.5	Dr, 10	Oct. 21, 1949 Mar. 27, 1952	9.25 6.24	....	L	....	....	
15D1	DWR 39	.....do............	....	152	20.5	Du	.....do.........	14.95	....	J 2	D, S	....	
15L1	....	.....do............	1947	141	135	Dr, 10	.....do.........	6.04	....	T 20	Irr	L	
15P1	....	J. W. Hoyt.......	1943	140	110	Dr, 12	....	....	....	J 5	D,Irr, S	....	
15P2	....	Orville Glos	1900	140	21.5	Dr	Dec. 9, 1949	17.20	....	....	U	....	
15R1	....	L. Wurz..........	....	135	12.0	Du	Dec. 13, 1949	8.29	....	L 1	D	....	
15R2	....	.....do............	....	135	120	Dr	....	....	....	C	Irr	L	
16A1	....	A. E. Myers	1947	149	18.5	Dr, 8	Oct. 21, 1949	12.48	62	J 1	D, S	L	
16A2	....	.....do............	1948	148	17.0	Dr, 8	.....do.........	10.85	....	....	U	....	
16A3	....	.....do............	1947	147	20.5	Dr, 6	.....do.........	7.00	....	....	U	....	
16B1	....	W. E. Lawson ...	1925	155	333	Dr, 10	.....do.........	10.04	66	T 30	Irr	Cp, W	Pumped 780 gpm on test.
16B2	....	.....do............	....	155	232	Dr, 10	.....do.........	13.98	....	....	U	W	Pumped 255 gpm on test.
16B3	....	.....do............	....	155	25.0	Du, 6	.....do.........	14.19	....	J 3	D	Cp, W	
16B4	....	Celso Marag- liano.	1940	155	60	Dr, 10	Oct. 20, 1949	19.75	62	T 7 1/2	Irr	....	Reported to pump 130 gpm with 7-ft drawdown.
16D1	....	Dennis Gagetta.	1946	166	100	Dr, 8	1946	[1]6	....	T 7 1/2	Irr	....	Reported to pump 300 gpm.
16F1	....	E. Defilippis....	1930	170	108	Dr	....	....	....	J 1/2	D	L	
16F2	....	Beaulieu Vine- yard.	1926	170	325	Dr, 8	Oct. 4, 1949	19.68	....	T 5	Ind	L	
16K1	DWR 4	A. C. Lawson...	....	159	23.5	Du	Nov. 9, 1949	19.79	....	J 1	D	....	
16L1	....	L. Tonnella	1949	171	221	Dr, 8	Oct. 4, 1949	35.00	....	L 2	D	L	Reported to pump 36 gpm.
16L2	....	Bianchi..........	1930	171	225	Dr, 8	....	....	....	J	D	L	
16N1	....	J. Ponti	1928	173	252	Dr	Oct. 4, 1949	59.00	....	L 3	D	Cp, L	
16N2	....	G. Costantini....	1923	193	321	Dr, 8	.....do.........	45.73	....	L 3	D,irr, S	....	
16N3	....	.....do............	1920	194	62	Du, 4	.....do.........	17.12	....	L, Hand	U	....	
16R1	....	Mrs. G. Minoggi	1914	147	22.5	Du, 3	Dec. 8, 1949	12.37	....	J 2	D,irr	....	

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 7 N., R. 5 W.—Continued							
7/5-17B1	....	Dennis Gagetta	....	170	160	Dr	....	....	....	J 5	D	....	
17B2	....	.....do..........	1946	161	82	Dr, 8	Oct. 20, 1949	10.95	63	J 3	D, S	Cp	
17J1	....	Beaulieu Vineyard.	1929	200	564	Dr	Oct. 4, 1949	60.70	....	T 7 1/2	D,Irr	Cp, L	
20H1	....	J. J. Cohn	1918	255	83.0	Dr, 6	.....do..........	9.13	....	....	U	....	Reported to pump 1 gpm.
21B1	....	Joseph Ponti ...	1890	160	18.0	Du	Dec. 8, 1949	13.99	57.5	C 1	D	Cp	Reported to pump 12 gpm.
21K1	....	Beaulieu Vineyard.	....	152	32.0	Dr	Dec. 13, 1949	7.33	....	J 1/2	D	Cp, W	
22D1	....	O. Del Bondio ..	1920	140	11.5	Du, 6	Dec. 9, 1949	9.15	....	J 1	D, S	....	
22E1	....	G. Barberini ...	1900	139	7.0	Du, 11 11 by 11	.....do..........	5.55	55	C 1	D	Cp	
22E2	....	W. Jergens......	1939	140	200	Dr, 8	.....do..........	7.53	....	C 1/4	D	....	Reported to pump 35 gpm.
22G1	....	George Van Vlack.	1941	131	56.0	Dr, 6	Dec. 1950 May 3, 1951	Flowing 1.40	....	....	U	C	
22G2	....	.....do..........	1951	131	40	Dr, 8	.....do..........	1.70	....	J 1/2	D	C	
22P1	....	Inglenook Vineyard Co.	1923	147	510	Dr	....	....	....	T 40	U	....	Reported to pump 800 gpm.
22Q1	DWR 36	A. Bartolucci ...	....	149	225	Dr, 6	Nov. 28, 1949	16.38	....	....	U	....	
23D1	....	N. V. Kaiser	1944	128	95	Dr, 9	Dec. 13, 1949	5.20	....	C 7 1/2	Irr	....	
23D2	....	D. B. Harris	1948	127	139	Dr, 12	Dec. 14, 1949	2.19	....	T 7 1/2	Irr	C, Cp, W	
23D3	....	.....do..........	....	127	20	Dr, 6	Mar. 1, 1951 Mar. 27, 1952	2.30 2.07	....	J 1/2	D	Cp	

23E1	DWR 18	G. H. Hall........	....	127	39.0	Dr, 12	Nov. 28, 1949	7.97	....	C 1	D	Cp	
23F1	....	Lewis Dairy	....	123	13.0	Du, 10	Oct. 5, 1949	6.57	....	J	Irr, S	Cp, W	
23K1	....	R. E. Keig.......	1937	118	165	Dr, 8	....	....	....	J 2	Dy, S	L	
23L1	....	P. Lewis.........	1939	120	150	Dr	Oct. 14, 1949	7.66	....	T 15	Irr	L	
23N1	DWR 28	J. R. Chinn......	1923	125	35	Dr	....	....	....	....	A	....	
23Q1	....	R. E. Keig.......	1937	116	240	Dr, 10	....	....	....	....	A	L	
23Q2	DWR 19	.....do............	....	115	20	Du	....	....	....	....	A	....	
23Q3	DWR 20	.....do............	....	115	48	....	....	....	....	....	A	....	
23Q4	....	.....do............	1946	116	110	Dr, 10	....	....	....	T 10	Irr	L	
24B1	....	C. E. Bowman..	....	157	18.5	Du	Dec. 15, 1949	[3]10.65	....	L 3/4	D	....	
24C1	....	Grapevine Inn ..	1930	136	26.0	Du	Dec. 19, 1949	7.56	....	[3]L	D	....	
25A1	....	Frank Perata...	....	163	56.5	Du, 4	Dec. 6, 1949	16.76	55	J 1	D	Cp	
25H1	....	O. D. Burch......	1927	139	25.5	Dr	Dec. 20, 1949	11.14	....	J 1 1/2	D, Dy	....	
25H2	....	.....do............	....	136	14.0	Du, 6	.....do..........	7.28	....	....	U	....	
25H3	....	A. Bradac	1949	132	190	Dr, 11	.....do..........	5.04	....	....	.....	Cp	
25N1	....	J. M. Hale.......	1928	100	61	Dr, 8	....	....	51.5	J 3/4	D	Cp, L	
26D1	DWR 29	J. R. Chinn......	....	127	17.5	Du	Nov. 29, 1949	1.05	80	C 2	D	Cp	
26E1	....	D. S. Sganzini ...	1933	124	64.5	Dr, 8	Nov. 16, 1949	+.70	85	J 2	D, Dy,	Cp	Natural flow measured at 27 gpm March 22, 1950.
							Mar. 22, 1950	+1.5			S		
26E2	W 3	.....do............	....	135	9.7	Du	June 1918	Flowing	90	....	U	....	
	C 4						Nov. 15, 1949	1.06					
26E3	....	.....do............	....	122	3.5	Du	Nov. 29, 1949	Flowing	....	....	S	....	
26L1	....	Glen Graham ...	....	110	26.5	Dr, 8	Dec. 1, 1949	6.49	....	....	U	....	
26L2	....	.....do............	....	115	56.0	Dr, 8	.....do..........	5.68	....	J 3	D, S	Cp	
							Mar. 27, 1952	+.34					
26L	W 5	.....do............	....	110	20	Du	June 1918	7.1	....	....	A	....	
	C 6												
26M1	W 4	F. K. Libenow...	1915	130	71	Dr, 6	.....do..........	7.3	....	J 1	D	Cp	
	C 5						Nov. 30, 1949	1.96					
26N1	....	P. King...........	....	146	28.5	Du	Dec. 1, 1949	12.13	....	L, Wind	D, S		
26R1	W 6	Napa State	....	111	18.0	Du	June 1918	6.0	....	....	U	....	
	C 7	Farm.					Dec. 1, 1949	10.98					
27D1	....	Stalling...........	1929	170	410	Dr, 8	....	....	....	....	A	L	
27D2	....	.....do............	1929	170	168	Dr	....	....	....	....	A	L	
27H1	W 2	Jessie R. Chinn.	....	140	34.0	Dr, 8	Oct. 11, 1949	5.59	62	L 1/3	D	Cp, L, W	
	C 3												

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
T. 7 N., R. 5 W.—Continued													
7/5-27M1	W 1	....	....	....	31	Du	June 1918	13.0	....	....	A	L	
	C 2												
28B1	....	J. N. Galkins....	1947	270	23	Dr, 8	....	....	....	J 1	D	L	
34C1	....	P. Pennland.....	1950	185	64	Dr, 8	June 8, 1951	1.93	....	J 1	D	L	
34C2	....	P. Dickerson...	1950	190	165	Dr, 8	.....do........	19.76	....	J 2	D	L	Reported to pump 10 gpm.
34H1	....	H. T. Sallman..	....	174	26.5	Du, 3 1/2	Dec. 14, 1949	16.06	58	J 1	D	Cp	
35	W 8	W. F. Ellis......	....	....	28	Du	June 1918	4.4	....	....	A	....	
	C 9												
35C1	....	S. J. Webber....	1928	164	200	Dr, 6	Dec. 1, 1949	7.72	....	....	U	L	
35D1	DWR 35	H. Pramme.....	....	158	165	Dr	June 1918	19.5	....	J 1	D	....	Reported to pump 3 gpm.
	W 7						Fall 1945	[1]16					
	C 8												
35E1	....	C. H. Schmidt..	1930	180	101.0	Dr, 12	Dec. 2, 1949	9.83	....	....	U	L	
35E2	DWR 25	A. M. Avilla.....	....	180	19.0	Du, 10	Nov. 29, 1949	12.74	....	....	U	....	
35F1	....	S. J. Webber....	1929	164	26.0	Du	Dec. 1, 1949	9.04	....	J 1/4	D	....	
35F2	....	Mrs. Minoggi...	....	175	100.0	Dr	Nov. 4, 1948	[1]27	....	J 3	D	....	
							Dec. 15, 1949	23.5					
35K1	DWR 27	Rock Villa.......	....	200	180.5	Dr	Nov. 29, 1949	51.84	....	L 3/4	D	Cp	
36C1	....	Pellisa and Hale.	....	100	....	Dr, 12	....	....	....	T 20	Irr	....	Reported to pump 600 gpm with 75-ft drawdown.
36H1	....	....	....	96	40.5	Dr, 12	Nov. 23, 1949	10.31	....	T 5	....	....	
36K1	....	R. Knight........	1948	94	85	Dr, 8	....	....	....	J	D	L	
36N1	....	B. H. Shilling....	1944	141.0	104	Dr, 8	Oct. 13, 1949	4.17	....	J 3/4	D, irr	Cp, L, W	Reported to pump 15 gpm with 6-ft drawdown.

36N2	W 9 C 10	P. Guillaume	....	120	13	Dr, 12	June 1918	Flowing	....	....	A	....	
36P1	....	L. Cesady	1933	114	189	Dr	....	....	....	L 1/2	D	Cp, L	
36P2	....	Bert Banks	1939	110	94.5	Dr, 6	Dec. 2, 1949	26.32	53	L 1	D	Cp, L	
36Q1	....	Jack Porrester	....	100	137	Dr	Nov. 23, 1949	19.4	....	J 3	D	....	
							T. 7 N., R. 6 W.						
7/6- 1H1	....	Marie Brehn	1915	267	35.5	....	Sept. 29, 1949	27.17	....	J 2	D,irr	....	Reported to pump 27 gpm.
							T. 8 N., R. 5 W.						
8/5-30G1	....	R. V. Talcott	1919	240	17.0	Du, 2	Oct. 4, 1949	6.66	....	C 1/4	D	....	
30M1	....	R. Tiedemann	1945	220	225	Dr, 12	....	....	....	T 15	Irr	....	
30P1	....	K. P. Slavens	1944	220	45.5	Dr, 8	Oct. 18, 1949	4.69	....	C	Irr	Cp, W	Reported to pump 350 gpm.
30R1	....	N. Ronchette	1919	....	106	Dr	....	....	....	....	D, S	....	
31F1	....	Joe Dowrelio	....	240	32.5	Du	Oct. 18, 1949	21.99	....	....	U	....	
31G1	....	P. Molinari	1905	210	28.5	Du, 3	.....do.....	25.56	....	J 3/4	D	....	Reported to pump 2 gpm.
31H1	DWR 70	E. G. Evans	1879	220	33.5	Du	.....do.....	25.77	....	J 1	D	....	
31H2	....	La Fata Bros.	1941	220	370	Dr, 12	.....do.....	28.84	....	T 7 1/2	Irr	L	Reported to pump 90 gpm.
31J1	....	.....do.....	....	220	50	Dr, 12	.....do.....	31.74	....	J 1 1/2	D	....	
31P1	....	St. Helena High School.	1919	237	90.0	Dr, 8	Oct. 6, 1949	24.35	....	....	U	W	
31P2	....	John Salvas-trini.	1949	237	175	Dr, 8	Nov. 4, 1949	26.02	....	J 2	D	Cp, W	
32J1	DWR 66	F. H. White	1918	192	50	Dr, 12	....	....	....	....	A	....	
32J2	....	.....do.....	1918	192	50	Dr, 12	....	....	....	....	A	....	
32J3	DWR 68	.....do.....	1918	192	50	Dr, 12	....	....	....	....	A	....	
32J4	DWR 67	.....do.....	1918	192	50	Dr, 12	....	....	....	....	A	....	Combined yield of wells 32J1—32J4 reported to be about 400 gpm.
32J5	....	C. F. Lynch	....	200	31.0	Du, 6	Oct. 4, 1949	19.67	....	....	U	....	
32K1	....	J. G. Mee	....	193	29.0	Dr, 12	Oct. 19, 1949	15.26	....	C	Irr	....	
32K2	....	.....do.....	....	193	23.0	Dr, 12	.....do.....	14.50	....	....	Irr	....	
32K3	....	.....do.....	....	193	29.0	Dr, 12	.....do.....	14.82	....	....	Irr	....	Wells 32K1—32K3 all pumped by one pump.

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 8 N., R. 5 W.—Continued							
8/5-32L1	DWR 69	J. G. Mee........	....	201	25.5	Dr, 12	Oct. 19, 1949	21.37	....	J 1	D	....	
32N1	....	E. A. Chaix.....	1910	207	100	[2]Dr	Oct. 14, 1949	24.15	....	L 1	D	....	
32P1	....	.....do...........	1910	202	34.0	Du	.....do..........	19.32	....	....	U	....	
32P2	....	.....do...........	1910	203	31.0	Du	.....do..........	20.47	....	....	U	....	
32P3	....	F. White.........	....	193	34.0	Dr, 12	.....do..........	15.37	....	....	U	W	
32R1	....	W.M. Wheeler..	....	183	35.5	Dr, 12	Oct. 19, 1949	8.03	61	C 7 1/2	Irr	Cp	
32R2	....	.....do...........	....	183	33.0	Dr, 8	.....do..........	8.30	....	....	Irr	....	Wells 32R1 and 32 R2 pumped by one pump. Combined yield reported to be 650 gpm.
33E1	....	R. E. Connolly..	....	210	59.0	Dr	Nov. 28, 1949	32.40	....	T 7 1/2	Irr, S	....	
33N1	....	....	....	183	15.5	Dr, 10	Oct. 19, 1949	7.94	....	L, Wind	S	....	
32N2	....	C. Acquistapace	1930	193	150	Dr	.....do..........	21.44	....	J 1/2	D	....	
33P1	....	Corbella Meat Co.	1948	210	123.5	Dr, 10	Aug. 2, 1949 Nov. 4, 1949	[1]24 25.91	....	J 1	D, S	....	
						T. 8. N., R. 6 W.							
8/6- 3E1	....	Lena Bennett...	1943	350	145	Dr	Nov. 23, 1949	45.53	....	L 1 1/2	D	....	Reported to pump 5 gpm.
3L1	....	C. Saviez........	....	330	165.5	Dr, 8	Nov. 11, 1949	49.88	....	J 3	D, S	....	
3M1	....	J. M. Blair.......	....	330	129.5	Dr, 4	Nov. 23, 1949	37.9	....	L 3/4	D	....	
3M2	....	.....do...........	....	330	....	Dr, 8	.....do..........	39	....	....	U	....	
3M3	....	.....do...........	....	330	27.5	Du, 4	.....do..........	20.16	....	J 1/2	U	....	
4F1	....	Tamagni Dairy.	1932	330	207	Dr, 8	....	[1]75	....	A 10	Dy	Cp	Reported to pump 100 gpm. Temperature

													reported, "above normal."
4Q1		L. Pocai		300	23.5	Du, 4	Nov. 10, 1949	15.18		J 1/4	D		
5E1		W. D. Tucker	1916	340	22.5	Du, 3	Nov. 8, 1949	14.26		L 1	D		
5F1		F. S. Wright		340	16.5	Du, 4	Oct. 20, 1949	13.77		J 3/4	D		
5G1				350	35.5	Du, 3	Sept. 29, 1949	34.89					
5M1		Gilda Barberis.		320	43.5	Dr, 8	Nov. 8, 1949	6.74		C 1/2	D		
5Q1		Chas. Rockstrah	1925	340	20.0	Du, 3	Oct. 20, 1949	14.34		L 1 1/2	D, S		Reported to pump 10 gpm.
5R1		B. E. Barber	1919	310	25.0	Du, 3	Nov. 8, 1949	22.00		C 1/2	D	Cp, W	
6H1		C. E. Boland	1913	330	18.5	Du, 2	Nov. 4, 1949	12.19		J 1/2	D		
6H2		do	1890	330	7.0	Du, 2	do	6.03					
6H3		do	1924	330	6.0	Du, 2	do	5.51			D		
6H4		G. Kinsel		340	24.5	Du, 3	do	19.15		P	D		
6L1		Shaffer Resort.	1945	330	16	Du, 3	Nov. 7, 1949			C 1/2	D		
6L2		do	1930	330	43.0	Dr, 9	do	11.09		L 1/4	D		
6L3		L. E. Light	1937	335	115	Dr, 8				J 1 1/2	D		
6M1		V. C. Bishop	1880	330	22.5	Du, 4	Nov. 4, 1949	10.82		J 1/4	D		
6M2		do	1905	330	26.0	Du, 3	do	11.30		J 1/2	D		
7B1		Alpine Villa	1946	400	230	Dr, 8	Nov. 8, 1949	59.36		T 1 1/2	D		
7B2		do	1880	370	17.5	Du, 6	do	4.99		J 1	D		
8D1		J. M. Salling	1939	320	18.0	Du, 10	Nov. 21, 1949	4.73		J 1/2	D		
9D1		Tamagni	1946	290	165	Dr, 10	July 1949	[1]45		T 10	Irr	C	Reported to pump 110 gpm with 20-ft drawdown.
9E1		F. McMullen	1949	330	131.0	Dr, 12	Nov. 10, 1949	20.13		J 1	D		
9F1		Mrs. S. H. Koller	1949		105						D	C	
9H1		Larkmeade Vineyard.	1946	290	210	Dr, 10				T 7 1/2	D,Ind		
9H2		do	1944	290	175	Dr, 10				T 7 1/2	D,Ind		
9R1				330	36.0	Du	Nov. 10, 1949	10.19		J 1/4	D		
10C1		A. W. Alm	1914	290	25.5	Du, 5	Nov. 11, 1949	18.21		J 1	D		
10G1		N. A. Miller	1946	290	9.0	Du, 3	Sept. 28, 1949	7		L 1	D		
10J1		C. F. Pisor	1924	280	220	Du	Oct. 20, 1949	18.59		J 1	D		
10Q1		Marloff Bros	1946	290	183.5	Dr, 10	Sept. 30, 1949	10.45		T 7 1/2	Irr, S	Cp, L, W	
10Q2	DWR 71	A. H. Word		273.57	90	Dr, 6					A		
10R1		Mrs. E. Crevea.	1914	260	23.0	Du, 2	Oct. 19, 1949	18.23		C 1/4	D		

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 8 N., R. 6 W.—Continued							
8/6-11R1	....	Schletti..........	....	360	112	Dr, 8	....	....	....	J	D	L	
14B1	....	E. F. Cole	1919	290	56.0	Dr, 8	Oct. 5, 1949	14.36	....	J 1/2	S	....	
14B2	....	.....do............	1917	290	32.5	Du, 6	.....do..........	11.87	....	....	U	....	
14C1	....	K. S. Cairns.....	1917	290	23.5	Du, 8	.....do..........	8.97	....	J 1	D	....	
14K1	....	Spear	....	240	187	Dr, 8	.....do..........	9.21	63	J 1	D	Cp	
14N1	....	M. Battuello.....	1947	240	162	Dr, 8	Oct. 13, 1949	16.71	....	L 1	D	....	
14Q1	....	R. Laurent.......	....	250	22.0	Du, 6	Oct. 5, 1949	14.78	....	C 1	D	....	
14R1	....	H. P. Nachtrieb.	1928	290	132	Dr, 8	Nov. 28, 1949	8.28	65	T 7 1/2	D	Cp, L	
15A1	....	T. K. McCaffrey	1909	280	25.0	Du, 5	Sept. 30, 1949	10.96	....	L	D	C, Cp	
							Mar. 9, 1951	2.63	58	....	......	....	
15A2	....	R. G. Hecking ...	1939	260	125	Dr, 8	Sept. 30, 1949	11.42	....	L 1/4	D	C, Cp	Reported to pump 140 gpm.
							Mar. 9, 1951	3.03	....	....	......	....	
15G1	....	Alfred Domingos	....	290	3.0	Du, 6	Sept. 28, 1949	5.19	....	1	D	....	
22J1	....	The Madrones Cottages.	....	330	135	Dr, 8	....	....	....	L 1/2	D	....	
22J2	....	.....do............	....	335	185	Dr, 6	.....do..........	[3]74	....	L 3	D	....	
							Oct. 21, 1949	46.58					
23B1	....	T. J. Laurent....	1949	240	72	Dr, 8	Oct. 5, 1949	5.80	67.5	J 1	D	Cp	Reported to pump 10 gpm.
23C1	....	....	....	260	42.0	Du, 3 1/2	Oct. 14, 1949	31.70	....	....	U	W	
23J1	....	....	....	....	34.5	Du, 5	Sept. 29, 1949	15.49	....	A	S	W	
23K1	....	A. F. Borla......	1919	220	13.5	Du, 6	Oct. 4, 1949	9.81	....	C 1/3	D	....	
23M1	....	F. Delfino	1938	285	113.0	Dr, 8	Oct. 13, 1949	58.63	....	J 3/4	D	L	Reported to pump 1 gpm.
23P1	....	Freemark Abbey Winery.	1919	300	61.0	Du, 6	Nov. 2, 1949	17.72	....	....	D	W	

24B1	....	N. P. Nielson...	1946	360	105.5	Dr, 6	Oct. 19, 1949	17.50	....	J 1/2	D	Cp, W	
24P1	....	O. E. Hultman...	....	240	42.5	Du, 5	Oct. 4, 1949	32.38	....	....	U	....	
25B1	....	Floyd Post......	1932	240	23.0	Du, 3	Sept. 29, 1949	13.48	....	L 3/4	D	....	
25B2	....	Chas. R. Jones.	....	250	92	Dr, 8	Oct. 4, 1949	38.93	....	J 3/4	D	....	
25C1	....	Chas. Hemsley.	1942	250	125	Dr, 10	.....do..........	30.14	....	J 1	D	....	Reported to pump 33 gpm.
25G1	....	J. A. Varozza...	1924	230	186	Dr, 8	Oct. 18, 1949	37.54	....	J 1/2	D	....	
25H1	....	H. E. Williams..	....	230	22.5	Du, 3	Oct. 14, 1949	14.66	....	....	U	....	
25H2	....	.....do............	....	230	....	Dr	....	....	71	T 15	Irr	Cp	
26B1	....	E. Kallenberg..	1910	240	27.5	Du, 4	Oct. 14, 1949	9.69	....	....	......	Cp	
26B2	....	H. S. Gebhart...	1860	240	31.0	Du, 5	.....do..........	12.03	....	1	......	....	
35H1	....	F. A. Lucas.....	....	300	53.5	Du, 6	Oct. 20, 1949	8.54	....	1/2	D	W	
							T. 8 N., R. 7 W.						
8/7- 1D1	....	B. W. Burrus...	1900	490	65.5	Du, 5	Nov. 3, 1949	33.36	....	....	U	....	
1D2	....	.....do............	1900	500	43.5	Du, 8	.....do..........	32.54	....	....	U	....	
							T. 9 N., R. 6 W.						
9/6-31C1	....	E. H. Doda......	1939	390	90.0	Dr, 6	Oct. 21, 1949	60.80	....	....	U	W	
31C2	....	O. B. Earle......	1925	540	276	Dr, 2	.....do..........	124.40	....	L	D	....	Water temperature reported to be "above normal."
31E1	....	....	....	380	19.0	Du, 6	Sept. 29, 1949	8.40	....	....	U	....	
31J1	....	Mrs. V. Reeves	1919	350	23.0	Du, 7	Oct. 21, 1949	13.64	....	J 1	D	....	
31K1	....	A. J. Andrews...	1939	360	64.0	Dr, 10	Nov. 3, 1949	17.49	....	J 1/2	D	....	
31L1	....	J. Herzog........	....	390	105	Dr, 6	....	....	....	J 1	D, S	....	Do.
31M1	....	A. Tedeschi.....	1919	380	300	Dr, 6	Nov. 4, 1949	18.76	....	C	D	....	Do.
31M2	....	.....do............	1920	380	26.0	Du	.....do..........	14.86	....	....	U	....	
31Q1	....	Mrs. A. Ghisolfo	1931	340	50.5	Dr, 12	Oct. 21, 1949	12.56	....	L 2	D, S	Cp, W	
32C1	....	Mrs. Ida Frediani.	1930	410	85	Dr	Nov. 4, 1949	22.07	....	....	U	....	
32M1	....	Rosedale Resort	1929	360	205	Dr, 6	Oct. 21, 1949	44.81	....	L 3/4	D	....	Reported to pump 10 gpm.
32M2	....	.....do............	1945	360	285	Dr, 10	....	....	....	J 3	D	....	Reported to pump 25 gpm.
32N1	....	J. A. Taylor....	1930	400	....	Dr, 8	Oct. 20, 1949	70.84	....	J 1	D	....	

See footnotes at end of table.

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 9 N., R. 6 W.—Continued							
9/6-32N2	....	J. A. Taylor	1926	380	44.0	Du, 4	Oct. 20, 1949	23.68	....	....	U	....	
32N3	....	....do........	1927	380	40.0	Du	.....do.........	36.54	....	....	U	....	
						T. 9 N., R. 7 W.							
9/7-23M1	....	J. E. Williams .	1918	460	92.5	Dr, 10	Oct. 3, 1949	12.12	....	....	U	W	
25B1	....	G. Barberis.....	....	440	84	Dr, 8	Oct. 7, 1949	8.18	....	J 1/2	D	....	
25C1	....	E. J. Wuest	1946	410	112	Dr, 6	Oct. 6, 1949	15.67	....	J 1/2	D	Cp	
25F1	....	....	....	390	39.0	Dr, 8	Oct. 7, 1949	22.74	....	J 1/2	D	Cp, W	
25N1	....	W. C. Wiggins...	1944	360	149.0	Dr, 8	Oct. 6, 1949	11.53	85	J 1	D	Cp, L W	
25N2	....	....do........	1918	380	26.5	Dr, 6	.....do.........	13.63	....	....	U	W	
25Q1	....	Mrs. M. M. Mefford.	1913	400	21.62	Du, 6	Nov. 3, 1949	7.9	....	....	U	....	
25Q2	....	Enderlin	1919	400	11.5	Du, 6	.....do.........	8.74	....	C 3/4	D	....	
26C1	....	C. Tubbs Estate	1935	440	....	....	....	....	....	....	A	L	
26G1	....	....do........	....	425	305	Dr, 12	Oct. 6, 1949 Mar. 22, 1950	Flowing Flowing	89	....	U	Cp, L	Flow measured as 1/2 gpm Mar. 22, 1950.
26H1	....	....	....	420	16	Du, 3	.....do.........	14.77	....	J	D	....	
26J1	....	Myrtledale Hot Springs.	....	390	160	Dr	....	....	....	....	D	....	Well erupts as a geyser. Water temperature "above normal."
26J2	....	....do........	....	390	180	Dr	....	....	....	....	D	....	Do.
26K1	....	H. J. Bruff.	....	410	....	Dr, 8	....	....	....	....	....	Cp	Well erupts as a

													geyser.
26L1	...	Fink and Seibel	...	420	27.0	Dr, 10	Oct. 3, 1949	12.61	...	J 1/2	D	...	
26M1	...	Nolasco Winery	1930	410	172	Dr	Oct. 7, 1949	9.16	...	...	U	L	
26N1	...	...do...	1947	410	207	Dr, 8	...do...	14.37	...	J 3	D	Cp	
26N2	...	...do...	1920	410	21	Du	...do...	8.72	...	C 2	D	Cp	
26P1	...	Roy Bentley...	1949	400	470	Dr, 8	...do...	4.79	...	T	Irr	Cp, L, W	Reported to pump 40 gpm. Water temperature reported to be "above normal."
26Q1	...	...	...	400	13	Du	Oct. 6, 1949	6.77	...	...	U	...	
26R1	...	S. J. Busch...	...	390	17.5	Du, 3	Mar. 9, 1950 May 3, 1951	8.11 9.25	...	J 1/2	irr	C, Cp	
26R2	...	...do...	...	390	320	Dr, 10	...	...	...	J 1	D	Cp	
26R3	...	...	...	...	147.5	...	June 21, 1950	Flowing	110+	...	U	Cp, L	
27F1	...	R. L. Page...	1947	430	122	Dr, 8	...	...	...	J 2	D	L	
27F2	...	...do...	...	430	11.5	Du, 3	Oct. 3, 1949	5.06	...	L	U	...	
27J1	...	A. J. Snodgrass.	1944	425	49.0	Du, 3	Sept. 29, 1949	7.63	...	J 1/2	D	...	
27K1	...	...do...	1948	425	75	Dr, 8	...do...	17.77	...	J 2	irr, S	...	
27R1	...	William Gilmore.	...	410	203	Dr, 8	Oct. 6, 1949	5.99	...	J 3	D	Cp, W	Reported to pump 35 gpm.
27R2	...	Mrs. Albee...	...	410	207	Dr, 8	...do...	14.45	...	L 3	D	...	Reported to pump 25 gpm.
35A1	...	H. G. Harvey...	...	375	33.0	Du, 3	Oct. 7, 1949	8.89	...	J 1	D	...	
35C1	...	H. E. Washburn.	...	400	26.5	Du, 4	Oct. 6, 1949	7.38	...	J 2	D	...	
35C2	...	Jack Scott...	...	390	72.0	Dr, 8	Oct. 3, 1949	10.29	...	T 3	Irr	...	
35D1	...	Roy Bentley...	...	400	14.0	Du, 3	Oct. 6, 1949	7.78	...	J 1	S	...	
35J1	...	George A. Scott	1920	390	35.5	Du	Oct. 3, 1949	16.62	...	L 5	D, irr	...	
35K1	...	K. Kilian...	1936	400	100	[1]Dr, 6	...do...	6.38	...	L 1 1/2	D, irr, S	L	
36A1	...	A. Foletti...	1924	390	17.5	Du, 6	Nov. 3, 1949	9.19	...	J	D	...	
36B1	...	Arcadia Motel..	...	380	360	Dr	...do...	[5]56.9	...	J 3	D	...	
36B2	...	...do...	...	380	56.0	Dr, 12	...do...	11.84	...	L 3/4	D	...	
36D1	...	Mrs. Turner...	...	375	53.5	Dr, 12	Oct. 7, 1949	8.17	...	...	U	W	
36G1	...	G. Rodgers...	...	375	16.0	Du, 3	Sept. 29, 1949	9.03	...	J 1/2	U	...	
36H1	...	Silverado Motel	1946	380	285	Dr, 12	Nov. 3, 1949	13.75	...	T 5	D	...	
36H2	...	G. Carli...	1914	380	27.5	Du, 5	...do...	10.18	...	L 3/4	D, irr	...	

See footnotes at end of table

Table 13.—*Description of water wells in Napa Valley, Calif.*—Continued

Well	Other numbers	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 9 N., R. 6 W.—Continued							
9/7-36H3	....	Fritz Gerchens.	1929	380	84.5	Dr, 6	Nov. 3, 1949	13.35	....	J 1/2	D	....	

[1]Measurement reported by owner or other reliable observer.
[2]Upper part of well hand dug.
[3]Well recently pumped.
[4]Measurement by California Division of Water Resources.
[5]Pumping.
[6]Water bottled and sold.
[7]Public swimming pool.

Table 14.—*Water levels in Napa Valley, Calif.*

Date	Water level	Date	Water level	Date	Water level

4/4-4E1 (DWR 47)

[Acquistapace. About 5 miles south-southwest of Napa, 0.75 mile south along Dutra Road, from the intersection of Gum Tree Lane, 125 ft northeast of centerline of Dutra Road, 15 ft south of fence line, 50 ft west of center of windmill tower. Unused well, diameter 6 in., depth 67.0 ft. Measuring point, top of casing south side, 0.8 ft above land-surface datum which is 10 ft above sea level. Measurements through 1931 by California Division of Water Resources]

Date	Water level	Date	Water level	Date	Water level
Oct. 24, 1930	4.2	May 3, 1950	6.72	Dec. 27, 1950	6.64
Mar. 25, 1931	.2	June 6	7.05	Apr. 2, 1951	5.65
Sept. 28	6.1	June 7	7.32	May 25	6.14
Dec. 20, 1949	7.79	Aug. 10	9.28	Oct. 9	7.72
Jan. 25, 1950	7.31	Sept. 7	9.35	Dec. 7	7.22
Mar. 1	6.49	Oct. 9	8.10	Mar. 27, 1952	5.46
Apr. 4	7.04	Nov. 8	7.94		

4/4-13E1 (DWR 79)

[G. Lawrence. About 7 miles south-southeast of Napa, 0.5 mile west of State Highway 12 and 29, 0.1 mile north of Green Island Road, 350 ft northwest of dwelling, 100 ft southwest of barn, 100 ft west of gum trees. Stock well, diameter 8 in., reported depth 98 ft. Measuring point, top of casing east side, 0.4 ft above land-surface datum which is 41.17 ft above sea level. Altitude of measuring point 41.57 ft above sea level, determined by California Division of Water Resources. Measurements through 1932 by that Division]

Date	Water level	Date	Water level	Date	Water level
Mar. 25, 1930	13.6	Dec. 19, 1931	14.6	Aug. 11, 1950	15.15
Oct. 28,	14.1	Jan. 22, 1932	13.8	Sept. 7	15.83
Mar. 20, 1931	14.6	Feb. 26	13.9	Oct. 9	17.00
Apr. 21	14.7	Mar. 27	13.4	Nov. 8	15.40
May 21	16.1	Dec. 21, 1949	15.54	Dec. 28	15.91
June 22	15.0	Jan. 25, 1950	15.20	Apr. 2, 1951	13.93
July 23	15.3	Mar. 1	13.78	May 25	12.45
Aug. 21	15.7	Apr. 4	13.30	Oct. 9	11.65
Sept. 28	14.6	May 3	13.24	Dec. 7	12.82
Oct. 20	13.8	June 6	13.85	Mar. 28, 1952	10.14
Nov. 22	14.7	July 7	14.28	Nov. 18	12.95

5/4-11M1

[DeWitt Machine Shop, 1024 Napa-Vallejo Rd. East of Napa, 110 ft east of centerline of highway, 50 ft south of shop, 15 ft north of John Hill's carlot. Unused well, diameter 8 in., depth 58.5 ft. Measuring point, top of casing north side, 0.3 ft above land-surface datum which is 13 ft above sea level. Water levels Jan. 13, 1951, to Nov. 21, 1951, selected highest daily readings from recorder charts]

Date	Water level	Date	Water level	Date	Water level
Feb. 3, 1950	6.40	Jan. 13, 1951	4.86	Mar. 31, 1951	6.43
Mar 1	6.47	18	3.67	Apr. 5	6.50
Apr. 4	7.01	22	2.56	10	6.63
11	6.72	26	3.42	15	6.95
14	7.14	29	3.65	20	7.12
May 3	7.96	Feb. 5	3.52	25	6.98
June 6	8.85	10	4.39	May 5	6.28
July 7	9.79	16	4.60	10	6.66
Aug. 10	10.33	18	4.77	15	7.34
Sept. 8	10.52	Mar. 9	4.18	20	7.02
Oct. 9	10.26	15	4.94	25	7.23
Nov. 8	9.42	20	5.42	31	7.66
Dec. 28	5.40	25	5.80	June 23	7.87

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

5/4-11M1—Continued

Date	Water level	Date	Water level	Date	Water level
June 26, 1951	8.22	Aug. 20, 1951	8.83	Oct. 25, 1951	9.12
30	8.81	25	8.91	30	8.70
July 5	8.03	31	8.97	Nov. 6	8.65
10	8.55	Sept. 5	9.02	10	8.55
15	8.43	14	9.12	15	8.38
20	8.36	20	9.32	21	7.97
25	8.56	25	9.38	Dec. 7	6.52
31	8.53	28	9.14	Jan. 5, 1952	5.36
Aug. 5	8.70	Oct. 9	9.32	Mar. 27	5.19
10	8.88	15	9.30	Nov. 18	9.15
15	9.16	20	9.23		

5/4-14J3 (DWR 83)

[Napa State Hospital. About 0.5 mile east of the centerline of State Highway 29, 500 ft south and 50 ft west of the intersection of Imola and Shurtleff Avenues, 8 ft north of northeast corner of garage, 130 ft east of well 5/4-14J1, 87 ft east of well 5/4-14J2. Unused well, diameter 12 in., reported depth 399 ft. Measuring point, hole in cover of casing, 0.8 ft above land-surface datum which is 75.72 ft above sea level. Altitude of measuring point 76.52 ft above sea level, determined by California Division of Water Resources. Measurements through 1932 by that Division]

Date	Water level	Date	Water level	Date	Water level
July 1920	75.20	Nov. 12, 1930	82.31	Mar. 16, 1950	116.15
Mar. 3, 1921	64.40	Dec. 15	83.73	Apr. 4	115.42
Aug. 29, 1928	83.08	Jan. 14, 1931	84.75	May 3	115.66
Sept. 15	85.42	Feb. 14	86.27	June 6	115.12
Oct. 15	86.90	Mar. 17	91.71	July 7	115.14
Nov. 15	95.90	Apr. 20	93.75	Aug. 11	114.25
Dec. 15	93.76	May 18	96.94	Sept. 7	113.44
Jan. 15, 1929	91.25	June 15	97.24	Oct. 9	113.03
Feb. 15	86.79	July 9	102.40	Nov. 8	111.92
Mar. 15	83.98	Aug. 8	109.78	Dec. 22	97.51
Apr. 15	84.01	Sept. 15	112.62	23	108.90
Jan. 13, 1930	92.95	Oct. 15	110.67	Jan. 5, 1951	109.46
Feb. 11	81.50	Nov. 16	111.35	19	102.18
Mar. 15	79.09	Dec. 15	109.05	Feb. 2	106.55
Apr. 17	78.44	Jan. 15, 1932	110.72	15	105.48
May 28	77.72	Feb. 15	110.43	Apr. 2	104.95
June 18	78.02	Mar. 31	110.22	May 25	103.31
July 7	78.55	Apr. 30	110.30	Oct. 9	104.02
Aug. 10	80.76	Oct. 17, 1942	[1]107.95	Dec. 7	89.08
Sept. 14	82.23	Dec. 16, 1949	115.79	Mar. 27, 1952	95.54
Oct. 14	82.84	Jan. 25, 1950	109.67		

[1]From records of Adams and Forbes.

5/4–15B3

[Calnap Tanning Co., 101 Coombs St. In Napa, 75 ft east of the centerline of Coombs Street, 50 ft north of company office, 9 ft south of fence line. Industrial well, reported depth 50 ft. Measuring point, top of casing south side, 0.8 ft above land-surface datum which is 8 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Jan. 25, 1950	15.14	Aug. 10, 1950	20.04	Apr. 2, 1951	13.05
Mar. 1	13.77	Sept. 8	25.50	May 25	14.43
Apr. 4	27.07	Oct. 9	17.72	Oct. 9	14.51
May 4	14.05	Nov. 8	14.24	Dec. 7	12.40
June 6	16.80	Dec. 27	11.58	Mar. 27, 1952	10.22
July 7	20.42				

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

5/4-15C2

[C. W. Johnson, 449 South Jefferson St. In Napa, 20 ft west of garage attached to dwelling, 12 ft south of north fence line. Irrigation well, diameter 8 in., reported depth 86 ft. Plugged at 66 ft. Measuring point, for measurements in part of well above 66 ft, top of casing east side, 0.5 ft above land-surface datum which is 22 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Feb. 2, 1951	16.02	Apr. 2, 1951	22.88	Dec. 7, 1951	15.17
13	14.03	Oct. 9	26.69	Mar. 27, 1952	14.80

[Measurements also made of water level for part of well below plug, made in ½-in. pipe that penetrates the plug. Measuring point, edge of ell on ½-in. pipe at west side of casing, 0.5 ft above land-surface datum]

Date	Water level	Date	Water level	Date	Water level
Feb. 2, 1951	22.80	Apr. 2, 1951	24.26	Dec. 7, 1951	23.18
13	22.65	Oct. 9	26.88	Mar. 27, 1952	22.35

5/4-21B3

[Milton Munger. About 2 miles southeast of Napa, 0.1 mile west of intersection of Hilton Avenue and Foster Road, 75 ft west of Grand View Road and 75 ft south of Hilton Avenue, 25 ft west of creekbed. Domestic well, diameter 8 in., reported depth 200 ft. Measuring point, top of casing south side, 0.3 ft above land-surface datum which is 100 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Jan. 12, 1950	11.56	July 26, 1951	[1]41	Jan. 18, 1952	[1]26
July 25	58.62	Aug. 19	[1]48	Mar. 28	18.32

[1]Measured by owner.

5/4-22M1

[Stewart's Dairy, 2195 Sonoma Highway. About 2.5 miles south-southeast of Napa, 1.25 miles south of intersection of Foster Road and Sonoma Highway, 150 ft east of Sonoma Road, 75 ft southeast of barn, 15 ft southeast of water tank, under windmill. Stock well, first 21 ft hand dug, concrete lined, 8-in. drilled well in bottom of pit, depth 99.0 ft. Measuring point, copper washer at top edge of 4-in. by 4-in. support across top of pit, 1.50 ft above land-surface datum which is 12 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Nov. 1, 1949	64.06	Apr. 4, 1950	60.83	Dec. 22, 1950	47.17
10	63.54	May 3	57.94	28	46.30
17	63.28	June 6	59.05	Feb. 2, 1951	43.38
28	62.82	July 7	59.02	Apr. 2	44.3
Dec. 1	62.67	Aug. 10	57.02	May 24	40.52
30	61.45	Sept. 7	56.78	Oct. 9	45.45
Jan. 25, 1950	59.53	Oct. 9	55.82	Dec. 7	41.89
Mar. 1	59.43	Nov. 8	53.53	Mar. 27, 1952	35.58

5/4-26B1

[Owner's No. 8. Adams and Forbes. About 3 miles south of Napa, about 0.2 mile south of Shipyard Acres housing project, 0.1 mile west of State Highways 12 and 29, in large pumphouse under wooden head frame. Public supply well, reported diameter 20 in., reported depth 1,440 ft. Measuring point, top of 1¼-in. coupling on pump base north side, 1.0 ft above land-surface datum which is 20 ft above sea level. Measurements from owner, except as indicated]

Date	Water level	Date	Water level	Date	Water level
Mar. 23, 1942	48.2	June 27, 1942	52.5	Oct. 9, 1942	57.9
May 5	38.04	Sept. 9	57.2	16	57.5

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

Date	Water level	Date	Water level	Date	Water level
July 1, 1943	50.7	Jan. 31, 1948	57.1	Nov. 21, 1948	71.9
31	52.5	Feb. 29	57.1	Dec. 8	70.9
Aug. 31	53.5	Mar. 31	56.2	17	69.6
Oct. 1	54.5	Apr. 30	56.2	21	70.0
31	54.4	May 31	58.6	28	70.6
Dec. 1	53.0	July 24	62.7	Jan. 9, 1949	69.6
Jan. 1, 1944	51.4	26	63.3	13	69.7
Feb. 1	50.2	28	63.9	21	69.5
Apr. 1	49.25	30	65.2	31	70.0
May 2	47.4	31	65.6	Feb. 7	69.7
14	61.0	Aug. 1	66.25	10	70.4
31	53.7	2	66.7	17	70.2
June 30	52.2	3	66.75	Mar. 1	70.4
July 31	52.3	4	67.6	7	70.85
Sept. 1	55.2	9	67.3	13	70.5
Oct. 1	57.0	10	68.45	20	70.7
Nov. 2	55.8	11	68.35	27	70.6
Dec. 3	54.2	13	69.1	Apr. 3	70.9
31	52.3	14	69.35	10	71.8
Apr. 1, 1945	51.3	15	69.6	17	72.2
June 1	52.2	16	70.2	24	72.0
July 2	54.7	20	70.3	May 1	73.4
Sept. 30	56.2	22	70.5	8	74.0
Dec. 30	52.3	23	71.1	15	74.3
Jan. 1, 1946	52.6	24	71.0	23	74.6
June 30	56.8	28	71.7	June 5	75.3
July 31	60.0	29	71.8	19	76.2
Sept. 30	62.8	31	71.3	23	75.9
Oct. 30	60.8	Sept. 1	71.9	July 17	78.7
Nov. 30	58.8	4	71.7	Aug. 1	77.9
Dec. 31	57.4	18	71.5	8	78.4
Feb. 1, 1947	56.5	21	70.7	29	78.9
Apr. 1	55.2	Oct. 1	71.5	Sept. 11	79.0
May 1	56.4	5	70.7	Oct. 1	78.4
June 1	57.7	7	70.6	18	79.6
30	58.2	8	70.7	Nov. 20	78.1
July 31	62.3	12	70.8	27	77.4
Aug. 31	62.3	17	71.1	Dec. 11	77.4
Sept. 30	62.6	19	70.4	17	77.0
Oct. 31	60.1	27	71.2	Jan. 24, 1951	[1]72.74
Nov. 30	58.9	Nov. 3	71.2	Mar. 28, 1952	[1]49.02
Dec. 28	57.9				

[1]Measured by U. S. Geological Survey.

5/4-26E1

[Owner's No. 7 (formerly C and H 7). Adams and Forbes. About 3 miles south of Napa, 0.42 mile west and 0.16 mile south of intersection of paved road to Basalt Co. and State Highway 12 and 29, 150 ft north of fence line in large pumphouse under wooden headframe. Public supply well, reported diameter $15\frac{1}{2}$-in., reported depth 806 ft. Measuring point, top $1\frac{1}{2}$-in. coupling north side of pump, 1.0 ft above land-surface datum which is 8 ft above sea level. Measurements from owner, except as indicated]

Mar. 23, 1942	38.15	Oct. 8, 1942	48.57	July 31, 1942	42.3
May 5	37.15	16	48.0	Aug. 31	44.2
June 27	43.85	June 13	41.3	Oct. 1	45.3
Sept. 9	47.95	July 1	40.8	31	43.5

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

Date	Water level	Date	Water level	Date	Water level
		5/4-26E1—Continued			
Dec. 1, 1942	41.5	Feb. 1, 1947	47.1	Dec. 28, 1948	58.7
Jan. 1, 1944	41.7	28	56.1	Jan. 13, 1949	57.7
Mar. 1	39.2	Apr. 1	45.5	Mar. 13	59.2
Apr. 1	40.25	July 31	54.4	Apr. 3	66.7
May 2	36.6	Sept. 30	53.8	10	60.4
June 30	39.0	Oct. 31	50.8	17	78.7
July 31	43.0	Dec. 28	49.5	May 29	63.6
Sept. 1	45.3	Jan. 31, 1948	47.3	June 19	65.1
Oct. 1	47.2	Feb. 29	48.1	July 3	66.3
Nov. 2	45.4	Mar. 31	47.2	10	66.4
Dec. 3	44.8	Apr. 30	46.9	17	66.4
Mar. 1, 1945	41.1	July 26	53.5	24	66.7
Apr. 1	40.9	27	53.7	Aug. 8	67.0
July 2	45.0	Aug. 6	57.3	14	67.4
Sept. 1	47.3	7	57.25	21	67.3
30	46.2	20	59.9	Sept. 16	67.9
Dec. 1	44.9	23	60.5	Oct. 1	67.7
30	42.1	28	61.3	16	67.8
Jan. 1, 1946	42.3	29	72.0	23	68.25
Mar. 31	43.3	31	71.5	30	67.8
Apr. 30	44.0	Sept. 1	72.0	Nov. 6	67.9
June 30	47.8	15	72.7	13	67.1
July 31	51.0	18	71.1	20	66.9
Aug. 31	54.3	Oct. 17	59.6	Dec. 4	66.3
Oct. 31	51.4	Nov. 14	61.1	Jan. 24, 1950	[1]62.52
Nov. 30	49.2	30	60.7	Mar. 26, 1952	[2]39.25
Dec. 31	47.75	Dec. 8	59.7		

[1]Pumped recently.
[2]Measured by U. S. Geological Survey.

5/4-27H1

[Owner's No. 4 (formerly McKee 4). Adams and Forbes. About 3 miles south of Napa, on northeast corner of island west of Basalt Co., in pumphouse under large wooden headframe. Unused well, reported diameter 16 in., reported depth 1,226 ft. Measuring point assumed to be top of casing, altitude 8.33 ft above sea level, from records of C and H Sugar Co. Measurements from records of Adams and Forbes, in feet below measuring point]

Mar. 23, 1942	37.95	Aug. 31, 1943	44.25	Apr. 1, 1944	40.5
May 5	37.95	Oct. 1	45.9	May 2	36.8
June 27, 1943	41.5	31	44.9	July 3	43.0
Sept. 9	48.8	Dec. 1	43.6	Sept. 1	45.9
Oct. 8	49.5	Jan. 1, 1944	42.1	Dec. 3	44.1
June 13	41.2	Feb. 1	41.8	31	43.6
July 1	41.4	Mar. 1	39.5	Feb. 28, 1947	46.2

5/4-27H2

[Owner's No. 5 (formerly McKee 5). Adams and Forbes. About 3 miles south of Napa on Basalt Co. property, about 600 ft south-southwest of well 5/4-27A1, in corrugated iron pumphouse under large wooden headframe at southwest side of machine shop. Public supply well, reported diameter 12 in., reported depth 860 ft. Measuring point top of 1¼-in. coupling north side of pump, 0.3 ft above land-surface datum which is

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

5/4-27H2—Continued

8.03 ft above sea level. Altitude of measuring point 8.33 ft above sea level, from records of C and H Sugar Co. Measurements from Adams and Forbes, except as indicated]

Date	Water level	Date	Water level	Date	Water level
Mar. 23, 1942	39.3	Feb. 28, 1947	46.6	Apr. 10, 1949	62.3
May 5	37.5	Apr. 1	45.3	17	62.7
June 27	41.2	May 1	43.0	24	63.5
29	50.86	June 1	48.3	May 1	64.2
June 13, 1943	41.1	30	50.7	8	64.7
July 1	41.05	July 31	54.0	15	64.9
31	42.6	Aug. 31	53.7	22	64.0
Aug. 31	43.7	Sept. 30	53.6	29	65.2
Oct. 1	43.75	Oct. 31	50.8	June 5	65.7
31	[1]44.75	Nov. 30	49.6	12	66.7
Dec. 1	[1]43.4	Dec. 28	49.0	19	66.8
Jan. 1, 1944	41.7	Jan. 31, 1948	47.9	26	67.3
Feb. 1	42.45	Feb. 29	48.1	July 3	68.0
Mar. 1	39.35	Mar. 31	47.5	10	68.2
Apr. 1	39.5	Apr. 30	46.9	17	68.3
May 2	37.1	May 31	48.1	24	68.2
31	36.6	July 31	55.4	Aug. 8	68.6
June 30	41.9	Sept. 1	61.6	14	68.7
July 31	43.2	15	61.6	21	68.7
Sept. 1	45.4	Nov. 9	61.3	28	68.9
Oct. 1	46.8	21	61.5	Sept. 11	68.5
Dec. 3	43.7	30	61.0	18	69.0
31	43.2	Dec. 8	61.1	Oct. 1	61.5
Mar. 1, 1945	41.0	Jan. 13, 1949	59.7	16	69.0
Apr. 1	41.4	21	59.9	18	69.3
July 2	44.2	31	60.4	23	68.9
Aug. 1	46.4	Feb. 7	60.5	30	68.8
Sept. 1	47.2	10	60.8	Nov. 6	68.8
Feb. 28, 1946	42.8	17	60.9	13	68.2
June 30	46.2	24	59.9	27	67.7
July 31	50.7	Mar. 1	61.0	Dec. 4	67.4
Sept. 30	53.7	7	61.2	11	67.2
Oct. 31	51.8	13	61.2	17	67.5
Nov. 30	49.3	20	59.7	Jan. 8, 1950	63.7
Dec. 31	47.8	27	61.15	24	[2]64.13
Feb. 1, 1947	47.1	Apr. 3	60.4	Mar. 28, 1952	[2]38.99

[1]Pumped recently.
[2]Measured by U. S. Geological Survey.

6/3-31G1

[Mrs. Buehler. About 3.5 miles northeast of Napa, 125 ft north of intersection of Hagen Road, Olive Hill Lane, and Third Avenue, 20 ft east of centerline of Olive Hill Lane. Unused well, diameter 12 in., reported depth 465 ft. Measuring point, top of casing south side, 1.0 ft above land-surface datum which is 145 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Dec. 15, 1949	1.98	June 7, 1950	[2]17.96	Dec. 22, 1950	6.29
Jan. 13, 1950	(1)	July 6	[2]29.62	27	4.25
25	(1)	Aug. 10,	31.55	27	3.83
Mar. 1	(1)	Sept. 14	25.84	Jan. 5, 1951	3.74
Apr. 5	(1)	Oct. 9	29.06	19	.01
May 4	(1)	Nov. 8	18.16	26	(1)

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

Date	Water level	Date	Water level	Date	Water level
		6/3-31G1—Continued			
Apr. 2, 1951	(1)	Oct. 11, 1951	35.01	Mar. 27, 1952	(1)
May 24	0.31	Dec. 7	14.82	Nov. 18	20.22

[1] Flowing.
[2] Nearby well being pumped.

6/3-31H1

[N. K. Davis. About 3.5 miles northeast of Napa, 0.30 mile along Cedar Knoll Ranch access road, east of the intersection of Olive Hill Lane, Hagen Road, and Third Avenue, 20 ft north of access road. Irrigation well, diameter 12 in., reported depth 330 ft. Measuring point, top of hole in pump base east side, 1.5 ft above land-surface datum and 180 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Dec. 15, 1949	26.52	May 4, 1950	16.88	Apr. 2, 1951	21.56
Jan. 25, 1950	21.98	Aug. 14	50.20	May 24	25.05
Mar. 1	16.37	Nov. 8	42.60	Dec. 7	39.43
21	15.18	Dec. 22	29.13	Mar. 27, 1952	21.06
Apr. 5	14.63	27	28.20		

6/4-8E1

[L. M. Ragatz. About 2 miles south of Yountville, 0.6 mile northeast of St. Helena Highway along Ragatz Lane, 300 ft north of Ragatz Lane, 225 ft east of dwelling, 25 ft east of shed, in frame pumphouse, 1 in. north of well 6/4-8E2 in which water level is the same. Domestic and stock well, diameter 6 in., depth 32 ft. Measuring point, top of casing west side, 1.0 ft above land-surface datum which is 70 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Nov. 30, 1949	14.73	July 6, 1950	15.46	Apr. 3, 1951	4.74
Jan. 25, 1950	9.48	Aug. 9	20.03	May 23	7.21
Mar. 1	4.36	Oct. 9	20.68	Dec. 7	8.62
Apr. 5	5.97	Nov. 8	16.27	Mar. 27, 1952	3.07
May 3	7.47	Dec. 27	4.14		

6/4-15Q1

[A. R. Johnston. About 4.5 miles north of Napa, 0.2 mile north of intersection of Silverado Trail and Soda Canyon Road, 100 ft east of machine shop, 25 ft southwest of chickenhouse. Domestic and stock well, diameter 8 in., reported depth 303 ft. Measuring point, top of casing north side, 0.5 ft above land-surface datum and 67 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 13, 1949	27.00	Mar. 1, 1950	17.58	Nov. 8, 1950	25.68
Nov. 1	25.90	Apr. 5	20.76	Dec. 27	4.90
10	25.30	May 5	21.04	Apr. 2, 1951	18.89
16	24.47	June 7	26.79	May 26	21.34
25	24.76	July 6	30.86	Oct. 11	29.32
Dec. 1	23.79	Aug. 9	41.05	Dec. 7	3.39
28	24.20	Sept. 14	32.08	Mar. 27, 1952	15.40
Jan. 25, 1950	14.01	Oct. 9	31.01		

6/4-15Q2

[A. R. Johnston. About 4.5 miles north of Napa, 0.15 mile north of intersection of Silverado Trail and Soda Canyon Road, 200 ft west of Silverado Trail, 150 ft north of creek, in open field. Unused well, diameter 8 in., reported depth 90 ft. Measuring

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

6/4-15Q2—Continued

point top of casing, 0.8 ft above land-surface datum which is 50 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Nov. 1, 1949	18.08	Apr. 5, 1950	6.53	Nov. 8, 1950	7.29
10	18.02	May 4	7.03	Dec. 28	6.24
16	14.72	June 7	15.63	Apr. 2, 1951	6.61
25	13.71	July 6	17.22	May 24	8.80
Dec. 1	13.20	Aug. 9	17.61	Oct. 11	17.99
28	6.52	Sept. 14	18.40	Dec. 7	5.82
Jan. 25, 1950	6.11	Oct. 9	18.00	Mar. 27, 1952	6.27
Mar. 1	6.47				

6/4-17A1

[Richard Ohlandt, 5211 Big Ranch Rd. About 5.5 miles north-northwest of Napa, 0.7 mile north-northwest of intersection of Big Ranch Road and Oak Knoll Avenue, 250 ft west of Big Ranch Road, 25 ft north of stock runway. Irrigation well, diameter 12 in., reported depth 250 ft. Measuring point, top of casing south side, 0.5 ft above land-surface datum which is 67 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 13, 1949	17.22	Mar. 1, 1950	8.38	Nov. 8, 1950	15.63
Nov. 1	16.78	Apr. 5	7.69	Dec. 27	4.65
10	17.01	May 4	8.30	Apr. 2, 1951	2.69
16	16.64	June 4	13.67	May 24	4.88
25	16.28	July 8	14.07	Oct. 11	17.76
Dec. 1	16.20	Aug. 10	16.49	Dec. 7	9.35
28	15.28	Sept. 8	19.00	Mar. 27, 1952	.73
Jan. 25, 1950	11.82	Oct. 9	20.25	Nov. 28	13.74

6/4-21P2

[Jack Dukes, 1285 Salvadore Ave. About 3 miles north-northwest of Napa, 0.42 mile west of Big Ranch Road along Salvadore Avenue, 90 ft south of the centerline of Salvadore Avenue, 60 ft west of dwelling in old orchard. Unused well, diameter 6 in., depth 91.8 ft. Measuring point, top of casing east side, 0.8 ft above land-surface datum which is 67 ft above sea level. Measurements Apr. 15, 1950 to Aug. 22, 1951, are selected noon readings from recorder charts]

Date	Water level	Date	Water level	Date	Water level
Nov. 23, 1949	20.80	June 30, 1950	13.78	Oct. 20, 1950	21.07
Jan. 25, 1950	11.87	July 15	17.08	31	20.61
Mar. 1	9.18	26	18.39	Nov. 5	20.87
Apr. 5	8.93	31	18.86	15	20.41
15	8.85	Aug. 5	19.25	Dec. 1	12.87
20	8.96	10	19.63	15	9.04
25	9.24	15	19.87	25	8.54
30	9.65	20	20.76	31	8.41
May 5	9.70	25	20.78	Jan. 5, 1951	8.11
10	9.87	31	21.03	15	7.81
15	10.14	Sept. 5	21.60	20	7.59
20	10.49	10	21.50	25	7.61
25	10.69	15	20.97	31	7.68
31	11.18	20	21.33	Feb. 5	7.36
June 5	11.56	25	21.01	10	7.48
10	12.02	30	21.17	15	7.50
15	12.19	Oct. 5	21.02	20	7.56
20	12.46	10	21.07	25	7.46
25	12.85	15	21.12	Mar. 1	7.42

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

6/4-21P2—Continued

Date	Water level	Date	Water level	Date	Water level
Mar. 5, 1951	7.27	May 16, 1951	9.20	July 15, 1951	14.57
10	7.33	20	9.54	19	15.08
15	7.45	25	10.03	25	15.38
20	7.59	31	10.65	31	16.33
25	7.87	June 5	11.10	Aug. 5	17.02
31	8.21	10	11.40	11	17.34
Apr. 5	8.4	15	11.88	17	18.66
12	8.8	20	12.37	22	19.12
20	8.6	25	12.89	Oct. 11	25.86
25	8.8	30	13.72	Nov. 6	20.32
May 5	8.47	July 5	14.08	Dec. 7	12.55
10	8.78	10	14.21	Mar. 27, 1952	8.73

6/4-22P1

[William D. Fisher, 3002 Big Ranch Rd. About 3 miles north of Napa, 0.3 mile northeast of intersection of El Centro Avenue and Big Ranch Road along Fisher's access road, 30 ft east of dwelling, 20 ft west of swimming pool. Domestic well, diameter 6 in., reported depth 125 ft. Measuring point, top of casing east side, 0.3 ft above land-surface datum which is 53 ft above sea level. Measurements by owner except as indicated]

August 1939	31.7	November 1940	28.7	February 1942	19.6
September	21.7	December	24.7	March	21.4
October	31.7	January 1941	19.8	April	21.0
November	31.7	February	18.2	May	22.8
December	31.7	March	19.1	June	25.5
January 1940	27.7	April	20.0	July	26.6
February	20.5	May	23.8	August	27.2
March	19.0	June	25.5	September	27.2
April	21.3	July	27.0	October	27.2
May	23.5	August	27.5	November	27.2
June	28.1	September	27.7	December	25.5
July	28.9	October	27.7	July 13, 1949	[1]28.7
August	29.2	November	27.6	Nov. 22	[2]29.27
September	29.2	December	23.8	Mar. 27, 1952	[2]18.96
October	28.9	January 1942	20.7		

[1]Measured by Don Imboden.
[2]Measured by U. S. Geological Survey.

6/4-22P2 (DWR 16)

[Wm. D. Fisher, 3002 Big Ranch Rd. About 3 miles north of Napa, about 400 ft southeast of well 6/4-21P1 in northeast end of toolhouse at foot of slope. Domestic well, diameter 8 in., depth 49.5 ft. Measuring point, top of casing south side, 0.5 ft above land-surface datum which is 42 ft above sea level. Measurments January 1926 to October 1942 by Mr. Pinkham, former owner, probably taken near end of month, except by California Division of Water Resources as indicated. Measurements after July 1949 by U. S. Geological Survey]

January 1926	9.7	July 1926	16.4	January 1927	5.5
February	10.8	August	17.0	February	6.3
March	11.6	September	17.7	March	8.2
April	13.7	October	18.3	April	10.3
May	14.8	November	14.0	May	11.3
June	15.6	December	5.8	June	12.5

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

Date	Water level	Date	Water level	Date	Water level
6/4-22P2—Continued					
July 1927	15.6	December 1931	13.0	August 1936	16.3
August	15.8	January 1932	11.3	September	16.9
September	16.0	February	11.6	October	17.2
October	15.7	Mar. 26	[1]4.6	November	17.3
November	14.6	March	12.8	December	17.1
December	9.5	April	13.7	January 1937	17.0
January 1928	9.2	May	14.9	February	11.6
February	10.1	June	15.9	March	8.3
March	8.1	July	16.8	April	10.8
April	11.5	August	17.3	May	13.5
May	13.3	September	17.8	June	14.8
June	13.7	October	18.0	July	16.1
July	14.8	November	18.2	August	16.6
August	15.6	December	18.2	September	17.0
September	15.8	January 1933	16.6	October	17.2
October	15.7	February	16.3	November	17.0
November	15.6	March	14.3	December	15.5
December	14.8	April	14.8	January 1938	10.5
January 1929	15.0	May	15.7	February	7.0
February	13.0	June	17.1	March	5.0
March	12.8	July	17.6	April	9.0
April	13.8	August	18.0	May	12.0
May	14.3	September	18.3	June	14.0
June	16.0	October	18.4	July	15.5
July	16.4	November	17.8	August	16.3
August	16.3	December	16.5	September	16.5
September	16.4	January 1934	16.3	October	16.5
October	17.0	February	14.2	November	16.8
November	17.3	March	14.3	December	16.8
December	16.5	April	14.8	January 1939	16.8
January 1930	13.8	May	16.3	February	17.1
Jan. 31	[1]13.0	June	16.8	March	16.6
February	10.8	July	17.0	April	17.5
March	11.0	August	17.4	May	17.8
April	12.0	September	18.3	June	19.0
May	13.3	October	18.3	July	19.4
June	14.5	November	17.9	August	19.5
July	15.8	December	17.3	September	19.5
August	16.2	January 1935	12.3	October	20.0
September	16.5	February	11.3	November	20.0
Oct. 23	[1]16.1	March	10.2	December	19.8
October	17.0	April	10.3	January 1940	12.9
November	16.6	May	12.3	February	4.3
December	17.0	June	14.5	March	5.7
January 1931	15.3	July	15.5	April	8.6
February	15.3	August	16.2	May	11.3
Mar. 18	[1]14.6	September	16.8	June	14.0
March	15.2	October	17.1	July	16.3
April	15.4	November	17.3	August	17.0
May	16.4	December	17.4	September	17.4
June	18.0	January 1936	14.5	October	17.3
July	18.2	February	8.5	November	17.3
August	18.3	March	9.3	December	12.3
Sept. 28	[1]18.5	April	11.5	January 1941	7.3
September	18.8	May	13.8	February	5.3
October	18.9	June	15.0	March	7.3
November	18.9	July	16.0	April	8.3

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

6/4-22P2—Continued

Date	Water level	Date	Water level	Date	Water level
May 1941	12.8	May 1942	11.8	July 6, 1950	16.68
June	14.4	June	14.4	Aug. 10	[2]18.3
July	15.5	July	15.3	Sept. 8	18.54
August	15.9	August	16.3	Oct. 9	18.87
September	16.5	September	16.3	Nov. 8	17.90
October	16.4	October	16.3	Dec. 27	8.93
November	16.6	July 15, 1949	16.9	Apr. 2, 1951	9.83
December	12.1	Nov. 22	18.10	May 24	14.06
January 1942	8.3	Apr. 5, 1950	12.13	Oct. 11	17.87
February	8.1	May 4	12.96	Dec. 7	13.24
March	9.7	June 7	15.72	Mar. 27, 1952	7.20
April	9.2				

[1]Measured by California Div. Water Resources.
[2]Pumped recently.

6/4-28K1

[A. E. Stumley, 1269 El Centro Ave. About 2.5 miles north-northeast of Napa, 0.57 mile west of Big Ranch Road along El Centro Avenue, 100 ft south of El Centro Avenue, 125 ft west of dwelling, 50 ft northwest of well 6/4-28K2. Unused well, diameter 6 in., reported depth 90 ft. Measuring point, top of casing west side, 0.5 ft above land-surface datum which is 62 ft above sea level]

May 15, 1949	[1]10	Nov. 10, 1949	24.33	Dec. 1, 1949	23.20
Oct. 11	24.06	25	[2]24.36	28	22.92
Nov. 1	31.76	25	24.37	Mar. 27, 1952	5.28
10	[2]22.30				

[1]Measured by Don Imboden.
[2]Pumped recently.

6/4-30C1

[D. P. Bales, 1346 Orchard Ave. About 5 miles northwest of Napa, 150 ft north of Orchard Avenue, 55 ft north of dwelling, in tank tower. Domestic well, diameter 8 in., reported depth 104 ft. Measuring point, top of casing north side, 0.5 ft above land-surface datum which is 152 ft above sea level]

Sept. 30, 1949	45.68	Mar. 1, 1950	31.30	Oct. 9, 1950	45.88
Nov. 1	42.40	Apr. 5	30.91	Nov. 8	41.56
10	41.28	May 3	31.48	Dec. 27	30.30
16	41.44	June 7	34.98	Apr. 2, 1951	24.75
25	40.97	July 6	39.50	May 24	25.96
Dec. 1	40.73	Aug. 10	40.96	Oct. 11	31.45
28	39.90	Sept. 14	45.59	Mar. 27, 1952	17.60
Jan. 25, 1950	35.96				

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

6/4-33F1

[Albert Gasser. About 1 mile north of Napa, 0.3 mile north of Union Station, 25 ft east of centerline of St. Helena Highway, in pasture, north of orchard. Unused well, diameter 12 in., reported depth 420 ft. Measuring point, top of casing east side, 0.8 ft above land-surface datum which is 74 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 11, 1949	12.74	Nov. 16, 1949	18.32	Dec. 28, 1949	17.94
13	20.87	28	18.35	Feb. 27, 1952	2.87
Nov. 1	18.53	Dec. 1	18.37	Nov. 18	9.91
10	18.08				

6/4-33J1

[C. Filippini. About 1 mile north of Napa, 0.25 mile west of California Division of Forestry headquarters, 100 ft south of the centerline of State Highway 29, in pumphouse at south edge of two large advertising signs. Unused well, diameter 6 in., depth 42.5 ft. Measuring point, top of casing north side, 0.3 ft above land-surface datum which is 60 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 13, 1949	7.36	Mar. 1, 1950	2.06	Nov. 8, 1950	6.40
Nov. 1	7.07	Apr. 4	2.16	Dec. 27	1.61
10	6.54	May 3	2.58	Apr. 2, 1951	2.01
16	6.72	June 7	3.49	May 24	2.25
25	6.91	July 6	4.46	Oct. 11	6.00
Dec. 1	7.01	Aug. 10	5.67	Dec. 7	1.44
28	6.49	Sept. 8	6.50	Mar. 27, 1952	1.61
Jan. 25, 1950	2.39	Oct. 9	6.94		

6/4-34D2

[Albert Gasser. About 1.5 miles north of Napa, 0.4 mile north-northwest Beard Avenue extended, 800 ft west of dwelling, 150 ft northwest of barn, 20 ft north of center of slough. Unused well, diameter 12 in., reported depth 380 ft. Measuring point, top of casing south side, 1.4 ft above land-surface datum which is 43 ft above sea level. Measurements Nov. 16, 1949 to Apr. 10, 1950 are selected noon readings from recorder charts]

Date	Water level	Date	Water level	Date	Water level
Nov. 16, 1949	13.29	Feb. 5, 1950	5.52	Apr. 11, 1950	3.11
20	13.25	10	5.00	May 4	3.60
24	13.27	15	5.10	June 7	7.00
30	13.24	20	5.18	July 6	10.35
Dec. 5	13.24	25	5.24	Aug. 10	12.07
10	13.12	28	4.67	Sept. 8	13.24
15	13.14	Mar. 5	3.29	Oct. 9	15.24
22	12.49	10	3.02	Nov. 8	14.04
26	12.34	15	2.94	Dec. 29	4.65
31	12.37	20	2.89	Apr. 2, 1951	4.76
Jan. 5, 1950	12.48	25	4.33	May 24	4.53
11	11.48	31	3.62	Oct. 11	14.65
19	9.72	Apr. 5	2.84	Dec. 7	4.78
25	8.67	10	3.39	Mar. 27, 1952	4.34
31	7.53				

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

6/5-1C1

[M. Frost. In Yountville, 0.45 mile northwest of fork in highway "Y", 0.03 mile southwest of intersection of paved road and State Highway 29, 115 ft southeast of dwelling, 30 ft northwest of chicken yard, 5 ft north of south fence line. Domestic well, diameter 6 in., reported depth 127 ft. Measuring point, top of board cover west side, 0.5 ft above land-surface datum which is 122 ft above sea level. Measurements by owner, except as indicated]

Date	Water level	Date	Water level	Date	Water level
July 6, 1941	29.5	Oct. 5, 1941	38.0	June 1, 1943	28.5
18	32.5	June 1, 1942	11.5	Oct. 1	37.5
26	31.5	July 6	29.5	July 19, 1944	36.0
Aug. 8	34.0	Aug. 24	34.0	June 16, 1945	33.5
Sept. 1	35.0	Sept. 9	34.5	Dec. 1, 1949	[1]35.34
9	36.0				

[1]Measured by U. S. Geological Survey.

7/4-30M1

[A. Braddock. About 1.5 miles northeast of Yountville, 0.31 mile northwest of intersection of Caymus Avenue and Yountville Road. 140 ft southwest of the centerline of Caymus Avenue, 5 ft south of tank, beneath steel windmill tower. Stock well, diameter 8 in., depth 30.5 ft. Measuring point, top of steel cover over casing, 0.2 ft above land-surface datum which is 114 ft above sea level. In measuring care must be taken that overflow from tank back into well does not splash tape and give a false reading]

Date	Water level	Date	Water level	Date	Water level
Dec. 20, 1941	2.50	Aug. 9, 1950	8.40	Apr. 3, 1951	0.50
Mar. 1, 1950	1.00	Oct. 9	8.35	May 24	4.70
Apr. 5	1.41	Nov. 8	[1]10.58	Nov. 6	9.62
May 3	1.21	Dec. 27	.78	Mar. 27, 1952	1.13
June 7	10.13				

[1]Pumped recently.

7/5-5H1

[R. MacAnnan, Jr., 227 Zinfandel Ave. About 1.7 miles southeast of St. Helena High School, 0.8 mile northeast of Zinfandel Station, 30 ft south of Zinfandel Avenue, 20 ft west of oak tree. Unused well, diameter 8 in., depth 40.0 ft. Measuring point, top of casing east side, 1.3 ft above land-surface datum which is 178 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Sept. 27, 1949	5.65	July 6, 1950	4.20	Apr. 3, 1951	2.32
Jan. 25, 1950	2.42	Aug. 9	5.06	May 24	3.03
Mar. 1	2.51	Sept. 14	6.13	Oct. 11	4.72
Apr. 5	2.40	Oct. 9	5.94	Dec. 7	2.41
May 3	2.80	Nov. 8	4.32	Mar. 27, 1952	2.50
June 7	3.78	Dec. 27	2.10		

7/5-5H2

[R. MacAnnan, Jr., 227 Zinfandel Ave. This well was 3 ft north of well 7/5-5H1. Destroyed in 1952. Land-surface datum is 178 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Sept. 27, 1949	5.80	July 6, 1950	4.48	Dec. 27, 1950	2.36
Jan. 25, 1950	2.66	Aug. 9	5.26	Apr. 3, 1951	2.34
Mar. 1	2.65	Sept. 14	6.16	May 24	3.20
Apr. 5	2.65	Oct. 9	6.13	Oct. 11	4.89
May 3	3.00	Nov. 8	5.55	Dec. 27	2.76
June 7	3.96				

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

Date	Water level	Date	Water level	Date	Water level

7/5-8D1

[S. S. Frederick, Box 265 Zinfandel Ave. West. About 1.5 miles southeast of St. Helena High School, 0.4 mile west of Zinfandel station, 650 ft southeast of Zinfandel Avenue, 47 ft southeast of old brick chimney, 10 ft southwest of very large oak tree stump. Unused well, diameter 10 in., depth 50.0 ft. Measuring point, top of casing north side, 0.2 ft above land-surface datum which is 190 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 14, 1949	14.78	Mar. 1, 1950	3.43	Nov. 8, 1950	14.72
Nov. 1	15.20	Apr. 5	3.44	Dec. 27	3.10
9	15.19	May 3	5.14	Apr. 3, 1951	3.55
16	15.26	June 7	6.07	May 24	5.54
23	15.26	July 6	7.75	Oct. 11	13.25
Dec. 1	15.29	Aug. 9	10.28	Dec. 7	4.68
28	15.22	Sept. 14	12.99	Mar. 27, 1952	3.02
Jan. 25, 1950	4.54	Oct. 9	14.56		

7/5-14A1

[H. Hopman. About 2.5 miles east of Rutherford, 0.16 mile west of Silverado Trail along Skellenger Lane, 5 ft south of fence line along south side of road. Stock well, diameter 8 in., reported depth 60 ft. Measuring point, top of casing south side, 1.0 ft above land-surface datum which is 143 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 14, 1949	15.43	Mar. 1, 1950	4.62	Nov. 8, 1950	11.22
Nov. 1	14.42	Apr. 5	4.89	Dec. 27	3.95
9	11.57	May 3	5.78	Apr. 2, 1951	4.05
16	11.44	June 7	8.70	May 24	5.92
28	11.14	July 6	10.52	Oct. 11	12.26
Dec. 1	11.10	Aug. 9	10.62	Dec. 27	8.81
28	10.71	Sept. 14	13.03	Mar. 27, 1952	2.88
Jan. 25, 1950	8.85	Oct. 9	11.89		

7/5-16B1

[W.E. Lawson. About 0.4 mile northeast of Rutherford, 0.3 mile along Rutherford Lane from intersection of St. Helena Highway and Rutherford Lane, and 0.16 mile north along Lawson access road to dwelling, 50 ft east of northeast corner of garage which is south of dwelling. Irrigation well, diameter 10 in., reported depth 333 ft. Measuring point, base of pump south side, 0.8 ft above land-surface datum which is 155 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 21, 1949	10.04	Sept. 14, 1950	12.85	May 24, 1951	3.88
Mar. 1, 1950	5.72	Oct. 9	10.35	Oct. 11	10.07
Apr. 5	3.75	Nov. 8	9.31	Dec. 7	6.66
May 3	3.01	Dec. 27	4.11	Mar. 27, 1952	.86
Aug. 8	12.65	Apr. 2, 1951	2.98	Nov. 18	13.65

7/5-16B2

[W. E. Lawson. About 0.4 mile northeast of Rutherford, 25 ft east of well 7/5-16B1. Unused well, diameter 10 in., reported depth 232 ft. Measuring point, top of casing south side, 0.5 ft above land-surface datum which is 155 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 21, 1949	13.98	Dec. 1, 1949	13.27	May 3, 1950	6.54
Nov. 1	13.76	28	13.25	June 7	[1]22.00
8	13.50	Jan. 25, 1950	9.33	July 6	[1]23.27
16	13.45	Mar. 1	5.93	Aug. 8	12.62
23	13.36	Apr. 5	5.98	Sept. 14	14.94

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

7/5-16B2—Continued

Date	Water level	Date	Water level	Date	Water level
Oct. 9, 1950	13.76	Apr. 3, 1951	5.46	Dec. 7, 1951	8.31
Nov. 8	13.05	May 25	6.93	Mar. 27, 1952	3.98
Dec. 27	5.66	Oct. 11	13.06	Nov. 18	13.45

[1] Nearby well being pumped.

7/5-16B3

[W. E. Lawson. About 300 ft north of well 7/5-16B1, 50 ft north of northeast corner of dwelling, in bamboo thicket. Domestic well, diameter 6 ft, depth 25.0 ft. Measuring point, top of brick coping north side, 0.2 ft above land-surface datum which is 155 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 21, 1949	14.19	Mar. 1, 1950	5.03	Nov. 8, 1950	[1]14.39
Nov. 1	[1]14.43	Apr. 5	4.69	Dec. 27	3.96
8	[1]14.35	May 3	5.35	Apr. 2, 1951	4.58
16	[1]14.62	June 7	5.04	May 24	6.07
23	[1]14.62	July 6	[1]6.33	Oct. 11	[1]13.85
Dec. 1	[1]14.69	Aug. 9	[1]8.78	Dec. 7	7.06
28	[1]14.55	Sept. 14	[1]12.87	Mar. 27, 1952	2.70
Jan. 25, 1950	[1]8.50	Oct. 9	[1]13.72	Nov. 18	14.20

[1] Pumping.

7/5-21D1

[Beaulieu Vineyard, 8253 St. Helena Highway. About 0.9 mile northwest of Oakville, 0.72 mile northwest of intersection of Oakville Road and St. Helena Highway, 0.3 mile south-southeast of St. Helena Highway, 300 ft northwest of dirt access road in vineyard, in corrugated iron pumphouse. Domestic well, 32.0 ft deep. Measuring point, top of pipe at west side of pump, 5.2 ft above land-surface datum which is 152 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Dec. 13, 1949	7.33	July 5, 1950	8.23	Apr. 3, 1951	2.29
Jan. 26, 1950	1.04	Aug. 9	10.26	May 24	3.05
Mar. 1	2.06	Sept. 14	8.24	Oct. 11	8.40
Apr. 5	2.43	Oct. 9	8.74	Dec. 7	1.28
May 3	3.10	Nov. 8	7.43	Mar. 27, 1952	1.45
June 7	5.47	Dec. 27	1.10		

7/5-23D2

[D. B. Harris. About 1.2 miles northeast of Oakville, 0.39 mile northwest of intersection of Oakville Road and paved road, 45 ft northwest of dwelling, 38 ft southwest of road, 2 ft south of power pole. Irrigation well, diameter 12 in., reported depth 129 ft. Measuring point, top of casing south side, 0.5 ft above land-surface datum which is 127 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Dec. 14, 1949	2.19	June 7, 1950	10.68	Apr. 3, 1951	+0.17
Jan. 25, 1950	+.48	July 6	6.46	May 24	2.71
Mar. 1	(1)	Sept. 14	5.06	Oct. 11	4.94
22	+.39	Oct. 9	5.41	Dec. 7	.03
Apr. 4	+.07	Nov. 8	2.77	Mar. 27, 1952	+.30
May 5	2.65	Dec. 27	+.28	Nov. 18	3.05

[1] Well flowing.

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

7/5-23F1

[Lewis Dairy. About 1.15 miles north of intersection of Oakville Road and St. Helena Highway, 0.1 mile northwest of Oakville Road, 200 ft northeast of centerline of side road, 50 ft south of barn, in pumphouse in open field. Irrigation well, diameter 10 ft, depth 13.0 ft. Measuring point, top of concrete rim north side, 1.3 ft above land-surface datum which is 123 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 5, 1949	6.57	Mar. 1, 1950	2.02	Nov. 8, 1950	6.01
Nov. 1	6.95	Apr. 5	2.73	Dec. 27	1.30
10	[1]7.02	May 3	3.60	Apr. 2	2.70
16	6.38	June 7	4.42	May 24	4.67
25	[2]6.62	July 6	4.27	Oct. 11	5.55
Dec. 1	6.17	Aug. 9	3.14	Dec. 7	.84
28	5.75	Sept. 14	5.72	Mar. 27, 1952	1.53
Jan. 25, 1950	1.26	Oct. 9	5.60		

[1]Pumping.
[2]Pumped recently.

7/5-27H1

[Jessie R. Chinn. About 2.25 miles north of Yountville, 0.6 mile southeast of Oakville Road and St. Helena Highway, 250 ft northwest of old dwelling, 50 f. east of centerline of highway, in old frame pumphouse. Domestic well, diameter 8 in., depth 34.0 ft. Measuring point, top of casing east side, at land-surface datum which is 140 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 11, 1949	5.59	Mar. 1, 1950	2.87	Oct. 9, 1950	5.62
Nov. 1	5.67	Apr. 5	3.00	Nov. 8	7.77
10	5.43	May 3	3.32	Dec. 27	[1]4.80
16	5.44	June 7	4.03	May 24, 1951	4.66
25	5.52	July 6	5.86	Oct. 11	6.97
Dec. 1	5.46	Aug. 9	4.77	Dec. 7	3.92
28	4.81	Sept. 14	5.23	Mar. 27, 1952	1.35
Jan. 25, 1950	3.21				

[1]Pumped recently.

7/5-36N1

[B. H. Skilling. About 0.25 mile north of Yountville, 800 ft west-southwest of Yountville cemetery, 50 ft southwest of railroad tracks, 50 ft north of east-west dirt road, in pumphouse in triangular area of pasture. Irrigation well, diameter 8 in., reported depth 104 ft. Measuring point, top of casing south side, 1.5 ft above land-surface datum which is 141 ft above sea level. Altitude of measuring point is 142.5 ft, according to owner. Measurements through June 1949 by owner]

Date	Water level	Date	Water level	Date	Water level
Feb. 13, 1947	3.16	Oct. 10, 1947	4.30	Nov. 10, 1949	4.71
Mar. 10	3.00	31	4.08	16	4.68
Apr. 1	3.00	Nov. 8	4.17	28	4.58
May 2	2.84	Feb. 26, 1948	3.92	Dec. 1	4.60
June 24	3.58	Apr. 7	5.00	28	4.32
Sept. 5	4.25	July 16	4.58	Jan. 25, 1950	3.63
19	4.67	Aug. 29	4.17	Mar. 1	2.44
21	4.42	Dec. 4	4.42	Apr. 5	[1]6.54
26	4.42	June 19, 1949	4.00	May 3	2.92
Oct. 2	4.50	Sept. 13	4.17	July 6	[2]18.33

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

Date	Water level	Date	Water level	Date	Water level
		7/5-36N1—Continued			
Aug. 9, 1950	[2]16.54	Nov. 8, 1950	4.68	Apr. 3, 1951	2.81
Sept. 14	[2]16.30	Dec. 27	3.14	Mar. 27, 1952	2.10
Oct. 9	5.36				

[1]Pumped recently.
[2]Pumping.

8/5-30P1

[K. P. Slavens, Route 2, Box 368. Northeast of St. Helena, at north edge of field, 30 ft northeast of east corner of sewage effluent settling pool on line parallel to fence, and 18 ft south of ditch. Irrigation well, diameter 8 in., depth 45.5 ft. Measuring points, top of casing 0.61 ft above land-surface datum, or top of pump discharge column 1.0 ft above land-surface datum which is 220 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 18, 1949	4.69	Apr. 5, 1950	(1)	Nov. 7, 1950	3.56
Nov. 2	4.66	May 3	2.21	Dec. 27	(1)
9	4.37	June 7	2.98	Apr. 2, 1951	(1)
22	4.30	July 6	4.00	May 24	3.58
Dec. 1	4.26	Aug. 9	6.56	Oct. 11	7.94
28	3.25	Sept. 14	[2]18.15	Dec. 7	.96
Jan. 25, 1950	1.15	Oct. 9	7.19	Mar. 26, 1952	(1)
Mar. 1	(1)				

[1]Flowing through slot in casing.
[2]Pumping.

8/5-31P1

[St. Helena High School. About 50 ft southwest of old stone high school building, inside southeast corner of tool shed. Unused well, diameter 8 in., depth 90.0 ft. Measuring point top of board cover through ½-in. hole, 0.93 ft above concrete floor and 1.68 ft above land-surface datum which is 237 ft above sea level. Water levels from Nov. 2, 1949 to Jan. 12, 1951 are selected noon readings from recorder charts]

Date	Water level	Date	Water level	Date	Water level
Oct. 6, 1949	24.35	Feb. 20, 1950	9.78	June 10, 1950	14.97
Nov. 2	25.22	25	10.52	13	15.37
10	23.75	Mar. 1	11.03	21	16.37
15	23.70	5	11.47	25	16.91
20	24.05	10	11.85	30	17.76
25	24.19	15	12.21	July 5	18.37
29	24.26	20	12.43	10	19.09
Dec. 5	24.18	25	12.23	15	19.76
10	23.49	31	12.01	20	20.41
15	23.30	Apr. 5	12.10	25	21.16
20	22.64	10	12.15	31	22.02
25	22.38	15	12.20	Aug. 4	22.29
31	21.77	20	12.28	11	22.96
Jan. 5, 1950	20.56	25	12.40	15	23.17
10	18.47	30	12.60	20	24.00
15	15.27	May 5	12.71	25	23.65
18	13.53	10	12.88	31	24.03
26	11.96	15	13.01	Sept. 9	25.48
31	11.42	20	13.27	15	25.40
Feb. 5	9.95	25	13.55	20	24.83
10	8.63	31	14.08	25	25.13
15	9.11	June 5	14.51	30	25.30

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

Date	Water level	Date	Water level	Date	Water level
8/5-31P1—Continued					
Oct. 10, 1950	25.20	Nov. 25, 1950	13.84	Jan. 12, 1951	11.09
15	25.44	Dec. 3	12.68	Feb. 2	8.76
20	25.44	10	9.13	15	9.13
25	25.40	15	8.26	Mar. 9	10.62
31	22.42	20	8.20	Apr. 3	12.05
Nov. 5	22.00	25	8.95	May 24	13.59
10	21.10	31	9.95	Oct. 11	24.94
15	20.05	Jan. 5, 1951	10.59	Dec. 7	11.99
20	15.59	10	11.03	Mar. 27, 1952	9.19

8/5-31P2

[John Salvastrini. About 75 ft south of St. Helena High School fence, 30 ft southwest of dwelling, 8 ft north of old stone tank house. Domestic well, diameter 8 in., reported depth 175 ft. Measuring point top of slot in south side of casing, C.2 ft above land-surface datum which is 237 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Nov. 1, 1949	23.43	Apr. 20, 1950	14.60	Aug. 25, 1950	[1]27.42
23	22.71	28	14.03	Sept. 1	27.34
Dec. 1	22.49	May 5	14.07	8	26.00
28	20.87	18	14.58	14	31.10
Jan. 18, 1950	13.47	24	14.93	22	28.64
25	12.51	31	15.52	Oct. 9	25.64
Feb. 8	9.06	June 7	[1]16.17	11	25.32
15	10.04	13	[1]17.02	27	24.0
23	11.61	21	[1]19.34	Nov. 10	22.27
Mar. 1	12.31	28	[1]20.28	Dec. 22	9.60
8	13.04	July 6	20.63	Jan. 12, 1951	12.38
14	13.52	14	[1]27.15	Apr. 2	13.61
22	13.96	28	23.60	May 24	15.14
30	13.26	Aug. 18	[1]31.44	Dec. 7	12.13
Apr. 5	14.80	18	[1]30.31	Mar. 27, 1952	10.48
12	13.49				

[1]Pumped recently.

8/5-32P3

[F. H. White. About 1.0 mile north of Zinfandel station, 0.75 mile northeast of State Highway 29, 0.35 mile northeast of White's dwelling, 0.1 mile northwest of White's Lane extended, 25 ft south and 15 ft east of southeast corner of vineyard, in open field. Unused well, diameter 12 in., depth 34.0 ft. Measuring point, top of casing north side, 0.8 ft above land-surface datum which is 193 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 18, 1949	15.37	Nov. 16, 1949	16.19	Dec. 1, 1949	16.33
Nov. 1	15.89	23	16.24	28	16.34

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

8/6-5R1

[B. E. Barber, Route 1, Box 240, Calistoga. About 2 miles southeast of Calistoga, about 2 miles southeast of Calistoga, about 0.5 mile northeastward along dirt access road from intersection of dirt access road and Highway 29, 75 ft west of driveway and 30 ft west of dwelling, at west side of pumphouse. Domestic well, diameter about 36 in. depth 25.0 ft. Measuring point, top of hole in board cover, 0.7 ft above land-surface datum which is 310 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Nov. 8, 1949	22.30	Apr. 5, 1950	15.20	Nov. 7, 1950	17.41
16	22.14	May 3	15.35	Dec. 27	17.37
22	21.97	June 7	16.06	Apr. 3, 1951	13.81
Dec. 1	21.78	July 6	17.38	May 23	14.71
28	21.34	Aug. 9	22.52	Oct. 11	23.31
Jan. 25, 1950	19.89	Sept. 14	23.09	Dec. 7	21.31
Mar. 1	16.59	Oct. 9	24.82	Mar. 26, 1952	12.51

8/6-10Q1

[Marloff Brothers. About 3.5 miles northwest of St. Helena, 0.25 mile northeast of Highway 29, 250 ft south of the centerline of Bale Lane, 250 ft west of the centerline of railroad, 12 ft east of wooden tank, in small enclosure in open field. Irrigation well, diameter 10., depth 183.5 ft. Measuring point, top of 5/8-in. hole in east side of pump base, 0.59 ft above land-surface datum which is 290 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Sept. 30, 1949	10.45	Apr. 5, 1950	1.39	Nov. 7, 1950	18.20
Nov. 2	16.99	May 3	1.95	Dec. 27	1.38
16	13.46	June 21	6.78	Apr. 3, 1951	1.27
22	11.61	July 6	5.68	May 24	2.62
Dec. 1	11.54	Aug. 9	[1]65.1	Dec. 7	4.67
28	8.62	Sept. 14	40.75	Mar. 26, 1952	.81
Jan. 25, 1950	4.39	Oct. 9	[1]74.2	Nov. 18	24.33
Mar. 1	1.29				

[1]Pumping.

8/6-23C1

[Owner unknown. About 2 miles northwest of St. Helena or 1.2 miles north of St. Helena along State Highway 29, 0.24 mile westward along unnamed road, 0.2 miles northward along unnamed road, 0.11 mile northeast along ranch access road, 60 ft west of old chimmey, on top of hill. Unused well, diameter 3 1/2 ft depth 42.0 ft. Measuring point, edge of copper washer nailed to board cover over top of well, 0.2 ft above land-surface datum which is 260 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 14, 1949	31.70	Apr. 5, 1950	24.32	Dec. 27, 1950	23.66
Nov. 2	31.81	May 3	24.98	Apr. 3, 1951	24.16
10	31.71	June 7	26.84	May 24	25.71
22	31.31	July 6	23.67	Oct. 11	30.57
Dec. 1	31.12	Aug. 9	29.89	Dec. 7	19.83
28	30.30	Sept. 14	31.07	Jan. 4, 1952	22.55
Jan. 25, 1950	23.53	Oct. 9	31.42	Mar. 26	21.57
Mar. 1	24.56	Nov. 7	30.99		

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

8/6-23J1

[Owner unknown. About 1.5 miles north of St. Helena, 0.2 mile south of Lodi Lane along Silverado Trail, 300 ft north of Silverado Trail, 23 ft northwest of fence corner post at stock watering trough, at head of triangular field. Stock well, diameter about 5 ft, depth 34.5 ft. Measuring point, top of wooden platform over well, 0.7 ft above land-surface datum which is 240 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Sept. 29, 1949	14.79	Nov. 16, 1949	15.00	Dec. 1, 1949	14.78
Nov. 2	15.23	22	16.92	28	16.22
10	14.92				

8/6-23P1

[Freemark Abbey Winery. About 2 miles northwest of St. Helena, 0.2 mile north of Lodi Lane, 350 ft northeast of Highway 29, 100 ft northeast of northeast corner of dwelling, under wooden tank tower. Domestic well, diameter about 6 ft, depth 61.0 ft. Measuring point, top of board cover, 0.5 ft above land-surface datum which is 300 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Nov. 2, 1949	17.72	Nov. 16, 1949	15.26	Dec. 1, 1949	9.54
10	13.31	22	11.20	28	19.40

8/6-24B1

[N. P. Nielson, Box 553A. About 2 miles north of St. Helena in Pratt Valley, 75 yd north and 23 yd west of south end of wire fence along dirt road at point on paved road, 0.1 mile northwest of intersection with Glass Mountain Rd. Domestic well, diameter 6 in., depth 105.5 ft. Measuring point, top of casing southeast side, 0.5 ft above land-surface datum which is 360 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 19, 1949	17.50	Mar. 1, 1950	6.85	Nov. 7, 1950	17.28
Nov. 2	17.65	Apr. 5	6.96	Dec. 27	6.78
10	17.36	May 3	6.52	Apr. 3, 1951	7.17
16	17.22	June 7	12.80	May 24	10.32
22	17.50	July 6	16.00	Oct. 11	17.37
Dec. 1	17.48	Aug. 9	17.66	Dec. 7	6.65
28	17.63	Sept. 14	17.93	Mar. 27, 1952	6.83
Jan. 25, 1950	6.79	Oct. 9	17.62		

8/6-35H1

[F. A. Lucas, Route 1 Box 680. In St. Helena, 350 ft north of dwelling, at north side of vineyard south of creek in frame pump house. Domestic well, diameter about 6 ft, depth 53.5 ft. Measuring point, top of board cover, at land-surface datum which is 300 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 20, 1949	8.44	Nov. 16, 1949	8.00	Dec. 1, 1949	7.76
Nov. 2	8.35	22	7.94	28	7.65
10	8.18				

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

9/6-31C1

[E. H. Doda, Box 441. About 0.9 mile north-northeast of Calistoga station, 0.49 mile northeast of intersection of Silverado Trail and ranch access road, 100 ft east of dwelling, 5 ft west of centerline of dirt road. Unused well, diameter 6 in., depth 90. ft. Measuring point, top of casing north side, 0.4 ft above land-surface datum which is 390 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 21, 1949	60.80	Nov. 16, 1949	60.92	Dec. 1, 1949	60.82
Nov. 2	61.96	23	60.91	28	58.35
11	60.82				

9/6-31Q1

[Mrs. A. Ghisolfo. About 0.8 mile east of Calistoga station, 0.2 mile southwestward from Silverado Trail, 300 ft east of gravel ranch access road, 18 ft west of fence line, in vineyard in frame pumphouse. Domestic well, diameter 12 in., depth 50.5 ft. Measuring point, top of casing south side, 1.0 ft above land-surface datum which is 340 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 21, 1949	12.56	Mar. 1, 1950	2.24	Nov. 7, 1950	12.73
Nov. 2	12.79	Apr. 5	2.17	Dec. 27	1.82
10	12.93	May 3	3.50	Apr. 3, 1951	3.62
16	12.97	June 7	5.94	May 24	5.18
22	13.02	July 6	7.82	Oct. 11	12.06
Dec. 1	13.14	Aug. 9	9.71	Dec. 7	5.13
28	13.30	Sept. 14	11.36	Mar. 26, 1952	1.57
Jan. 25, 1950	2.81	Oct. 9	12.12		

9/7-23M1

[J. E. Williams. About 3 miles north of Calistoga, 0.4 mile north of Bennett Land along Eavy Road, 100 ft north of dwelling, 12 ft west of fence, beneath large pine tree. Unused well, diameter 10 in, depth 92.5 ft. Measuring point, top of casing north side, 0.5 ft above land-surface datum which is 480 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 3, 1949	12.12	Mar. 1, 1950	5.85	Nov. 7, 1950	9.28
Nov. 1	12.99	Apr. 5	5.62	Dec. 27	5.58
10	9.28	May 3	5.92	Apr. 3, 1951	6.02
16	11.43	June 7	10.42	May 23	7.03
23	11.32	July 6	11.20	Oct. 10	12.19
Dec. 1	11.22	Aug. 9	11.65	Dec. 7	4.87
28	8.79	Sept. 14	12.00	Mar. 26, 1952	5.30
Jan. 25, 1950	4.95	Oct. 9	11.07		

9/7-25F1

[Owner unknown. About 1.5 miles northwest of Calistoga station, 0.4 mile northwest of Greenwood Avenue and Silverado Trail, 0.1 mile southwest of Silverado Trail, 100 ft east of creek, 20 ft northeast of barn, on concrete pier. Domestic well, diameter 8 in., depth 38.5 ft. Measuring point, top of casing southeast side, 0.5 ft above land-surface datum which is 390 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 7, 1949	22.74	Nov. 16, 1949	22.20	Dec. 1, 1949	21.30
Nov. 2	23.05	23	21.22	28	13.55
10	22.34				

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

Date	Water level	Date	Water level	Date	Water level

9/7-25N1

[W. C. Wiggins. About 1.2 miles northwest of Calistoga station, 0.13 mile northeast of intersection of Greenwood and Grant Avenues, 140 ft northwest of the centerline of Greenwood Ave. 10 ft northeast of driveway along east side of dwelling. Domestic well, diameter 8 in, depth 149 ft. Measuring point, top of casing east side, 1.0 ft above land-surface datum which is 380 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 6, 1949	11.53	Mar. 1, 1950	4.51	Dec. 27, 1950	21.5
Nov. 1	11.22	Apr. 5	4.31	Apr. 3, 1951	4.95
10	9.83	May 3	6.13	May 23	12.64
16	11.00	June 7	7.50	Oct. 10	10.24
23	[1]10.98	July 6	[2]12.50	Dec. 7	6.20
Dec. 1	[2]15.65	Aug. 9	[1]17.97	Mar. 26, 1952	6.40
28	[1]14.90	Oct. 9	15.36	Nov. 18	11.98
Jan. 25, 1950	8.73	Nov. 7	13.30		

[1]Pumped recently.
[2]Pumping.

9/7-25N2

[W. C. Wiggins. On concrete slab 48 ft southwest of well 9/7-25N1. Unused well, diameter 6 in., depth 26.5 ft. Measuring point top of concrete slab northwest side, 0.5 ft above land-surface datum which is 380 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 7, 1949	13.63	Mar. 1, 1950	4.32	Nov. 7, 1950	11.25
Nov. 1	13.86	Apr. 5	5.03	Dec. 27	3.56
10	13.59	May 3	6.50	Apr. 3, 1951	5.77
16	13.77	June 7	8.18	May 23	7.44
23	13.87	July 6	9.47	Oct. 10	13.24
Dec. 1	13.98	Aug. 9	11.45	Dec. 7	6.87
28	13.89	Sept. 14	13.14	Mar. 26, 1952	3.63
Jan. 25, 1950	8.73	Oct. 9	13.71	Nov. 18	13.10

9/7-26P1

[Roy Bentley. About 2 miles northwest of Calistoga station, 0.2 mile northwest of Tubbs Lane along State Highway 28, and 0.25 mile northeast State Highway 28 along ranch access road, 5 ft southwest of creek at northeast corner of garage. Irrigation well, diameter 8 in., reported depth 470 ft. Measuring point, top of casing south side, 1.3 ft above land-surface datum which is 400 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 3, 1949	4.79	Mar. 1, 1950	1.91	Apr. 3, 1951	1.29
Nov. 10	5.46	Apr. 5	1.55	May 23	1.23
16	5.29	May 3	1.46	July 17	7.54
23	5.25	Nov. 7	5.28	Oct. 10	4.33
Dec. 1	5.57	Dec. 27	1.52	Dec. 7	1.44
28	5.68	Feb. 7, 1951	1.47	Mar. 26, 1952	1.39
Jan. 25, 1950	1.92				

Table 14.—*Water levels in Napa Valley, Calif.*—Continued

9/7-27R1

[William Gilmore. About 2.3 miles northwest of Calistoga station, 0.7 mile northwest of intersection of Tubbs Lane and State Highway 28, 90 ft southeast of bridge on ranch access road, in small prune orchard at south side of open field, 10 ft northeast of frame pumphouse. Domestic well, diameter 8 in., reported depth 203 ft. Measuring point, top of casing northwest side, 1.5 ft above land-surface datum which is 410 ft above sea level]

[Measurements above (+) or below land-surface datum]

Date	Water level	Date	Water level	Date	Water level
Oct. 6, 1949	5.99	Nov. 23, 1949	4.05	Dec. 28, 1949	2.37
Nov. 1	5.05	Dec. 1	3.65	Mar. 21, 1950	+1.47
16	4.23				

9/7-36D1

[Mrs. Turner. About 1.2 miles northwest of Calistoga station, 100 ft west of intersection of Greenwood and Grant Avenues, 70 ft northwest of Greenwood Avenue, in frame pumphouse in orchard. Unused well, diameter 12 in., depth 53.5 ft. Measuring point, top of casing north side at land-surface datum which is 375 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Oct. 7, 1949	8.17	Nov. 16, 1949	8.33	Dec. 1, 1949	8.65
Nov. 1	8.46	23	8.65	28	8.60
10	8.40				

Table 15.—*Chemical analyses of water in Napa Valley, Calif.*

Samples collected by the Geological Survey were analyzed by the Geological Survey's City, Utah, laboratory, and "S" for the Sacramento, Calif., laboratory. Samples col- of Plant Nutrition at Berkeley, Calif. These are indicated by the symbol "UC." Sam- San Bernardino in grains per gallon and converted to parts per million. These are signed to the sample. Samples collected and analyses made by other individuals or logical Survey are given as reported and hence they have not been rounded or cor-

The symbol "+" in a column indicates that the constituent is present but the amount was 0.005 ppm. Sum of determined constituents is the arithmetic total in parts per mil- by 2.03 before addition. For sodium and potassium, where no figure is given for po- includes potassium computed as sodium plus any error of analysis.

Well	Collector, analyst, and laboratory number	Depth (feet)	Geologic deposit from which water was withdrawn[5]	Date sampled	Specific conductance (micro-mhos at 25° C)	pH	Constituents, in			
							Sum of determined constituents	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)
4/4- 5C1	SL 6338	155	Qu	3– 9–51	741	6.6	504	40	1.5	0.18
13E1	CZ-SB 4261	98	Qyal	8–24–49	....	7.1	....	30	.1	......
16E1	(1) (2)	306	Qyal, Qoal	1950	....	6.8	7,860	17	.1	......
5/3- 5P1	SL 6292	450	Tsv	3– 9–51	307	7.8	256	84	.28	0
6J1	UC 8696	290	Tsv, Td	[3]7– 9–51	650	6.5	375	......	......	
6N2	UC 8348	205	Tsv	2–24–50	1,253	8.6	....	......	.....	......
6P1	UC 8350	285	Tsv	2–24–50	1,100	8.6	628	......	.....	......
2E1	UC 7989	112.5	Qyal, Qoal	Aug. 1948	450	6.25	238	......	.....	......
5Q1	UC 7793	140	TKJ	Jan. 1948	8,550	8.3	4,840	......	.....	......
	CZ-SB 4142	....	....	8– 1–49	....	8.3	....	15	.3	......
5/4-11F3	SL 6345	165	Qoal or Tsv	2–13–51	680	7.6	457	75	1.8	0
11M1	SL 6529	58.5	Qyal, Qoal	2–13–51	519	7.1	314	43	.10	0
13G2	CZ-SB 4112	120	Tsv, Td	7–23–49	....	3.4	....	75	19	......
13L1	(1) (6) (7)	906	Tsv	2–24–44	....	.....	250	......	......	......
14H2	SL 6393	150	Qoal	3– 9–51	284	7.2	236	86	.04	0
15B3	SL 6287	50	Qyal	3– 1–51	5,020	6.4	2,570	1.4	10	2.3
15C2	SL 6343	66	Qoal	2–13–51	1,090	6.9	605	32	5.7	0
15E1	SL 6290	158.0	Qoal	3– 1–51	668	7.4	393	49	.81	0
15K1	(1) (8)	1,168	Qyal, Qoal	9–21–46	....	.....	5,790	18	12.	T
	SL 6288	....	....	2–14–51	10,280	6.8	6,060	30	6.6	18
17F1	SL 6291	160	TKJ	2–15–51	17,160	7.4	[4]11,700	.2	15	0
21B4	UC 8708	208	Tsv	7–23–51	1,600	8.5	858	......	......	......
21P2	S 4180	235	TKJ	3–26–52	2,080	8.2	[4]1,230	25	......	......
23C2	(1) (6) (7)	323	Tsv	2– 7–44	....	......	[4]222	......	......	.....
27H1	(1) (6) (9)	1,226	Tsv	8– 6–48	....	7.5	[4]689	61	......	......
32J1	UC 8356	29.0	Qyal	3–18–50	450	6.6	225	......	......	......
6/4-25F1	UC 8285	110	Qh	Oct. 1949	300	7.9	152	......	......	......
25R1	(1) (6) (10)	409	Tsv, Td	....	....	7.5	[4]198	20	2.0	......
27C1	UC 8315	60	Qoal	Dec. 1949	200	7.4	118	......	.....	......
28K2	SL 6289	155	Qoal	3– 1–51	246	7.4	164	31	.02	.05
35L3	UC 7857	100	Qyal, Qoal	Apr. 1948	230	6.15	135	......	......	......
7/5- 19[11]	UC 8027	....	....	Oct. 1948	290	7.45	158	......	......	......
20[11]	UC 8026	....	....	.....do.....	1,010	7.1	615	......	......	......
20[11]	UC 8028	....	....	.....do.....	450	7.55	250	......	......	......
20[11]	UC 8043	....	....	.....do.....	510	7.5	292	......	......	......

See footnotes at end of table.

Table 15.—*Chemical analyses of water in Napa Valley, Calif.*—Continued

Quality of Water laboratories. These are indicated by symbol "SL" for the Salt Lake
lected by the Napa farm advisor were analyzed by the University of California's Division
ples collected by the Culligan Zeolite Co. were analyzed by the company's laboratory at
indicated by "CZ." The number after the letter symbol is the laboratory number as-
agencies are indicated by special footnotes. Figures in analyses by other than the Geo-
rected to conform with Survey standards.

not determined; "T" indicates that the constituent is present, but in an amount less than
lion, of all constituents determined, except bicarbonate for which the figure is divided
tassium, the concentration of sodium was computed by difference, and that figure

parts per million												
Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Boron (B)	Fluoride (F)	Hardness as ($CaCO_3$)	Percent sodium
42	36	46	1.4	88		44	64	185	0	0.2	253	28
......	......	......	......	227	......	262	380	......	......	......	......	......
......	......	......	......	......	......	......	......	......	......	......	106	......
19	15	27	4.4	192	......	3.0	6.5	.1	.11	.2	109	34
55	20	40	......	50	......	210	25	......	0	......	[4]219	26
20	5	......	......	260	45	......	205	+	18	......	[4]70	......
20	10	220	......	300	40	15	170	+	8	......	[4]91	84
20	20	45	......	195		20	35	......	......	......	[4]132	41
45	30	1,820	......	235	25	......	2,800	......	11	......	[4]236	95
......	......	......	......	304	......	86	3,200	......	......	......	75	......
16	8.7	121	4.8	268	......	.5	92	.5	2.0	.3	76	76
25	30	31	5.0	180	......	22	67	.3	.20	.3	186	26
......	......	......	......	......	......	667	140	......	......	......	759	......
70	18	10	......	101	72	12	18	......	......	......	[4]248	7
16	13	18	3.3	81	......	21	24	15	.02	0	93	29
324	270	242	7.2	27	......	1.5	1,700	3.1	.11	.1	1,920	21
64	50	68	4.0	82	......	71	268	1.2	.04	.2	365	29
32	25	64	3.8	186	......	2.2	123	.1	.15	.2	183	43
1,160	494	224	......	144	T	162	3,650	1.0	......	......	4,920	9
709	524	770	40	155	......	208	3,680	......	.2	.1	3,920	30
35	28	4,670	75	5,860	......	6.0	3,970	......	31	.8	202	97
30	10	290	......	265	20	145	230	......	.92	......	[4]116	85
32	16	400	6.1	430	0	179	360	.9	.48	0	146	85
41	10	35	......	140	45	2.0	20	......	......	......	[4]144	34
62	18	158	......	[4]286	......	17	230	......	......	......	[4]229	60
30	10	40	......	130	......	50	30	......	0	......	[4]116	43
15	10	35	......	145	......	0	20	......	.44	......	[4]79	55
14	8	46	......	152	......	18	16	......	......	......	[4]68	60
15	10	15	......	85	......	15	20	......	.04	......	[4]79	32
13	8.9	24	1.6	112	......	12	11	5.9	.07	.1	69	42
10	10	30	......	60	......	35	20	......	.21	......	[4]66	52
35	10	10	......	165	......	10	10	......	.18	......	128	16
70	90	35	......	530	......	140	15	......	.42	......	545	13
40	25	20	......	220	......	45	10	......	.16	......	203	17
60	20	20	......	245	......	60	10	......	.14	......	232	16

Table 15.—*Chemical analyses of water in Napa Valley, Calif.*—Continued

Well	Collector, analyst, and laboratory number	Depth (feet)	Geologic deposit from which water was withdrawn[5]	Date sampled	Specific conductance (micromhos at 25° C)	pH	Constituents, in			
							Sum of determined constituents	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)
7/5-20[11]	UC 8044	....	....	Oct. 1948	450	7.6	252	....	......	.....
22G1	UC 8513	56.0	Qyal, Qoal	....	1,300	7.4	668	....	......	.....
22G2	UC 8633	40	Qyal, Qoal	5–8–51	1,300	7.5	730	....	......	.....
22P1	(1) (6) (12)	510	Tsv?	6–10–29	....	.....	......	6.85	0.09	.....
	UC(1)	....	....	1–7–42	....	.....	......	....	......	.....
23D2	SL 6296	139	Qyal, Qoal	3–1–51	399	7.5	264	47	.10	0
26E1	SL 6346	64.5	Qyal	3–16–51	397	7.3	358	131	.07	.26
8/6-9D1	UC 8597	165	Tsv	3–9–51	690	7.7	343	....	.....	.....
9F1	UC 8474	105	Qyal, Qoal	1951	310	6.7	162	....	.....	.....
15A1	SL 6295	25.0	Qyal, Qoal	3–9–51	295	7.3	228	59	.81	.45
15A2	SL 6339	125	Qyal, Qoal	3–9–51	211	7.4	173	53	.09	0
26P1	S 3810	470	Tsv	Oct. 1951	372	8.3	201	30	......	.....
26R1	UC 8064	17.5	Qyal	Nov. 1948	800	7.2	370	......	......	.....
	UC 8082	....	....	Nov. 1949	800	7.0	363	....	......	.....
26R2	UC 7780	320	Tsv	Jan. 1948	926	7.0	469	....	......	.....
27F1	UC	122	Qyal, Qoal	Oct. 1949	100	7.2	98	....	......	.....
(13)	S 4181	....	....	5–29–52	331	7.6	[4]198	27	......	.....
(13)	S 4627	....	....	7–15–52	3,450	7.6	[4]1,870	2.7	......	.....
(14)	(1) (15)	....	....	....	311	7.8	176	11	1.4	.1

[1]Record from owner or owner's agent.
[2]Analysis by Pacific Pump and Supply Co., San Francisco, Calif. Constituents converted from hypothetical combinations in grains per gallon to ions in parts per million.
[3]Well pumped 30 minutes.
[4]Calculated by U. S. Geological Survey.
[5]For explanation by symbols see geologic map (pl. 2).
[6]Constituents converted from hypothetical combinations in parts per million to ions in parts per million.

Table 15.—*Chemical analyses of water in Napa Valley, Calif.*—Continued

parts per million												
Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Boron (B)	Fluoride (F)	Hardness as ($CaCO_3$)	Percent sodium
45	15	30	......	225	....	10	40	....	0.18	....	174	25
35	30	190	......	285	....	0	270	....	14	....	211	66
40	40	190	......	290	....	0	300	....	15	....	264	61
....	....	6.2	......	....	....	....	5.3	....	....	....	....	......
....	....	....	......	....	....	....	....	....	8.5	....	....	......
21	30	20	3.0	241	....	13	8.0	1.5	.21	0	176	19
27	15	37	8.2	212	....	13	19	.1	.78	.3	129	37
35	5	85	......	[4]130	....	55	95	....	3.20	....	108	67
20	20	15	......	135	....	10	30	....	0	....	132	21
13	8.4	39	6.6	180	....	4.1	5.8	.3	.13	.1	67	53
20	10	10	3.4	112	....	12	7.0	1.4	.03	.2	91	19
15	18	137	2.3	166	6.0	17.7	128	2.8	1.5	.1	111	41
35	5	105	......	190	....	10	115	....	4.64	....	108	71
30	20	85	......	155	....	10	135	....	5.4	....	157	56
15	....	170	......	165	....	....	190	....	11	....	37	91
15	5	15	......	75	....	15	10	....	0	....	58	33
19	16	21	2.2	124	0	24	24	3.1	.11	0	113	28
45	75	532	25	122	0	160	960	7.4	.4	0	421	72
18	24	....	11	168	0	10	11	6.0	....	....	144	14

[7]Analysis by California Division of Architecture.
[8]Analysis by S. V. Spiridonoff, San Francisco, Calif.
[9]Analysis by Pacific Engineering Co., San Francisco, Calif.
[10]Analysis by Lo Prest Co., San Francisco, Calif.
[11]Spring.
[12]Analysis by Smith Emery Co., San Francisco, Calif.
[13]Napa River at Maxwell Bridge.
[14]Lake Hennessey water, from pipeline at reservoir.
[15]Analysis by Brown and Caldwell, San Francisco, Calif.

Table 16.—*Partial chemical analyses of water in Napa Valley, Calif.*

[Analyses are by the Geological Survey unless otherwise indicated. Symbol "CZ" indicates the analysis is by the Culligan Zeolite Co., laboratory in San Bernardino, Calif.]

Well	Date of collection	Depth (feet)	Geologic deposit from which water was withdrawn[1]	Source of analysis	Parts per million			Specific conductance (micromhos at 25° C)
					Chloride (Cl)	Iron (Fe)	Hardness as $CaCO_3$	
3/4- 4L1	11- 8-49	300	Qyal, Qoal	....	358	....	350	2,490
4L	11- 8-49	....	From slough	....	10,800	....	3,400	29,400
4/4- 2Q1	7-13-49	120	Qyal	CZ	....	0	291	....
	3-10-50	....	....	....	105	....	304	943
4C1	1-11-50	80	Qyal	....	39	....	120	439
4P	12-20-49	....	From slough	....	9,550	....	....	35,700
5C1	7-13-49	155	Qh	CZ	....	0	140	....
	1-26-50	....	....	....	66	....	262	751
5D1	3-13-51	60	Qh	....	32	....	60	357
5D2	3-13-51	60	Qh	....	80	....	138	657
6N1	3-16-50	....	Qoal, Qh?	....	115	....	191	690
7A1	3-13-51	54	Qoal	....	2,020	....	1,630	6,580
8M1	12-21-49	175	Qyal	....	63	....	90	586
9C2	12-20-49	200+	Qyal,Qoal?	....	166	....	80	933
13E1	10- 9-50	98	Qyal	....	422	....	725	2,460
16D1	1-11-50	231	Qyal, Qoal	....	137	....	235	873
16E1	1950	306	Qyal, Qoal	Owner	....	.1	106	....
	8-23-51	....	....	....	145	....	185	934
5/3- 5M1	1-11-50	117	Tsv	....	26	....	230	675
5N1	1-13-50	135	Tsv	....	29	....	120	402
5N2	1-13-50	115	Tsv	....	26	....	140	424
5P1	1-31-50	450	Tsv	....	11	....	106	307
6H1	2- 7-51	150	Tsv, Td	CZ	301	26	....	....
	[2]4- 3-51	280	Tsv	....	25	....	305	799
6M1	8-25-49	295	Tsv	CZ	....	0	67	....
6M2	1-30-50	65	Tsv	....	16	....	15	344
6N1	1-11-50	120	Tsv	....	57	....	55	565
6N2	1-12-50	205	Tsv	....	216	....	80	1,230
	3- 51	....	....	....	182	....	72	1,200
7E2	1-13-50	135	Tsv	....	33	....	160	880
7H1	1-24-50	40	Qt	....	20	....	75	232
7H2	4-11-50	65	Qt?	CZ	....	2.3	185	....
7L1	2- 7-50	120	Tsv, Td?	....	65	....	213	707
7M1	1-12-50	98	Tsv, Td?	....	74	....	80	561
7N1	5-21-51	172	Tsv	....	21	....	95	314
8C1	2-15-50	95	Tsv	....	23	....	80	286
1F1	1-13-50	80	Tsv	....	52	....	160	560
2M1	11-18-49	25	Qyal	....	28	....	110	422
3Q1	2-14-50	316	Qyal, Qoal	....	17	....	122	448
4G1	12-22-49	190	Qyal, Qoal	CZ	....	.8	80	....
4Q1	4-12-50	100	Qyal,Qoal?	CZ	....	5.3	258	....
5H1	12-10-49	132	....	CZ	....	.2	103	....
	12-30-49	....	Qyal, Qoal	....	12	....	115	295
5/4- 5Q2	3-16-51	150	Qal, KJ?	....	28	....	105	596
6K1	2- 3-50	60	Qyal	....	16	....	50	401
9E1	12-15-49	330	Qyal, Qoal	....	17	....	70	230
9K1	3-16-51	85	Qyal,Qoal?	....	78	....	160	602
9Q2	2- 2-50	147	Qyal, Qoal	....	42	....	129	497

See footnotes at end of table.

Table 16.—*Partial chemical analyses of water in Napa Valley, Calif.*—Continued

Well	Date of collection	Depth (feet)	Geologic deposit from which water was withdrawn[1]	Source of analysis	Parts per million			Specific conductance (micromhos at 25° C)
					Chloride (Cl)	Iron (Fe)	Hardness as $CaCO_3$	
5/4-10F1	3- 1-51	100	Qyal, Qoal	....	134	....	200	799
11F1	2-13-51	75	Qyal,Qoal?	....	97	....	71	687
11F3	2- 2-51	165	Qoal or Tsv	....	93	....	82	689
11H1	1-24-50	150	Tsv	....	18	....	55	216
11L1	11-18-49	92.5	Qyal	....	16	....	60	224
12B2	4- 4-51	....	Tsv	....	11	....	61	207
12F1	1-30-50	203	Tsv?	....	17	....	47	282
12J1	1-13-50	303	Tsv	....	70	....	160	619
12M1	1-12-50	115	Tsv?	....	64	....	50	531
13G1	7-23-49	180	Tsv	CZ	....	0	664	....
	1-12-50	....	....	....	30	....	1,150	255
13G2	7-23-49	120	Tsv, Td	CZ	140	19	759	....
	1-12-50	....	....	....	44	....	700	166
13G3	1-12-50	345	Tsv	....	12	....	90	273
14C1	12- 2-49	220	Qyal, Qoal	....	21	....	74	224
14H2	1-12-50	150	Qoal	....	27	....	85	268
14H3	2- 2-50	240	Qoal	....	18	....	60	212
14L1	3-31-49	525	Qoal, Tsv	Owner	30	....	77	....
14P1	3-31-49	600	Qoal, Tsv	...do.....	42	....	87	....
	12-16-49	....	....	....	50	....	85	470
15B	12-22-49	....	From slough	....	5,570	....	2,400	1,920
15B2	12-22-49	125	Qyal,Qoal?	....	2,440	....	2,000	7,900
15C1	6-23-49	80	Qoal	CZ	2,840	0	937	....
	[3]2- 2-51	....	....	....	174	....	309	914
15C2	[3]2- 2-51	66	Qoal	....	158	....	274	833
15M1	3- 1-51	750	Qoal	....	56	....	134	498
16H2	3- 1-51	240	Tsv?	....	63	....	108	501
16K1	12-20-49	136	Tsv	....	70	....	190	713
19J2	6- 9-49	108	KJ	CZ	....	0	226	....
	3-16-51	....	....	....	82	....	110	1,240
19L1	2-14-51	95	Tsv?,KJ?	....	20	....	78	396
21A1	12-23-49	545	Tsv	....	20	....	105	278
21B1	3- 9-51	140	Tsv	....	14	....	56	187
21B3	1-12-50	200	Tsv	....	256	....	90	1,380
	3- 9-51	....	....	....	46	....	72	413
	8- 1-51	....	....	....	227	....	100	1,220
21B6	7-23-51	200	Tsv	....	133	....	65	1,010
21K1	4- 6-50	113.0	Tsv	....	308	....	199	341
22M1	11- 1-49	99.0	Tsv	....	54	....	90	662
23C2	3-31-49	323	Tsv	....	24	....	79	....
26B1	7-23-49	1,440	Tsv	Owner	32	....	....	....
	1-24-50	....	....	....	19	....	85	374
26E1	7-23-49	806	Tsv	Owner	24	....	....	....
	1-24-50	....	....	....	50	....	100	430
27H1	8- 6-48	1,226	Tsv	Owner	230	....	....	....
	7-23-49	....	....	...do.....	216	....	....	....
27H2	7-23-49	860	Tsv	... do.....	88	....	....	....
	1-24-50	....	....	....	26	....	75	352
27Q1	12-21-41	600	(4)	....	2,620	....	2,500	7,940
27R	12-22-49	....	From slough	....	7,482	....	2,900	28,500
29E2	10-11-49	110	Qh	CZ	....	0.2	250	....

See footnotes at end of table.

Table 16.—*Partial chemical analyses of water in Napa Valley, Calif.*—Continued

Well	Date of collection	Depth (feet)	Geologic deposit from which water was withdrawn[1]	Source of analysis	Parts per million			Specific conductance (micromhos at 25° C)
					Chloride (Cl)	Iron (Fe)	Hardness as $CaCO_3$	
5/4-29F1	2- 2-51	106	Qh	....	74	......	60	766
29H1	3- 9-51	44.5	Qoal	....	25	......	95	269
30B2	3-21-50	570	KJ	....	254	......	75	1,450
30R1	3-21-50	1,400	KJ	....	559	......	100	263
31N1	3- 9-51	180	Qh?	....	161	......	64	1,520
31N2	3- 9-51	180	Qh?	....	39	......	73	885
32R1	3-13-51	....	Qyal	....	86	......	162	607
32R2	3-13-51	150	Qoal, Qh?	....	18	......	65	371
35G2	5- 3-51	185	Tsv	....	20	......	64	263
36C1	3-23-51	150	Tsv	....	12	......	60	190
36C3	3-23-51	From spring	Tsv	....	8.8	......	43	140
5/5-23R1	1-26-50	480	Qh or Tsv	....	13	......	60	336
26G1	1-26-50	410	Tsv	....	9.2	......	75	278
6/3-19M1	2- 6-51	190	Tsv	....	15	......	52	142
30M1	1- 1-50	228	Tsv	....	20	......	80	322
30N1	3-22-50	380	Tsv	....	19	......	78	306
31G1	3-22-50	465	Tsv	....	10	......	58	279
31H1	8-10-50	330	Tsv	....	9.3	......	30	150
31K1	12-14-49	348	Tsv	....	11	......	70	282
6/4- 6P1	4-19-50	120	Qyal, Qoal	....	19	......	140	404
7E1	12-22-49	120	Qyal, Qoal	....	15	......	150	380
8E1	6- 7-50	32	Qyal	....	19	......	205	547
8M1	12-22-49	80	Qyal,Qoal?	....	13	......	120	342
15Q1	10- 9-50	303	Qoal, Qh	....	12	......	41	265
17G2	4-27-50	192	Qyal, Qoal	....	12	......	146	419
18A1	7-19-51	250	Qyal, Qoal	....	11	......	110	285
18A2	7-19-51	105.5	Qyal, Qoal	....	11	......	110	284
18A3	7-19-51	755	Tsv	....	9.8	......	98	268
21P1	2-15-51	48	Qoal	....	12	......	74	227
22P2	10- 9-50	49.5	Qoal	....	10	......	65	207
23J1	8-17-49	700	Tsv	CZ	....	0	96	....
	4- 3-50	....	....	....	21	......	80	437
24M1	4- 3-50	....	Tsv	....	17	......	106	381
25B1	2- 9-50	129	Tsv	....	15	......	80	274
25B2	1-11-50	185	Tsv	....	9.8	......	35	131
25D1	12-13-49	305	Qh?, Tsv	....	20	......	125	400
26H1	3-23-50	643	Tsv	....	19	......	48	386
26L2	1- 1-50	180	Qoal, Qh?	....	9	......	14	289
26N1	1- 1-50	150	Qyal, Qoal	....	30	......	90	382
28F1	2- 8-50	99	Qyal, Qoal	....	9	......	62	217
30C1	10- 9-50	104	Qoal	....	36	......	177	599
32D1	11-10-49	78.5	Qoal	....	20	......	160	616
33F1	10-12-49	420	Qyal, Qoal	....	17	......	190	446
33H1	3- 9-51	104	Qyal, Qoal	....	14	......	87	308
34B1	11-18-49	77	Qoal	....	13	......	45	202
34H	12- 8-49	....	From slough	....	14	......	170	406
35G3	1-31-50	260	Qoal	....	27	......	89	364
35K1	3-22-50	1,586	Tsv	....	130	......	10	749
35L2	1-12-50	260	Qyal, Qoal	....	19	......	40	497
36C1	11- 7-49	447	Qh, Tsv?	CZ	....	5.2	154	....
36J1	2- 2-50	432	Tsv	....	17	......	26	318

See footnotes at end of table.

Table 16.—*Partial chemical analyses of water in Napa Valley, Calif.*—Continued

Well	Date of collection	Depth (feet)	Geologic deposit from which water was withdrawn[1]	Source of analysis	Parts per million			Specific conductance (micromhos at 25° C)
					Chloride (Cl)	Iron (Fe)	Hardness as $CaCO_3$	
6/4-36L1	1-11-50	243	Tsv	....	26	......	25	445
35Q1	1-12-50	76	Tsv	....	9.2	......	55	240
6/5- 1B1	12- 2-49	87	Qoal	....	22	......	110	335
1C1	12- 1-49	127	Qoal	....	9.7	......	85	247
1C2	12- 2-49	104	Qoal	....	22	......	85	247
1C3	12- 2-49	125	Qoal	....	22	......	105	302
24R1	11-25-49	186	Qyal,Qoal? Tsv?	CZ	....	0	178	....
	4-18-50	....	....	....	6.5	......	131	386
7/4-30L1	1-20-49	171	Qyal, Tsv	....	13	......	85	224
30M1	10- 9-50	30.5	Qyal	....	9.5	......	58	173
30Q2	12- 2-49	126	Qyal, Tsv	....	27	......	240	775
31E2	10-13-50	272	Qyal, Tsv	CZ	....	.5	111	....
7/5- 3D1	11- 4-49	From spring	Tsv	....	11	......	95	270
3D2	11- 4-49	From spring	Tsv	....	13	......	130	339
3M1	2- 1-50	700+	Tsv	....	13	......	50	222
3N2	11- 3-49	....	Qyal	....	11	......	145	359
4C1	10-19-49	270	Tsv, Td	....	10	......	50	153
4H1	11- 3-49	220	Tsv, Td	....	15	......	45	189
6D1	11- 6-49	58.0	Qyal	....	12	......	150	366
8K1	10-20-49	250	Qyal, Qoal	....	8.1	......	175	324
9M1	10-18-49	15.0	Qyal	....	57	......	315	723
10K1	11- 3-49	32	Qyal	....	10	......	160	368
14A1	10- 9-50	60	Qyal	....	12	......	120	338
14G1	10-14-49	265	Qyal, Tsv	....	11	......	115	306
14J1	11-18-49	143	Qyal	....	8.8	......	80	227
15A1	10-21-49	355	Qyal, Qoal	....	12	......	95	363
16B1	6- 7-50	333	Qyal, Qoal	....	9.0	......	145	453
16B3	10- 9-50	25.0	Qyal	....	13	......	178	412
16N1	10- 4-49	252	Qyal, Qoal	....	13	......	130	336
17B2	10-20-49	82	Qyal,Qoal?	....	14	......	180	445
17J1	10- 4-49	564	Tsv	....	6.5	......	70	198
21B1	12- 8-49	18	Qyal	....	20	......	188	422
21K1	12-13-49	32	Qyal	....	14	......	110	253
	10- 9-50	....	....	....	13	......	103	266
22E1	12- 9-49	7.0	Qyal	....	11	......	130	275
23D3	3- 1-41	20	Qyal	....	19	......	242	503
23E1	11-28-49	39.0	Qyal	....	16	......	240	474
23F1	10- 9-50	13.0	Qyal	....	20	......	258	566
25A1	12- 6-49	56.5	Qyal	....	9.6	......	85	198
25H3	12-20-49	190	Qyal, Tsv	....	9.2	......	80	192
25N1	12- 2-49	61	Qyal	....	5.6	......	110	111
26D1	11-29-49	17.5	Qyal	....	40	......	150	503
26E1	11-16-49	64.5	Qyal	....	23	......	110	429
26L2	12- 1-49	56.0	Qyal	....	12	......	50	110
26M1	3-16-51	71	Qyal	....	9.0	......	110	363
27H1	10- 9-50	34.0	Qyal	....	7.7	......	95	291
	3-23-51	....	....	....	9.2	......	110	352
34H1	12-14-49	26.5	Qyal	....	8.5	......	70	178
35K1	3-23-51	180.5	Qyal, Qoal	....	9.2	......	40	129
36N1	10- 9-51	104	Qoal, Tsv?	....	9.5	......	94	254

See footnotes at end of table.

Table 16.—*Partial chemical analyses of water in Napa Valley, Calif.*—Continued

Well	Date of collection	Depth (feet)	Geologic deposit from which water was withdrawn[1]	Source of analysis	Parts per million			Specific conductance (micromhos at 25° C)
					Chloride (Cl)	Iron (Fe)	Hardness as $CaCO_3$	
7/5-36P1	12- 2-49	189	Qoal, Tsv?	....	25	......	135	400
36P2	12- 2-49	94.5	Qoal	....	14	......	110	285
8/5-30P1	10- 9-50	45.5	Qyal	....	22	......	92	471
31P2	11- 4-49	175	Qyal, Qoal	....	9.2	......	130	439
32R1	10-19-49	35.5	Qyal	....	13	......	140	352
8/6- 5R1	10- 9-50	25	Qyal	....	30	......	78	302
10Q1	9-30-49	183.5	Qyal, Qoal	....	7.1	......	60	266
14K1	10- 5-49	187	Tsv?	....	6.9	......	35	115
14R1	11-28-49	132	Tsv	....	5.6	......	60	191
23B1	10- 5-49	72	Qyal	....	8.3	......	45	247
24B1	10- 9-50	105.5	Tsv	....	11	......	38	138
25H2	10-14-49	....	....	....	8.9	......	75	280
26B1	7-17-51	27.5	Qyal	....	8.0	......	42	117
9/6-31Q1	10-21-49	50.5	Qyal	....	9.2	......	40	143
9/7-25C1	10- 6-49	112	Qyal	....	11	......	90	422
25F1	10- 7-49	39.0	Qyal	....	12	......	60	193
25N1	10- 3-49	149.0	Tsv?	....	190	......	75	912
26G1	10- 3-49	305	Tsv	....	191	......	110	959
26K1	3-22-50	....	Tsv	....	226	......	80	1,020
26N1	10- 7-49	207	Tsv?	....	13	......	55	414
26N2	10- 7-49	21	Qyal	....	8.8	......	85	194
26P1	2- 7-51	470	Tsv	....	96	......	140	727
26R1	5- 3-51	17.5	Qyal	....	37	......	80	355
26R2	5- 3-51	320	Tsv	....	192	......	29	917
26R3	6-21-50	147.5	Tsv	....	192	......	18	919
27R1	10- 6-49	203	Qyal or Tsv?	....	28	......	40	526
(5)	11- 3-49	....	....	....	10	......	145	363
(6)	12-11-50	....	....	....	17	......	142	270
(6)	3-16-51	....	....	....	13	......	80	188
(7)	....	....	....	Owner	15	......	38	....

[1] For explanation of symbols see geologic map (pl 2).
[2] Sample taken after well deepened to 280 feet and original 150 feet cased off.
[3] Sample taken from well above plug.
[4] Casing rusted probably contaminated by water from nearby tidal slough.
[5] From Lake Hennessey.
[6] City water from main at Napa.
[7] From Lake Marie reservoir, Napa State Hospital.

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*

[For wells having no perforated interval shown, customary practice is to preperforate all casing except the top few lengths]

	Thickness (feet)	Depth (feet)
4/4-4C1		
[Norman's Resort. Drilled by O. J. Pearson. On alluvial plain. Altitude 12 ft. Casing perforated from 20 to 80 ft]		
Younger alluvium:		
"Surface"	10	10
Huichica(?) formation:		
Clay, yellow	15	25
Clay, yellow; sand and some gravel	35	60
Gravel and sand; some yellow clay	20	80
4/4-5C1		
[P. C. Lund. Drilled by N. Miller. On older alluvial plain. Altitude 3C ft]		
Huichica formation:		
Clay, red	92	92
Gravel, water	6	98
Clay, red	57	155
4/4-16D1		
[James Pritchett. Drilled by J. W. Evans & Sons. On island. Altitude 0 ft]		
Younger and older alluvium, undifferentiated:		
"Tule mud"	70	70
Gravel and water	38	108
Clay, gray	10	118
Clay, yellow	12	130
Clay, blue	11	141
Gravel and water	8	149
Clay, gray	29	178
Gravel and water	4	182
Clay, blue	34	216
Gravel and water	3	219
"Cement," gray	9	228
Huichica(?) formation:		
Clay, yellow; and boulders	3	231
4/4-16E1		
[Ernest Nelson. Drilled by J. W. Evans & Sons. On island. Altitude 0 ft. Casing cemented from 0 to 185 ft, perforated from 185 to 306 ft]		
Younger and older alluvium, undifferentiated:		
"Tule mud," blue	52	52
Gravel, salty water	4	56
"Tule mud," blue	37	93
Gravel, salty water	6	99
"Tule mud," blue	39	138
Sand	5	143
Gravel	21	164
"Tule mud," blue	75	239
Sand	2	241
Clay, sandy, yellow	38	279

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
4/4-16E1—Continued		
Younger and older alluvium, undifferentiated:—Continued		
Gravel, coarse, fresh water	1	280
Sand, coarse, fresh water	21	301
Clay	5	306
5/3-5M2		
[L. Allen. Drilled by J. W. Evans & Sons. On hillside. Altitude 240 ft]		
Sonoma volcanics:		
Soil	3	3
Tuff	63	66
Rock, broken; water	3	69
Tuff	59	128
Rock, broken; water	4	132
Tuff	3	135
5/3-5N1		
[W. M. Paige. Drilled by J. W. Evans & Sons. On hillside. Altitude 240 ft]		
Sonoma volcanics:		
Soil	8	8
Ash	28	36
Tuff	23	59
Rock, broken; water	3	62
Lava, cemented	58	120
Lava, broken; water	10	130
Lava, cemented	5	135
5/3-5N3		
[C. Trouslot. Drilled by J. W. Evans & Sons. On hillside. Altitude 450 ft. Well uncased from 40 to 192 ft]		
Sonoma volcanics:		
Rock and clay	22	22
"Tule mud," brown	10	32
"Tule mud," black	19	51
Rock and lava	73	124
Basalt rock, hard	4	128
Lava, gray	23	151
Lava, blue; and water	31	182
Basalt rock, hard	10	192
5/3-5P1		
[M. Stanton. Drilled by J. W. Evans & Sons. On hillside. Altitude 500 ft]		
Sonoma volcanics:		
Tuff	30	30
"Chalk" (diatomite)	9	39
Clay	45	84
Tuff	99	183
Gravel, water	12	195
Rocks, hard	29	224

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/3-5P1—Continued		
Sonoma volcanics:—Continued		
Gravel, water	10	234
"Cement"	29	263
Rocks	15	278
"Cement"	90	368
Gravel, cemented	23	391
Gravel, water	20	411
"Cement"	9	420
"Diorite"	30	450
5/3-6J1		
[L. A. Kech. Drilled by owner. On hill slope. Altitude 200 ft]		
Sonoma volcanics:		
Soil	3	3
Diatomite	67	70
"Tule mud"	15	85
Undescribed	65	150
Rock, hard	28	176
Lava, vesicular	79	255
Lava, brown	10	265
Basalt, (some quartz grains in washed cuttings)	25	290
5/3-6M1		
[H. Denny. Drilled by J. W. Evans & Sons. On low plain. Altitude 125 ft]		
Sonoma volcanics:		
Soil	5	5
Clay	40	45
Clay, boulders; water	10	55
Clay and boulders	92	147
Lava, blue; water	16	163
Lava, hard	7	170
Conglomerate, brown	20	190
Lava, red; water	7	197
Conglomerate, gray	8	205
Undescribed	45	250
Lava, water	45	295
5/3-6M2		
[J. C. Beatty. Drilled by J. W. Evans & Sons. On low plain. Altitude 135 ft. Casing perforated 25 to 65 ft]		
Sonoma volcanics:		
Soil	4	4
"Chalk" and rock (diatomite and rock)	20	24
Boulders and clay	11	35
Gravel, water	3	38
Rock, blue	22	60
Rock, water	5	65

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/3-6N1		
[A. L. Simpkins. Drilled by J. W. Evans & Sons. On hillside. Altitude 120 ft]		
Sonoma volcanics:		
Soil	1	1
"Hardpan" and boulders	29	30
Rock, blue	15	45
Water	1	46
Rock, blue	64	110
Rock, water	5	115
Rock	5	120
5/3-6N2		
[L. V. Evans. Drilled by J. W. Evans & Sons. On low plain. Altitude 155 ft]		
Sonoma volcanics:		
Soil	8	8
"Chalk rock" (diatomite)	40	48
Rock, white (tuff)	82	130
Rock, broken; water	20	150
Rock, white	55	205
5/3-6N3		
[T. B. Wright. Drilled by J. W. Evans & Sons. On hillside. Altitude 120 ft]		
Sonoma volcanics:		
Rock and clay	18	18
Clay	37	55
Gravel and sand; water	8	63
Rock and clay	23	86
Gravel, water	1	87
Rock	33	120
Rocks, water	26	146
5/3-6Q1		
[Don Searl. Drilled by J. W. Evans & Sons. On low plain. Altitude 163 ft. Casing perforated from 24 to 88 ft uncased from 88 ft]		
Sonoma volcanics:		
Soil	3	3
"Chalk rock" (diatomite)	7	10
"Tule mud"	25	35
Lava, blue; water	10	45
Lava, cemented, blue	30	75
Lava, black; water	7	82
Lava, cemented, blue	136	218
Lava, water	7	225
Rock, blue, hard	3	228

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)

5/3-7D1

[George Kucek. Drilled by J. W. Evans & Sons. On low plain. Altitude 125 ft. Uncased from 46 to 145 ft]

Sonoma volcanics:		
Soil	4	4
"Chalk rock" (diatomite)	4	8
"Tule mud"	57	65
Lava, cemented, blue	5	70
Lava, blue	50	120
Rock, blue, hard	10	130
Broken lava; water	15	145

5/3-7E3

[Mount George Union School. Drilled by J. W. Evans & Sons. On low plain. Altitude 118 ft]

Sonoma volcanics:		
No record	186	186
Rocks	38	224
Rocks, soft; water	18	242
Clay, yellow	28	270
Rocks, blue, soft; water	8	278
Rocks, yellow	32	310
Rocks, blue	92	402
"Cement"	27	429
Conglomerate, soft; water	2	431
Lava, hard	13	444
Lava, brown; water	4	448
"Cement"	30	478

5/3-8C1

[B. A. Johnson. Drilled by J. W. Evans & Sons. On hillside. Altitude 290 ft. Cased from 0 to 25 ft]

Sonoma volcanics:		
Soil	1	1
Tuff, brown	19	20
Tuff, green	34	54
Lava and water	2	56
Tuff, gray	24	80
Lava and water, flowing	10	90
Lava	5	95

5/3-17C1

[E. F. Lazarus. Drilled by J. W. Evans & Sons. On small lava plateau. Altitude 600 ft]

Sonoma volcanics:		
Tuff	84	84
Rock, hard	21	105
Tuff	80	185
Lava, brown; some water	25	210
Tuff, blue	27	237
Lava, broken; water	24	261

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-1G1		
[A. Marshall. Drilled by J. W. Evans & Sons. On hill slope. Altitude 142 ft]		
Sonoma volcanics:		
Soil	3	3
Tuff	25	28
Clay	21	49
Rocks, water at 57 ft	9	58
Tuff	3	61
Rocks and water	17	78
5/4-1R1		
[A. C. Buchta. Drilled by J. W. Evans & Sons. On hill slope. Altitude 130 ft]		
Sonoma volcanics:		
Soil	2	2
Tuff, white	18	20
Clay, yellow	21	41
Rock	9	50
Tuff, white	10	60
Rock, brown	11	71
Tuff, gray, and boulders	25	96
Rock, broken	55	151
Rock, clay; some water	41	192
Rock, hard	7	199
Clay	15	214
Rock, hard	10	224
Rock, brown	4	228
Rock, hard	4	232
Rock, brown	3	235
Rock, hard	48	283
Lava; some water	50	333
Tuff	6	339
Rock, white	10	349
Quartz gravel, cemented; some water	20	369
5/4-2B1		
[R. I. Parrish. Drilled by J. W. Evans & Sons. On hill slope. Altitude 70 ft]		
Older alluvium:		
Soil	3	3
"Hardpan"	27	30
Sonoma volcanics:		
Rock, yellow	26	56
Water, little	1	57
Rock, yellow	23	80
Rock, brown	50	130
Rock, red	30	160
Rock, brown; water	42	202
5/4-3M1		
[Destroyed. Drilled as oil well test hole]		
Younger and older alluvium, undifferentiated:		
Soil	9	9

Table 17.—*Drillers' logs of water wells in Napa Valley Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-3M1—Continued		
Younger and older alluvium, undifferentiated:—Continued		
Clay	31	40
Gravel and water	4	44
Clay	36	80
Gravel	5	85
Clay	22	107
Gravel	3	110
Clay	58	168
Gravel, water	6	174
Clay	26	200
Gravel	4	204
Clay	74	278
Gravel	2	280
Clay	10	290
Gravel, water	14	304
Clay	71	375
Watery sand	5	380
Clay and gravel, mixed	285	665
Gravel, no water	10	675
Clay	105	780
Gravel, water	25	805
Clay	60	865

5/4-3Q1

[C. Dagalia. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 22 ft]

	Thickness (feet)	Depth (feet)
Younger alluvium:		
Dug well undescribed	40	40
Older(?) alluvium:		
Clay, yellow	38	78
Boulders and clay; water	19	97
Clay, yellow	15	112
Clay, white	11	123
Clay	15	138
Clay and boulders	39	177
Gravel, water	1	178
Clay	18	196
Clay and boulders	31	227
Clay, yellow	7	234
Boulders and clay	5	239
Gravel, water	2	241

5/4-4K2

[Jim Towey. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 64 ft]

	Thickness (feet)	Depth (feet)
Younger and older alluvium, undifferentiated:		
Soil	3	3
Clay, yellow	22	25
Gravel, water	2	27
Clay, yellow	9	36
Clay, blue	2	38
Clay, yellow	13	51
Gravel, water	14	65
Clay, yellow	22	87
Gravel, water	5	92
Clay, yellow	8	100

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)

5/4-5H4

[C. M. Wigington. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 93 ft]

	Thickness (feet)	Depth (feet)
Older and younger alluvium, undifferentiated:		
Soil	8	8
Clay, yellow	9	17
Clay, yellow; and boulders	9	26
Clay, yellow	10	36
Gravel, water	1	37
Clay, yellow	29	66
Gravel, water	2	68
Boulders and clay	7	75

5/4-5Q2

[A. L. Southgate. Drilled by J. W. Evans & Sons. On alluvial plain. Altitude 117 ft]

	Thickness (feet)	Depth (feet)
Younger alluvium:		
Clay, blue; and silt	50	50
Sandstone, yellow	100	150
Shale, blue		150

5/4-5R1

[C. L. Dunkin. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 97 ft]

	Thickness (feet)	Depth (feet)
Younger and older alluvium, undifferentiated:		
Soil, black	4	4
Clay, yellow	21	25
Gravel and water	1	26
Clay, blue	14	40
Water, small amount	1	41
Sonoma volcanics:		
Lava mud, green	5	46
Lava, broken; water-bearing	21	67
Knoxville and Horsetown formation, undifferentiated:		
Shale, blue	3	70

5/4-9D1

[W. A. Hawes. Drilled by J. W. Evans & Sons. On steep hill slope. Altitude 120 ft]

	Thickness (feet)	Depth (feet)
Sonoma volcanics:		
Soil	3	3
Tuff	60	63
Boulders and sand; water	7	70
Boulders, cemented	23	93
Lava, water	5	98
Lava and cemented	29	127
Lava, water	8	135
"Cement"	-	135

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

5/4-9E1

[H. C. Bryan. Drilled by McKinzie. On steep hill slope. Altitude 160 ft]

	Thickness (feet)	Depth (feet)
Sonoma volcanics:		
Lava	298	298
Open hole, water reached (probably tuffaceous quicksand)	12	310
Sand, white, bailed 30-50 yds		
Clay, blue; water	70	380

5/4-9K2

[M. H. Manassee. Drilled by O. J. Pearson. On younger alluvial plain. Altitude 42 ft. Casing perforated from 22 to 108 ft]

	Thickness (feet)	Depth (feet)
Younger and older alluvium, undifferentiated:		
"Surface"	7	7
Clay, yellow	13	20
Clay, yellow; and gravel water	5	25
Clay, yellow	22	47
Clay, yellow; good gravel water	33	80
Clay, yellow; some gravel	28	108

5/4-9L1

[H. Reames. Drilled by J. W. Evans & Sons. On steep hill slope. Altitude 80 ft. Casing perforated from 35 to 70 ft and 135 to 244½ ft]

	Thickness (feet)	Depth (feet)
Sonoma volcanics:		
Soil and clay	64	64
Gravel, some water	2	66
Clay and boulders	39	105
Gravel, no water, lost some water	3	108
Clay	67	175
Clay, gravel	25	200
Clay	20	220
Clay, gravel, some water	20	240
Clay	18	258

5/4-9Q1

[A. E. Shroyer. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 35 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
Soil	2	2
Clay, yellow	63	65
Gravel, water	1	66
Clay, yellow	104	170
Gravel, water	2	172
Clay, yellow	6	178

5/4-10P4

[City of Napa. Well destroyed]

	Thickness (feet)	Depth (feet)
Older and younger alluvium, undifferentiated:		
Clay	37	37
Clay, blue	38	75
Gravel	11	86
Clay and gravel	10	96

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Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-10P4—Continued		
Older and younger alluvium, undifferentiated:—Continued		
Clay	10	106
Clay and gravel	10	116
Clay	46	162
Gravel	32	194
Clay	34	228
Gravel	13	241
Clay and gravel	6	247
Gravel	7	254
Clay	46	300
5/4-11E1		
[Destroyed oil well test hole]		
Older and younger alluvium undifferentiated:		
Clay	60	60
Boulders	100	160
"Shale"	10	170
Sand	40	210
Clay, yellow; flow of water at 360 ft	150	360
Sonoma volcanics(?):		
"Shale," more water	90	450
"Shale"	50	500
"Shale," blue; warm water	200	700
5/4-11L3		
[L. F. Barnes. Drilled by J. W. Evans & Sons. On Cut terrace. Altitude 25 ft. Casing perforated from 28 to 69 ft]		
Older alluvium:		
Soil	2	2
Clay, boulders	8	10
Sand and clay	18	28
Clay, sandy; and boulders	3	31
Dry sand and gravel	19	50
Gravel and water	17	67
Sonoma volcanics:		
Lava rock and mud	2	69
5/4-12B1		
[H. Park. Drilled by Lee O. Green. On hill slope. Altitude 120 ft]		
Sonoma volcanics:		
Topsoil	2	2
Clay, gravel	1	3
Rock, porous	14	17
Clay, gravel	1	18
Rock	8	26
Sand rock	1	27
Rock, hard	4	31
Boulders	7	38
Rock, coarse gravel	8	46
Rock	3	49
Rock, white	6	55

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-12B1—Continued		
Sonoma volcanics:—Continued		
Rock, porous	21	76
Rock, red, porous	32	108
"Shale"	18	126
Rock	15	141
Gravel, sandy	9	150
5/4-12E1		
[Robert Jacks. Drilled by J. W. Evans & Sons. On hillside. Altitude 120 ft. Cased from 0 to 21 ft]		
Sonoma volcanics:		
Soil and boulders	4	4
Tuff, brown	76	80
Rock, broken; and water	2	82
Rock	85	167
Rock, hard	13	180
Rock, broken; and water	9	189
Tuff, blue	66	255
5/4-12J1		
[John Carbone. Drilled by J. W. Evans & Sons. On terrace. Altitude 78 ft]		
Terrace deposit:		
Soil	7	7
Gravel, and clay, water	5	12
Sonoma volcanics:		
Clay	70	82
"Tule clay"	29	111
Boulders, cemented	59	170
Lava, cemented	39	209
Lava, water	49	258
Lava, cemented; some water	13	271
Lava, water	22	293
Lava, cemented	10	303
5/4-13E1		
[F. Summers. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 60 ft]		
Older alluvium:		
Soil	9	9
"Hardpan"	21	30
Gravel, water	5	35
"Hardpan"	13	48
Clay, blue	17	65
Clay, blue; "shale"	75	140
Gravel, some water	8	148
Sonoma volcanics:		
"Shale"	5	153

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-13L1		
[Napa State Hospital. Log from Napa State Hospital files. On older alluvial plain. Altitude 83 ft]		
Older alluvium:		
Washed clay, yellow, sandy, containing gravel	49	49
Clay, blue, sandy	34	83
Clay, black, slightly sandy and containing a large percent of vegetable matter	17	100
Clay, blue, sandy	25	125
Sonoma volcanics:		
Tuff	90	215
Tuff, chiefly fine white ash	45	260
Tuff, chiefly fragments of pumice and basalt	5	265
Tuff	5	270
Tuff, chiefly pumice	100	370
"Tule"	5	375
Tuff	15	390
Basalt	11	401
Clay, blue	5	406
Tuff, brown	14	420
Clay, blue, sticky	5	425
Tuff, brown	5	430
Basalt	2	432
Clay, brown; soft	6	438
Basalt, very hard	2	440
Ash	5	445
Clay, blue, sticky	5	450
Tuff, brown	5	455
Clay and rock	17	472
Basalt	3	475
Basalt, porous	10	485
Clay, blue, sticky	15	500
Basalt and lava	10	510
Clay, blue, sticky	8	518
Basalt	2	520
Clay, sticky	2	522
Basalt and lava	3	525
Basalt and pink lava	5	530
Clay, sticky	5	535
Basalt and lava	2	537
Clay, sticky	2	539
Basalt and lava	6	545
Basalt and lava, pink	10	555
Basalt and lava, black	13	568
Sand and lava	2	570
Tuff and lava	10	580
Tuff and lava, red	5	585
Tuff and lava, blue	25	610
Lava and sandy	5	615
Tuff, red and yellow	5	620
Basalt and lava, black	20	640
Tuff, black	10	650
Tuff, and black sand	15	665
Clay, sticky, some rock	5	670
Basalt and lava	5	675
Tuff and sand	5	680
Sand, black	10	690

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-13L1—Continued		
Sonoma volcanics—Continued		
Tuff and gray sand	5	695
Tuff, various colors	5	700
Tuff and lava	5	705
Tuff and sand	15	720
Sand and lava	9	729
Basalt	4	733
Lava	3	736
Basalt	6	742
Lava and sand	4	746
Basalt	4	750
Lava and sand	5	755
Tuff, blue	10	765
Sand, gray	5	770
Sand and lava, various colors	9	779
Tuff and lava	6	785
Tuff and basalt	7	792
Basalt	4	796
Basalt, very hard	20	816
Basalt	5	821
Basalt, very hard	1	822
Basalt	2	824
Basalt, very hard	2	826
Basalt	9	835
Basalt, very hard	25	860
Basalt, soft	5	865
Basalt, black and hard	4	869
Basalt, soft and pink	6	875
Basalt, hard	3	878
Basalt, soft and pink	7	885
Basalt, very hard	10	895
Basalt, hard	9	904

5/4-14C1

[P. A. Gasser. Drilled by O. J. Pearson. On edge of older alluvial plain. Altitude 17 ft. Casing perforated 30 to 220 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
"Surface"	6	6
Clay, yellow	49	55
Gravel and boulders; water	15	70
Clay, yellow	110	180
Gravel and boulders; water	10	190
Clay and boulders, yellow; some water	30	220

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)

5/4-14H3

[A.B.Coranado. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 56 ft]

Older alluvium:		
Soil	10	10
Clay, yellow	44	54
Gravel, water	1	55
Clay	26	81
Gravel, water	6	87
Clay and boulders	15	102
Boulders, clay and "shale"	88	109
Gravel, sand, water	50	240

5/4-14L1

[Napa State Hospital. Drilled by O. J. Pearson. Deepened by R. L. Norris. At foot of hill slope. Altitude 14.5 ft. Well gravel packed]

Older alluvium:		
"Surface"	5	5
Clay, yellow	25	30
Gravel	13	43
Clay, yellow	7	50
Clay, blue, gravel;and boulders	47	97
Sonoma volcanics(?):		
"Tule mud"	33	130
Clay, blue	45	175
Tuff, brown, soft	5	180
Tuff, hard, gray	20	200
Tuff	15	215
Volcanic ash	48	263
Conglomerate,basaltic	62	325
Basalt, hard	25	350
Clay, blue rock	4	354
Basalt and clay	15	369
Clay, blue	13	382
Basalt and clay	51	433
Basalt, hard	5	438
Clay	2	440
Basalt, hard	25	465
Clay, hard, and rock	23	488
Clay	4	492
Lava, red	10	502
Clay and rock	18	520
Basalt, hard; and clay	5	525

5/4-14L2

[Napa State Hospital. Drilled by T. L. Mckenzie. Well destroyed. Altitude 16 ft]

Older alluvium:		
Gravel and clay	56	56
Clay, yellow	24	80
Gravel, flowing water	5	85
"Tule mud"	20	105
Sonoma volcanics:		
Volcanic ash, compact	150	255
Volcanic rock and sands gradual increase in water from 225 to 323 ft	68	323
Basalt rock	2	325

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-14P1		
[Napa State Hospital. Drilled by O. J. Pearson. At edge of younger alluvial plain. Altitude 10 ft. Casing perforated from 160 to 600 ft]		
Younger alluvium:		
"Surface"	5	5
Sand and gravel water	35	40
Older alluvium:		
Clay, blue; and sand	20	60
Boulders	15	75
Clay, blue	25	100
Boulders	8	108
Clay, gray	22	130
Clay, blue, with boulders	30	160
Clay, hard, gray	5	165
Clay, blue, with boulders	103	268
Boulders	6	274
Clay, blue, with boulders	16	290
Conglomerate, basaltic	20	310
Clay, blue with boulders	55	365
Boulders	20	385
Sonoma volcanics:		
Lava rock	115	500
Basalt rock	100	600
5/4-15C2		
[C. W. Johnson. Drilled by McLain. On older alluvial plain. Altitude 22 ft. Well plugged at 66 ft]		
Old well, material undescribed	60	60
Older alluvium:		
Clay and some gravel	22	82
Clay, blue		
Gravel at bottom; salty water	4.5	86.6
5/4-15K1		
[A. Sheveland. On younger alluvial plain. Altitude 6 ft]		
Older and younger alluvium, undifferentiated:		
Soil	3	3
Clay, yellow	9	12
Sand, water	1	13
Clay, yellow	7	20
Sand and gravel	8	28
Gravel and clay	7	35
Sand, blue; and clay	6	41
Clay, blue	29	70
Clay, yellow	31	101
Clay and sand, yellow	4	105
Clay and sand	13	118
Clay, yellow	73	191
Gravel	4	195
Clay, yellow	10	205
Clay, white	22	227
Gravel strips	11	238
Clay, yellow	14	252
Sand and gravel, blue	24	276

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-15K1—Continued		
Older and younger alluvium, undifferentiated:—Continued		
Clay, blue	6	282
Boulders	16	298
Clay, blue	29	327
Boulders	11	338
Clay, blue	2	340
"Tule"	170	510
"Tule mud"	70	580
Sand, blue	78	658
Rock, soft, blue	19	677
Clay, blue	114	791
Sonoma volcanics(?):		
"Shale," possibly andesite	11	802
"Shale," brown	67	869
"Tule mud"	22	891
"Serpentine"	1	892
"Tule mud"	11	903
Boulders	7	910
"Shale" brown	8	918
Clay, blue	22	940
"Tule mud"	10	950
Rock	7	957
Rock and clay	23	980
Rock, black	4	984
Conglomerate, grayish blue	46	1030
Rock, hard	6	1036
Sand and gravel	9	1045
Rock, loose	25	1070
Sandstone, gray and boulders, black	20	1090
Rock, volcanic gray	62	1152
Rock, black	16	1168

5/4-15P2

[J. Ghiletta. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 8 ft]

	Thickness (feet)	Depth (feet)
Older and younger alluvium, undifferentiated:		
Clay, yellow	25	25
Clay, boulders	65	90
Gravel, salty water	15	105
Clay, yellow; boulders	190	295
"Tule mud, driftwood"	55	350
Clay, blue	20	370
Clay and boulders, yellow	230	600
Sonoma volcanics (?):		
Rock	150	750
Clay and boulders, yellow	110	860
Volcanic ash	130	990
Gravel, "cement," some water	20	1010
Ash, brown	185	1195
Rock, broken; water	19	1214

5/4-17F1

[B. G. Baker. Drilled by McLain. In Congress Valley. Well destroyed]

	Thickness (feet)	Depth (feet)
Capay shale:		
"Shale," blue; salty water	160	160

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

5/4-19J1

[J. Zweifel. Drilled by J. W. Evans & Sons. On terrace. Altitude 105 ft]

	Thickness (feet)	Depth (feet)
Terrace deposits:		
Soil	12	12
Markley sandstone:		
Sandstone, water	88	100

5/4-19J2

[Tom Donahue. Drilled by J. W. Evans & Sons. On terrace. Altitude 100 ft. Uncased from 25 ft]

	Thickness (feet)	Depth (feet)
Terrace deposit:		
Clay, blue	18	18
Markley sandstone:		
Sandstone, blue	41	59
Rock, broken; water	4	63
Sandstone, blue	27	90
Sandstone, broken; water	3	93
Sandstone	15	108

5/4-19Q1

[R. C. Potter. Drilled by Day. On flood plain of Carneros Creek. Altitude 100 ft]

	Thickness (feet)	Depth (feet)
Recent alluvium:		
Silt, black	45	45
Huichica formation:		
Clay, yellow	130	175

5/4-19R1

[A. M. Ross. Drilled by McLain. On terrace. Altitude 125 ft]

	Thickness (feet)	Depth (feet)
Terrace deposit:		
Soil	18	18
Monterey shale(?):		
Shale, black, thin-bedded	117	135

5/4-21A1

[J. Ghiseletta. Drilled by O. J. Pearson. On hill slope. Altitude 35 ft. Cased from 0 to 333 ft, casing perforated from 75 to 90, 207 to 225, 240 to 300 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
"Surface"	4	4
Boulders	26	30
Sonoma volcanics:		
Clay, red	27	57
Clay, red; some sand and gravel	18	75
Boulders	20	95
Clay and sand, gray	35	130
Clay, blue; some sand	77	207
Boulders	18	225
Clay, blue; some sand	15	240
Clay and boulders, blue	60	300
Clay, sandy blue	30	330
Basalt, shattered	60	390
Lava ash, brown and basalt	60	450
Basalt	95	545

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-21P2		
[J. G. Carr. Drilled by McLain. On cut terrace. Altitude 25 ft]		
Shale, blue	235	235
5/4-26B1		
[Adams and Forbes No. 8. Log from files of California Pacific Utilities Co. On cut terrace. Altitude 20 ft]		
No record	0	380
Sonoma volcanics:		
Basalt, gray, slightly vesicular and amygdaloidal, finely porphyritic	380	380
Basalt, gray; fine-grained	5	385
Basalt, gray, some red	5	390
Basalt, slightly oxidized, vesicular	3	393
Basalt, gray, vesicular	2	395
Basalt, red, vesicular; some gray vesicular basalt	10	405
Basalt, mixed red and gray, vesicular	15	420
Basalt, light gray, fine-grained	15	435
Fragments of vesicular basalt; some oxidized	3	438
Basalt, gray, fine-grained	47	485
Basalt, slightly oxidized, vesicular	7	492
Basalt, red, vesicular	3	495
Basalt, reddish-brown, vesicular and amygdaloidal; some pyrite.	10	505
Basalt, dark gray, vesicular; slightly amygdaloidal	10	515
Basalt, dark gray, fine-grained, fairly porphyritic	10	525
Basalt, mixed oxidized and unoxidized, vesicular and amygdaloidal	5	530
Basalt, slightly vesicular and amygdaloidal	10	540
Basalt, dark gray, slightly vesicular and amygdaloidal	15	555
Finely porphyritic with glassy texture		
Basalt, dark gray, some red which might be "cave"	10	565
Basalt, dark gray, slightly porphyritic and amygdaloidal	5	570
Basalt, mixed gray and brown vesicular basalt	10	580
Basalt, mixed gray and reddish-brown, vesicular	5	585
Basalt, mixed gray and brown vesicular	5	590
Basalt, dark gray, slightly vesicular and amygdaloidal	5	595
Basalt, gray, slightly vesicular	2	597
Basaltic agglomerate vesicular	3	600
Basalt, slightly oxidized, vesicular; some pyrite	5	605
Basalt, gray, slightly amygdaloidal and vesicular	10	615
Basalt, fine-grained gray	5	620
Basalt, gray, vesicular; some pumice	5	625
Tuff, consists of fragments of red and gray basalt, pumice, obsidian, and pyrite	103	728
Basalt, red, sample contains "cave" of tuff, vesicular	7	735
Vesicular basalt, reddish-brown	5	740
Vesicular basalt, mixed brown and gray	10	750
Basalt, gray, fine-grained, sample contains large percentage of "cave"	5	755
Basalt, gray, fine-grained, slightly glassy texture, slightly porphyritic some "cave" of red vesicular basalt in sample	5	760
Basalt, gray, fine-grained samples contains considerable "cave"	5	765
Basalt, gray, fine-grained, slightly glassy, sample contains much "cave"	5	770
Basalt, gray, fine-grained	29	799

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-26B1—Continued		
Sonoma volcanics:—Continued		
Agglomerate mixture of red and black vesicular basalt and a little pumice	6	805
Agglomerate	16	821
Basalt, gray, fine-grained	9	830
Basalt, dark gray, slightly vesicular and amygdaloidal	5	835
Basalt, vesicular and amygdaloidal, some oxidized basalt in sample	15	850
Basalt, slightly oxidized	5	855
Agglomerate, basaltic, red and gray, vesicular	5	860
Agglomerate	35	905
Agglomerate, slightly tuffaceous	5	910
Agglomerate	43	953
Agglomerate, soft grayish brown	12	965
Agglomerate, basaltic, chiefly black, some red vesicular and amygdaloidal	15	980
Agglomerate, basaltic, chiefly red vesicular basalt	35	1,015
Agglomerate, basaltic, chiefly brownish-gray vesicular and amygdaloidal basalt	10	1,025
Agglomerate, basaltic, chiefly brownish-red vesicular basalt	40	1,065
Basalt, gray porphyritic, slightly vesicular	25	1,090
Tuffaceous agglomerate, chiefly basalt, some pumice	50	1,140
Agglomerate, basaltic, mixed oxidized and unoxidized basalt, some pumice	42	1,182
Agglomerate, basaltic red vesicular	5	1,187
Agglomerate, basaltic, mixed oxidized and unoxidized basalt	49	1,236
Tuff, oxidized	101	1,335
Tuffaceous agglomerate, basaltic	55	1,390
Tuff, top of tuff oxidized	50	1,440

5/4-26E1

[Adams and Forbes No. 7. Log from files of C & H Sugar Co. On older alluvial plain. Altitude 8 ft. Casing cemented from 0 to 391 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
Soil	4	4
Gravel, red	6	10
Gravel, hard mixed	8	18
Sandy yellow clay and gravel. Fresh water (5 pts) at 49 ft	44	62
Clay, blue, and gravel	63	125
Sonoma volcanics:		
Agglomerate, volcanic with blue-black clay. Piece of redwood at 250 ft	135	260
Tuff, contains pumice, stickylike clay	55	315
Agglomerate, red to black, basaltic, red at 365 ft, vesicular to nonvesicular, no pumice	60	375
Basalt, black, hard	62	437
Agglomerate, red, basaltic, vesicular; some black	17	454
Basalt, gray, fine-grained, shows some oxidization	11	465
Agglomerate, red to brown, vesicular	10	475
Basalt, gray, fine-grained, vesicular to nonvesicular	5	480
Agglomerate, gray, basaltic; pumice present	15	495
Tuff, coarse-grained, pumice, some pyrite	7	502
Agglomerate, grayish green, vesicular; some pumice and obsidian	58	560

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.—Continued*

	Thickness (feet)	Depth (feet)
5/4-26E1—Continued		
Sonoma volcanics:—Continued		
Red vesicular agglomerate, some unoxidized basalt	10	570
Basalt, light gray, some red vesicular basalt near bottom of strata	50	620
Agglomerate, basaltic, consists of red and gray vesicular and nonvesicular basalt	10	630
Tuff, agglomerate, contains pumice, obsidian, red and gray vesicular basalt, and nonvesicular gray basalt	8	638
Basalt, gray, fine-grained, finely porphyritic, finely vesicular near bottom, slightly oxidized at bottom of strata, jointed throughout	60	698
Tuff, agglomerate, vesicular and nonvesicular gray basalt, and red vesicular basalt	15	713
Agglomerate, basaltic, consists chiefly of dark gray, very vesicular basalt, some oxidized basalt	29	742
Basalt, light gray, slightly vesicular, very hard and jointed. Strata still persists at 806 ft although much softer and more vesicular than higher strata	64	806

5/4-26M1

[Adams and Forbes No. 6. Log from files of C & H Sugar Co. On younger alluvial plain. Altitude 7.42 ft. Casing cemented from 0 to 307 ft]

	Thickness (feet)	Depth (feet)
Younger and older alluvium, undifferentiated:		
Soil	4	4
Clay, yellow, and gravel	40	44
Clay, blue, and gravel	51	95
Sonoma volcanics:		
Lava, black, soft vesicular	40	135
Tuff, dark color, very little pumice	145	280
Basalt, gray	60	340
Basalt, mixed gray, vesicular and red oxidized basalt	30	370
Basalt, gray	35	405
Mixed tuff and basalt	5	410
Basalt, grayish-black	6	416
Tuff	14	430
Basalt, gray	5	435
Basalt, reddish-brown vesicular oxidized	5	440
Basalt, gray, glassy to vesicular	96	536
Tuff, sticky like clay, contains pumice	56	592
Basalt, gray, glassy to vesicular	38	630
Basalt, red oxidized, glassy to vesicular	25	655
Basalt, blue-black	20	675
Basalt, blue-black, vesicular	17	692
Tuff, sticky, contains pumice	143	835
Mixed tuff and glassy basalt	5	840
Tuff	35	875
Mixed tuff and basalt	15	890
Basalt, light-gray, porphyritic	10	900
Mixed tuff and basalt, very hard	39	939

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-26M2		
[Adams and Forbes. Log from C & H Sugar Co. On low alluvial plain. Altitude 3.27 ft. Casing cemented from 0 to 150 ft and 225 to 375 ft]		
Younger alluvium:		
Soil	3	3
Sandy clay, yellow	27	30
Older alluvium:		
Clay, blue, hard	20	50
Sandy clay, blue	43	93
Sonoma volcanics:		
Agglomerate, red, vesicular	57	150
Basalt, blue-gray	185	335
Agglomerate, mixed red and basalt	5	340
Basalt, gray	35	375
Basalt, blue-gray	33	408
Agglomerate, red, vesicular	24	432
Basalt	10	442
Agglomerate, red, vesicular	41	483
Basalt, brownish-black, vesicular	107	590
Basalt, light-gray	15	605
Basalt, dark-gray	15	620
Basalt, mixed gray, vesicular and red vesicular agglomerate	62	682
5/4-26N1		
[Adams and Forbes. Log from files of C & H Sugar Co. On edge of older alluvial plain. Altitude 8 ft. Casing cemented from 0 to 65 ft]		
Older alluvium:		
Soil	2	2
"Hardpan"	4	6
Clay, sandy	6	12
Clay and gravel	33	45
Clay, yellow	5	50
Sonoma volcanics:		
Agglomerate, red, vesicular	335	385
Basalt, blue, "platy to blocky;" some blue clay	65	450
5/4-27A1		
[Adams and Forbes. Log from files of C & H Sugar Co. On edge of older alluvial plain. Altitude 7.37 ft. Casing, 12 in from 0 to 71 ft, 10 in from 0 to 191 ft]		
Older alluvium:		
Soil and gravel	10	10
Gravel in yellow clay	2	12
Soft sandstone, yellow, changing to sandy yellow clay	18	30
Stiff clay, yellow with gravel	23	53
Sandy clay, blue with gravel	6	59
Dark stiff clay	28	87
Blue sand with clay	8	95
Gravel, blue, water-worn	7	102
Sand, blue, with clay	28	130
Sonoma volcanics:		
"Volcanic tuff"	58	188
Very hard tuff or shale	6	194
Blue gray clay with sand and sharp gravel	10	204

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-27A1—Continued		
Sonoma volcanics:—Continued		
Dark clay	38	242
Brown sandy clay	10	252
Blue clay	3	255
Brown clay	68	323
Gravel and sand	9	332
"Volcanic tuff"	3	335
Gravel, blue; sand and clay with light green lava. Water seeping over top	100	435
Clay, blue; and sand	7	442
Mud, brown; and sand. Flow of water 5 gpm	33	475
Sand and gravel. Flow of water 12 gpm	17	492
"Volcanic tuff"	12	504
Brown ash and cinders	18	522
Porous dark cinders	10	532
Cinders, brick red. Flow of water 50 gpm	10	542
Tuff and volcanic cinders	28	570
Hard lava	60	630
Tuff and lava rock	142	772
Hard lava	23	795

5/4-27H1

[Adams and Forbes. Log from files of C & H Sugar Co. On low alluvial plain. Altitude 8 ft. Casing cemented from 0 to 485 ft]

	Thickness (feet)	Depth (feet)
Older and younger alluvium, undifferentiated:		
Soil	7	7
Clay, blue	13	20
Clay, yellow; and gravel	35	55
Clay, yellow	9	64
Clay and gravel	11	75
Muck, blue	9	84
Mud and gravel	36	120
Clay, blue; and gravel	10	130
Clay, blue	63	193
Clay, blue; and gravel	52	245
Clay, blue, black mud, and gravel	80	325
Lava, gravel, waterworn	33	358
Sonoma volcanics:		
Cinders, red	4	362
Clay, blue, and gravel	25	387
Mud and gravel, black	8	395
Clay, blue, and boulders; smooth lava boulders	17	412
Cinders, red and black	60	472
Lava, blue-black	33	505
Lava ash, red	4	509
Lava, blue, hard	14	523
Lava, black	16	539
Lava rock	36	575
Lava, blue, soft	97	672
Hard lava	5	677
Soft lava	18	695
Hard lava	25	720
Lava, blue, soft and sticky	100	820
Loose lava, light blue	10	830
Hard dark lava	12	842

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-27H1—Continued		
Sonoma volcanics:—Continued		
Volcanic ash and lava particles, sticky like clay	118	960
Hard black lava	20	980
Lava rock and red cinders	10	990
Lava, gray	15	1,005
Tuff, gray	10	1,015
Lava, blue-gray	55	1,070
Tuff and pumice, gray	15	1,085
Tuff, gray; hard lava	25	1,110
Tuff, gray or sandy clay	116	1,226

5/4-27H2

[Adams and Forbes. Log from files of C & H Sugar Co. On edge of low alluvial plain. Altitude 8 ft. Casing cemented from 0 to 465 ft]

	Thickness (feet)	Depth (feet)
Younger alluvium:		
Soil	3	3
Clay, yellow; and gravel	62	65
Older(?) alluvium:		
Clay, blue; and gravel	160	225
Mud, black	78	303
Clay, blue	17	320
Clay, blue; and black mud	34	354
Sonoma volcanics:		
Clay, gravel blue; blue rock and boulders	106	460
Lava, hard	10	470
Lava, very hard	22	492
Lava, soft	3	495
Clay, blue	14	509
Clay and lava rock	9	518
Lava, hard	9	527
Rock and brown clay	28	555
Clay and hard rock	7	562
Lava rock	8	570
Lava, hard	10	580
Lava, black	28	608
Lava, hard; boulders	16	624
Lava, hard	6	630
Clay, blue	27	657
Lava, hard	7	664
Rock, soft	4	668
Cinders, red	5	673
Lava, hard	32	705
Lava, hard	15	720
Cinders	5	725
Hard lava	15	740
Gray sandstone	5	745
Lava, soft	5	750
Hard lava	8	758
Clay, green, sticky and sand	44	802
Boulders and clay	5	807
Clay and sand	8	815
Lava rock	7	822
Clay and lava sand	8	830
Lava, black	30	860

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-27K1		
[Adams and Forbes. Log from files of C & H Sugar Co. On low alluvial plain. Altitude 8 ft. Well plugged in 1931]		
Younger and older alluvium, undifferentiated:		
Adobe, black	6	6
Fine gravel in clay	7	13
Stiff clay, yellow	11	24
Gravel with yellow clay	16	40
Stiff clay, yellow	3	43
Stiff clay, blue	25	68
Sand, blue with clay	7	75
Gravel, blue, water-worn. Water rose to 12 ft below surface	30	105
Gravel in clay	5	110
Sonoma volcanics:		
"Boulder" (hard lava(?)	7	117
Lava rock, porous	18	135
Lava rock, greenish color	55	190
Clinker and gravel. Increase in water	14	204
Cinders, reddish-brown, slight flow of water	31	235
Ash or mud, dark brown	8	243
Lava rock, green	24	267
Cinders. Increase in flow of water	6	273
Rock, very hard close-grained dark-colored	3	276
5/4-27K2		
[Adams and Forbes. Logs from files of C & H Sugar Co. On low alluvial plain. Altitude 8 ft. Well plugged in 1922]		
Younger and older alluvium, undifferentiated:		
Soil	3	3
"Tule mud"	7	10
Clay or mud, blue	32	42
Clay, sandy, yellow; gravel with clay	9	51
Stiff clay, sandy, blue	9	60
Gravel blue with clay	17	77
Clay, sandy, blue	6	83
Sand, blue with clay	9	92
"Tule mud"	13	105
Stiff clay, sandy, blue	9	114
Sand, blue with clay	4	118
Stiff clay, blue	7	125
Sand, blue, and gravel with clay	10	135
Stiff clay, blue	13	148
Clay, sandy, blue with gravel streaks	22	170
Stiff clay, blue with gravel streaks	60	230
Sonoma volcanics:(?)		
"Volcanic tuff", slight increase in water	29	259
Mud or clay, brownish with fine sand and gravel	21	280
Fine sand and gravel with clay	12	292
Struck a redwood log. Fine sand and clay	18	310
Gravel, blue water-worn with green lava rock. Increase in flow of water	19	329
Gravel with more clay	14	343
Mud or ash, brown	12	355
Gravel, blue, water-worn	3	358
Ash brown, with gravel	24	382
Gravel, blue, water-worn	11	393
Fine gray sand and clay	7	400
Clay, sandy, blue	7	407
Conglomerate of burnt rock, cinders	43	450
Rock, dark, close-grained	6	456

Table 17.--*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)

5/4-27Q1

[G. H. McFarland. Log from files of C & H Sugar Co. On low alluvial plain. Altitude 7 ft. Casing from 0 to 548 ft, perforations unknown]

Younger alluvium:		
Soil	6	6
Hard gravel, salty water	28	34
Loose gravel, salty water	81	115
Older alluvium:		
Clay, blue	5	120
Sand, blue, and clay	132	252
Knowville and Horsetown formations(?) undifferentiated:		
Shale, brown	35	287
Shale, brown; and blue sand	32	315
Shale, brown; blue clay, yellow clay, blue shale	67	382
Clay, yellow; and gravel	108	490
Clay, blue and yellow; "volcanic rock gravel"	65	555
Sand, blue, close	15	570
Sand, blue, compact	5	575
Undescribed	137	712

5/4-27R1

[G. H. McFarland. Log from files of C & H Sugar Co. On low alluvial plain. Altitude 3 ft. Casing cemented from 0 to 270 ft]

Younger alluvium:		
Mud, blue	42	42
Gravel	40	82
Clay, blue; and gravel	25	107
Older alluvium:		
Clay, green, impervious	18	125
Gravel	3	128
Clay, blue; and gravel	40	168
Dark-lava gravel	3	171
Sonoma volcanics:		
Lava, blue-gray	4	175
Tuff, maroon, with lava	3	178
Lava with maroon tuff	2	180
Tuff, maroon	87	267
Tuff with lava	3	270
Tuff, maroon	5	275
Lava, dark, porous	42	317
Lava, dark, with tuff	5	322
Lava, dark; some blue clay with sand	35	357
Sand, dark colored with clay	11	368
Lava, dark, fine-grained	117	485

5/4-27R2

[G. H. McFarland. From files of C & H Sugar Co. On low alluvial plain. Altitude 5 ft. Reported by owner as plugged]

Younger alluvium:		
"Tule mud"	4	4
Clay, blue	21	25
Clay, sandy, blue	20	45
Loose gravel	28	73

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-27R2—Continued		
Younger alluvium:—Continued		
Boulders and gravel	21	94
Light gravel	11	105
Clay and gravel	2	107
Older alluvium:		
"Volcanic" clay, green	43	150
Rock, green	10	160
Sonoma volcanics:		
Lava, red; rock	90	250
Rock, red, harder	16	266
Rock, blue, hard	3	269
Rock, red, hard	3	272
Rock, red, softer	30	302
Lava, red	28	330
Rock, very hard	1.5	331.5
5/4-29F1		
[E. Chase. Drilled by J. W. Evans & Sons. On cut terrace. Altitude 93 ft]		
Huichica formation:		
Soil	3	3
Clay, yellow	35	38
Clay, blue	17	57
Water	1	58
Clay, blue	26	84
Knoxville and Horsetown formations, undifferentiated:		
Sandstone	6	90
Shale	16	106
5/4-29K1		
[J. Patek. Drilled by J. W. Evans & Sons. Well destroyed. Altitude 80 ft]		
Huichica formation:		
Soil	2	2
Clay, yellow	23	25
Boulders and clay	1	26
Clay, yellow	7	33
Boulders and clay	9	42
Clay, yellow	63	105
5/4-29N2		
[McEllerin. Drilled by C. McLain. Along shallow drainage channel. Altitude 69 ft]		
Huichica formation:		
Clay, brown		310
Not enough water for domestic use.		
5/4-29Q1		
[H. Morkt. Drilled by J. W. Evans & Sons. On low hill. Altitude 77 ft. Well destroyed]		
Huichica formation:		
Clay, yellow	-	-
Clay, blue	-	-
Clay, yellow	-	170

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-29Q2		
[H. Morkt. Drilled by J. W. Evans & Sons. At foot of low hill. Altitude 70 ft]		
Huichica formation:		
Soil	8	8
Clay, yellow	37	45
Sand, yellow and water	25	70
Clay, blue	69	139
Gravel and water	4	143
Clay, yellow and boulders	6	149
5/4-30B2		
[R. C. Potter. Drilled by C. McLain. On younger alluvial plain. Altitude 110 ft]		
Recent alluvium:		
Silt, black	42	42
Huichica formation:		
Clay, yellow	154	196
Sonoma volcanics(?):		
Rock, grayish-yellow	334	530
Neroly sandstone:		
Sandstone, flow of water	40	570
5/4-30P1		
[L. Longhurst. Drilled by Q. J. Pearson. On low hill slope. Altitude 118 ft]		
Huichica formation:		
"Surface"	15	15
Clay, yellow	185	200
Clay, blue	53	253
Clay and gravel; some water	4	257
Clay, blue	90	347
5/4-30R1		
[C. Stornetta. Drilled by O. J. Pearson. On younger alluvial plain. Altitude 70 ft. Cased from 0 to 1,040 ft]		
Alluvium and Huichica formation, undifferentiated:		
Clay, yellow	900	900
Neroly sandstone:		
Shale, gray or sandstone, flow of brackish water	500	1,400
5/4-35R4		
[A. Kurts. Drilled by Lee O. Green. On younger alluvial plain. Altitude 39 ft]		
Younger and older(?) alluvium, undifferentiated:		
Topsoil	5	5
Gravel in clay	25	30
Clay, yellow	38	68
San Pablo group, undifferentiated:		
Shale, gray	149	217
Shale, black	212	429
Gum, black, asphaltlike	10	439
Rock	14	453
Shale, gray	629	1,082

532671 O—60——14

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/4-35R4—Continued		
San Pablo group, undifferentiated:—Continued		
Rock	8	1,090
Shale, hard	15	1,105
Boulders	10	1,115
Shale, black	87	1,202
Sand, black	3	1,205
Shale, light	3	1,208
5/5-26G1		
[Stornetta's Dairy. Drilled by O. J. Pearson. On hill slope. Altitude 285 ft. Cased from 0 to 40 ft]		
Sonoma volcanics:		
"Surface"	3	3
Rock, gray tuff	42	45
Rock, blue tuff, water	195	240
Basalt boulders, water	20	260
Rock, blue tuff	30	290
Lava rock, red	10	300
Volcanic ash, white	55	355
Rock, blue tuff	55	410
6/3-19M1		
[J. E. Wilson. Drilled by J. W. Evans & Sons. On hill slope. Altitude 540 ft]		
Sonoma volcanics:		
Pumice	60	60
Volcanic rock, black	100	160
Rock, soft red, source of water	30	190
6/4-4E1		
[J. G. Regusci. Drilled by O. J. Pearson. On edge of alluvial fan. Altitude 110 ft]		
Younger alluvium:		
"Surface"	5	5
Clay, yellow and boulders	60	65
Sonoma volcanics:		
"Granite," gray	50	115
Tuff	40	155
"Granite," gray	55	210
Tuff	217	427
Volcanic ash	23	450
Tuff	5	455
Volcanic	5	460
Volcanic rock, gray	3	463
Volcanic rock, black	12	475
Volcanic rock, gray	3	478
"Shale rock," black	122	600

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/4-5A1		
[Parker Ranch. Drilled by Bean Spray Co. On younger alluvial plain. Altitude 107 ft]		
Younger and older alluvium, undifferentiated:		
Soil	4	4
"Hardpan" and clay	14	18
Boulders, gravel, sand; and some clay	41	59
Clay	22	81
Gravel, boulders; and clay	8	89
Boulders and clay	10	99
Hard,sand and gravel	6	125
Cemented conglomerate	33	138
Franciscan group(?):		
Rock	181	319
6/4-5B1		
[Parker Ranch. Drilled by Bean Spray Co. At edge of younger alluvial plain. Well destroyed]		
Younger and older alluvium:		
Soil	10	10
Clay	3	13
"Hardpan" and clay	41	54
Franciscan group:		
Rock	4	58
6/4-5B2		
[Parker Ranch. Drilled by Bean Spray Co. On edge of younger alluvial plain. Well destroyed]		
Younger alluvium:		
Soil	12	12
Clay	6	18
Franciscan group:		
Rock	10.4	28.4
6/4-5J1		
[J. G. Regusci. Drilled by Bean Spray Co. On younger alluvial plain. Well destroyed]		
Younger and older alluvium, undifferentiated:		
Soil	25	25
Gravel and clay	17	42
Clay, gravel; and boulders	22	64
Gravel, hard	12	76
Clay and boulders	2	78
Clay	2	80
Clay and boulders	2	82
Gravel	7	89
Clay	5	94
Clay and boulders	2	96
Clay and gravel	24	120
Boulders	2	122
Clay, sandy	6	128
Clay, soft	32	160
Clay, tough	18	178
Gravel, good	4	182

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/4-5J1—Continued		
Younger and older alluvium, undifferentiated:—Continued		
Clay	4	186
Gravel, good	6	192
Clay and gravel	19	211
Franciscan group(?):		
Rock	81	292
6/4-5Q1		
[F. Zwissig. Drilled by Bean Spray Co. On younger alluvial plain. Altitude 65 ft]		
Younger and older alluvium, undifferantiated:		
Soil	12	12
Clay, yellow	19	31
Clay, sandy, yellow	18	49
Clay, sandy, blue	5	54
Clay, blue, tough	16	70
Sand, blue; and clay	3	73
Clay, yellow, tough	4	77
Sand, gravel, and boulders, and clay mixtures	30	107
Sand, gravel, and boulders	5	112
Sandy clay and gravels	33	145
Sand and gravel	6	151
Gravel, boulders, and sand	3	154
Sandy clay and gravel	12	166
Franciscan group(?):		
Rock	1	167
6/4-6P1		
[P. R. Allen. Drilled by D. McLean. On younger alluvial plain. Altitude 75 ft]		
Younger and older alluvium, undifferentiated:		
Topsoil	15	15
Sand	2	17
Gravel	14	31
Clay, yellow	6	37
Gravel	9	46
Sand	8	54
Clay, blue	8	62
Clay, sandy	10	72
Gravel, fine	6	78
Clay, blue	15	93
Gravel, fine	17	110
Clay, brown	10	120
6/4-6R1		
[F. Zwissig. Drilled by Bean Spray Co. On younger alluvial plain. Altitude 100 ft. Well plugged from 65 to 241.7 ft]		
Younger alluvium:		
Adobe soil	18	18
Clay, yellow	14	32
Sand and clay	4	36
Sand and gravel	7	43
Clay, yellow	2	45

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/4-6R1—Continued		
Older(?) alluvium:		
Sand rock	3	48
Yellow clay	2	50
Rock	1	51
Clay, blue	24	75
Sand and gravel	8	83
Sand, cemented; gravel and clay mixture with soft streaks	79	162
Sand, cemented; and boulders	19	181
Clay, sandy	8	189
"Hardpan" and boulders	44	233
Sonoma volcanics:		
Rock	9	242
6/4-6R2		
[F. Zwissig. Drilled by O. J. Pearson. On younger alluvial plain. Altitude 100 ft. Casing perforated from 16 to 220 ft]		
Younger and older alluvium, undifferentiated:		
"Surface"	15	15
Clay, yellow	23	38
Gravel	12	50
Clay, blue	15	65
Clay, blue and gravel	15	80
Clay, yellow and gravel	25	105
Gravel	4	109
Clay, yellow and gravel	23	126
Gravel	5	131
Clay, yellow and gravel	5	136
Clay, blue	12	148
Clay, blue and gravel	8	156
Clay, yellow and gravel	9	165
Clay, yellow and boulders	40	205
Gravel and boulders	5	210
Boulders	6	216
Sonoma volcanics:		
Rock, solid white, very hard	4	220
6/4-15Q1		
[A. R. Johnston. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 67 ft]		
Older alluvium:		
Soil	2	2
Clay and boulders	46	48
Clay	27	75
Rock, water	9	84
Clay	21	105
Clay and gravel	42	147
Gravel, dry	15	162
Huichica formation(?):		
Tuff	23	185
Gravel, some, and tuff; some water	25	210
Tuff, blue	35	245
Tuff, gray; some water	19	264
Tuff, brown	9	273
Lava and gravel, water	22	295
Tuff, gray	8	303

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/4-15Q3		
[G. Jepson. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 65 ft]		
Older alluvium and Huichica(?) formation, undifferentiated:		
Soil	5	5
Clay, and boulders	22	27
Gravel, some water	3	30
Clay, and boulders	24	54
Gravel, some water	3	57
Clay and boulders	75	132
Gravel, water	3	135
Boulders and clay	42	177
Gravel, some water	3	180
Boulders and clay	129	309
Gravel, water	18	327
6/4-17A1		
[Richard Ohlandt. Drilled by O. J. Pearson. On younger alluvial plain. Altitude 67 ft]		
Younger and older alluvium, undifferentiated:		
"Surface"	10	10
Clay, yellow, and gravel	60	70
Boulders and gravel	50	120
Clay, yellow	60	180
Gravel	20	200
Clay, yellow	25	225
Boulders and gravel	10	235
Clay, yellow	15	250
6/4-18A3		
[J. M. Rodgers Dairy. Drilled by R. Mayes. On younger alluvial plain. Altitude 82 ft]		
Formations undifferentiated:		
Soil	3	3
Clay	12	15
Gravel and sand	10	25
Clay	15	40
Gravel	3	43
Clay	39	82
Gravel and boulders, loose	16	98
Clay	42	140
Gravel and boulders, fairly loose	18	158
Clay	14	172
Boulders and gravel	32	204
Clay and boulders	36	240
Gravel	8	248
Clay and boulders, tight	40	288
Gravel, fairly loose	16	304
Rock	16	320
Clay, sticky and tight	8	328
Rock	7	335
Mud, blue	5	340
Gravel and boulders	14	354
Clay and boulders	27	381
Rock	6	395
Gravel	13	408

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/4-18A3—Continued		
Formations undifferentiated:—Continued		
Rock	6	414
Gravel	8	422
Rock	12	434
Clay	8	442
Rock	16	458
Gravel and boulders	21	479
Clay and boulders	41	520
Gravel	5	525
Rock	20	545
Clay	20	565
Boulders and clay	40	605
Gravel and clay	15	620
Rock	10	630
Clay	20	650
Boulders and clay	44	694
Rock	8	702
Clay and boulders	28	730
Rock	-	730

6/4-19B1

[Oak Knoll Ranch. Drilled by R. Mayes. Near edge of younger alluvial plain. Altitude 125 ft]

Younger and older(?) alluvium, undifferentiated:		
Clay and boulders	80	80
Sonoma volcanics:		
Volcanic flow with pyrite mineralization	45	125

6/4-21Q1

[J. Gonnders. Altitude 66 ft. Well destroyed]

Recent alluvium:		
Soil	3	3
Clay	27	30
Water gravel	19	49
Older alluvium:		
Clay	15	64
Gravel, dry	11	75
Clay	14	89
Gravel	5	94
Clay	16	110

6/4-22B2

[Guy Hartman. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 60 ft. Casing perforated from 20 to 75 ft. Open hole from 74 to 117 ft]

Older alluvium:		
Boulders and clay	50	50
Gravel, water	3	53
Clay and boulders	57	110
Gravel, water	3	113
Boulders and clay	4	117

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/4-22B3		
[R. Johnston. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 86 ft]		
Older alluvium:		
Soil and boulders	3	3
"Hardpan" and boulders	51	54
Water, small amount	1	55
Clay and boulders	47	102
Boulders and water	4	106
Clay and boulders	131	237
6/4-23F1		
[G. Brown. Drilled by J. W. Evans & Sons. On dry creek bank. Altitude 75 ft]		
Huichica formation:		
Soil	3	3
Boulders	15	18
Rock, gray	72	90
Rock, broken; and water	6	96
Rock, brown	64	160
Rock, gray	42	202
Rock, broken, water	10	212
Rock, gray	8	220
6/4-23J1		
[V. Maxwell. Drilled by J. W. Evans & Sons. On bluff above younger alluvial plain. Altitude 77 ft]		
Huichica formation:		
Soil	4	4
Clay, yellow	30	34
Clay, blue	65	99
Clay, tough	24	123
Rock	3	126
Boulders, cemented	21	147
Tuff, brown	141	288
Boulders and tuff	45	333
Sonoma volcanics:		
Rock	104	437
"Diorite"	77	514
"Cement"	31	545
Conglomerate rock	47	592
Lava, water, 75 gpm or more	5	597
Lava, cemented	57	654
Lava, hard	21	675
Lava	25	700
6/4-25B1		
[Ben McKinzey. Drilled by J. W. Evans & Sons. On hillside. Altitude 160 ft]		
Sonoma volcanics:		
Pumice	18	18
Tuff, blue	45	63
"Tule mud," blue	30	93
Rock, hard	12	105
Lava, gray; some water	18	123
Lava, black broken; water	6	129

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)

6/4-25B2

[R. K. Northrope. Drilled by O. J. Pearson. On hillside. Altitude 120 ft]

Sonoma volcanics:		
"Surface"	5	5
Pumice, gray	75	80
Pumice, gray and boulders	20	100
Lava rock and boulders	85	185

6/4-25D1

[Vichy Springs. On top of small hill. Altitude 95 ft. Well cased from 0 to 60 ft]

Huichica formation:		
Sandstone, yellow, soft	32	32
Gravelly sand, blue	23	55
Clay, greenish	30	85
Volcanic matter; water	55	140
Broken rock and sandstone; water	115	255
Gravel and sand; water	50	305

6/4-26F1

[D. Daniels. Drilled by J. W. Evans & Sons. On top of low hill. Altitude 62 ft. Casing perforated from 43 to 131 ft, uncased from 131 to 204 ft]

Older alluvium:		
Soil	3	3
Clay	9	12
Clay and boulders	20	32
Clay, blue	10	42
Rocks, broken; water	3	45
Clay, blue	39	84
Clay, gray	17	101
Clay, blue	30	131
Huichica formation:		
Lava, mud	36	167
Lava, water	4	171
Mud, volcanic	27	198
Lava, water	6	204

6/4-26H1

[Hedgeside Distillery. Drilled by J. W. Evans & Sons. On low hill. Altitude 85 ft]

Huichica formation:		
Soil	18	18
"Hardpan"	24	42
Gravel, water	2	44
Muck, yellow and boulders; water	91	135
Boulders, cemented	25	160
"Cement" and cemented boulders	83	243
Gravel, water	3	246
Rock, broken, and "cement;" water	12	258
Sandy gravel and "cement;" water	24	282
"Tule muck"	45	327
Gravel, sand, and rock; water	54	381

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/4-26H1—Continued		
Sonoma volcanics:		
Broken basalt; water	37	418
Lava, red	14	432
"Cement", red, broken; water	45	477
Gravel, cemented		477
Gravel, cemented	39	516
Lava, hard, stratified; water	24	540
Basalt, hard	55	595
Lava, cemented	7	602
Lava, broken, water	41	643
6/4-26L1		
[V. A. Bradley. Drilled by J. W. Evans & Sons. On low hill top. Altitude 53 ft]		
Older alluvium and Huichica formation, undifferentiated:		
Previously drilled	174	174
Clay, blue	2	176
Sonoma volcanics(?):		
Rock, hard	12	188
Rock, broken; water	6	194
Clay, gray	31	225
Rock, broken; water	5	230
Clay, gray	19	249
6/4-26L2		
[R. R. Mohr. Drilled by J. W. Evans & Sons. In small valley. Altitude 50 ft]		
Older alluvium:		
Soil	3	3
Clay	17	20
Clay and gravel, some water	1	21
Clay and boulders	15	36
Clay, blue	9	45
Huichica formation(?):		
Tuff and gravel, water	135	180
6/4-26N1		
[H. J. Vollmer. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 32 ft]		
Younger and older alluvium, undifferentiated:		
Soil	12	12
Clay	14	26
Clay, gravel, water	13	39
Clay	22	61
Clay, gravel, water	2	63
Boulders and clay	33	96
Boulders, sand, gravel, water	6	102
Clay and gravel; some water	21	123
Clay, blue; some water	21	144
Boulders and clay	6	150

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/4-27C2		
[John Platt. Drilled by J. W. Evans & Sons. On edge of older alluvial plain. Altitude 40 ft]		
Older alluvium:		
Soil	5	5
Clay, yellow	15	20
Clay, blue	7	27
Gravel	6	33
Clay, yellow	60	93
Gravel	5	98
Clay	12	110
Gravel	5	115
Clay, blue	17	132
Gravel, gray, cemented	3	135
Clay, yellow	10	145
Gravel, cemented	50	195
Clay, yellow	15	210
Clay, yellow; and rock	30	240
6/4-27M1		
[W. A. Bird. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 55 ft]		
Older alluvium:		
Soil	3	33
Clay, yellow	21	24
Gravel, water	2	26
Clay, yellow	64	90
Gravel, water	10	100
Clay, yellow	8	108
6/4-27N1		
[C. M. Ellis. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 50 ft. Casing perforated from 39 to 141 ft]		
Older alluvium:		
Undescribed	41	41
Gravel, sand, water	13	54
Clay	4	58
Gravel, water	11	69
Gravel, boulders, water	22	91
Gravel, water	8	99
Clay, soft	3	102
Gravel, water	13	115
Clay, gravel, water	26	141
6/4-28F1		
[F. E. Scott. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 68 ft]		
Older alluvium:		
Soil	3	3
Clay, yellow	12	15
Gravel	2	17
Clay, yellow	8	25
Gravel, water	10	35
Clay, yellow	15	50

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/4-28F1—Continued		
Older alluvium:—Continued		
Gravel, water	5	55
Clay, yellow	35	90
Gravel, water	5	95
Clay, yellow	4	99

6/4-28K2

[A. E. Stumley. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 62 ft. Casing perforated from 21 to 150 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
Soil	2	2
Clay, yellow	33	35
Gravel and water	1	36
Clay, yellow	19	55
Gravel, water	2	57
Clay, yellow	25	82
Gravel, water	5	87
Clay, sandy	6	93
Clay, blue	34	127
Gravel, water	18	145
Clay, water	10	155

6/4-28Q1

[W. H. Luhman. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 57 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
Undescribed	30	30
Boulders and clay	10	40
Gravel, water	3	43
Clay	7	50
Gravel, water	2	52
Clay, yellow	17	69
Clay and boulders	12	81
Clay, some water	138	219

6/4-30C1

[D. P. Bales. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 152 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
Soil and clay	20	20
Gravel, water	8	28
Clay	7	35
Clay, gravel, water	15	50
Clay	40	90
Gravel, water	5	95
Clay, boulders	10	105
Boulders, gravel	9	114

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/4-32J1		
[A. McKenzie. Drilled by O. J. Pearson. On younger alluvial plain. Altitude 97 ft. Casing perforated 12 to 42 ft, uncased from 42 ft]		
Younger and older alluvium, undifferentiated:		
"Surface"	10	10
Clay, yellow, sand and gravel	160	170
Clay, yellow	275	445
Clay, yellow, sand and gravel	17	462
Clay, yellow	13	475
6/4-32N1		
[F. Thomas. Drilled by J. W. Evans & Sons. On small hill. Altitude 140 ft]		
Knoxville and Horsetown formations, undifferentiated:		
Soil and clay	30	30
Shale, blue	135	165
"Clay, yellow and boulders"	81	246
"Gravel, some water"	1	247
"Clay, yellow, and some boulders"	151	398
"Clay, sandy"	104	502
"Sand, gravel, some water"	17	519
6/4-33L2		
[A. McKenzie. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 75 ft]		
Younger and older alluvium, undifferentiated:		
Soil	6	6
Clay	15	21
Sand, boulders, water	19	40
Boulders and clay	16	56
Clay	9	65
Boulders and clay	75	140
Clay	15	155
Boulders and clay	15	170
Clay	28	198
Gravel, sand, water	4	202
6/4-33M1		
[W. Gugliemetti. Drilled by N. F. Keyt. On younger alluvial plain. Altitude 85 ft]		
Younger and older alluvium, undifferentiated:		
Topsoil	2	2
Clay, yellow	13	15
Clay and boulders, yellow	7	22
Clay and gravel, yellow	40	62
Clay, yellow	48	110
Gravel	23	133
Clay and gravel, yellow	34	167
Clay, yellow	9	176

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/4-34D2		
[A. Gasser. Drilled by O. J. Pearson. On bank of slough. Altitude 40 ft]		
Older alluvium:		
"Surface"	10	10
Clay, yellow	35	45
Gravel	20	65
Clay and gravel	20	85
Clay, yellow	20	105
Rock and clay, mixed	5	110
Clay, yellow	15	125
Boulders and clay	5	130
Clay, yellow	20	150
Clay and gravel	5	155
Clay, yellow	35	190
Gravel	3	193
Clay, yellow	12	205
Gravel and clay	30	235
Clay, yellow	8	243
Gravel and clay	4	247
Clay, yellow	8	255
Gravel and clay	10	265
Clay, yellow	20	285
Gravel	2	287
Clay, yellow	3	290
Gravel	2	292
Clay, yellow	23	315
Boulders and gravel	2	317
Clay, yellow	26	343
Gravel	4	347
Gravel and clay	18	365
Clay, yellow	15	380
6/4-35G2		
[T. E. Longworth. Drilled by O. J. Pearson. On older alluvial plain. Altitude 37 ft]		
Older alluvium:		
"Surface"	4	4
Clay and boulders	8	12
Clay and boulders, yellow	13	25
Clay and boulders, blue	10	35
Clay, yellow	50	85
Gravel and boulders, water	12	97
Clay, yellow	43	140
Clay and gravel, yellow	50	190
Clay, blue	34	224
Sonoma volcanics:		
Volcanic ash, blue, water	26	250
Clay, blue	8	258

Table 17.—*Drillers' logs of water wells in Napa Vslley, Calif.*—Continued

6/4-35G3

[L. W. Johnson. Drilled by O. J. Pearson. On older alluvial plain. Altitude 38 ft. Casing to 170 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
"Surface"	10	10
Clay, yellow; gravel, no water	20	30
Hard boulders	9	39
Clay, yellow and boulders	41	80
Boulders, some water	5	85
Boulders and clay	20	105
Clay, yellow	15	120
Sand and broken rock	18	138
Clay, yellow	9	147
Clay, yellow; and sand	13	160
Clay, blue; sand and gravel	60	220
Clay, yellow, sand and gravel	18	238
Sonoma volcanics:		
Volcanic ash, blue	12	250
Lava rock, black	10	260

6/4-35G4

[Cliff Lowe. Drilled by O. J. Pearson. On older alluvial plain. Altitude 27 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
"Surface"	10	10
Clay, yellow; and gravel	30	40
Clay, yellow	15	55
Clay, blue, and boulders	65	120
Clay, yellow, sand and gravel	15	135
Clay, yellow	10	145
Clay, blue and boulders	55	200
Clay, blue	15	215
Sonoma volcanics:		
Lava rock, soft, water	30	245
Basalt, water	5	250

6/4-35L2

[L. C. Wilkins. Drilled by O. J. Pearson. On younger alluvial plain. Altitude 25 ft]

	Thickness (feet)	Depth (feet)
Younger alluvium:		
"Surface"	6	6
Boulders	9	15
Older alluvium:		
Clay, yellow	53	68
Boulders	7	75
Clay, yellow	18	93
Boulders	9	102
Clay, yellow	48	150
Clay and some gravel, yellow	15	165
Clay and some gravel, blue	10	175
Sonoma volcanics:		
Volcanic ash, black	75	250
Hard lava or soft basalt	10	260

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

6/4-35P2

[D. E. Barber. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 22 ft. Cased from 0 to 104 ft, casing perforated from 21 to 100 ft]

	Thickness (feet)	Depth (feet)
Younger and older alluvium, undifferentiated:		
Soil	5	5
Sandy loam	21	26
Gravel and water	22	48
Lava mud, white	28	76
Gravel and water	1	77
Cemented gravel and lava	7	84
Gravel and water	1	85
Sonoma volcanics(?):		
Lava, gray	12	97
Gravel and water	3	100
Pumice	5	105

6/4-35Q1

[G. Hewitt. Drilled by J. W. Evans & Sons. On hill slope. Altitude 140 ft]

	Thickness (feet)	Depth (feet)
Sonoma volcanics:		
Tuff and rock	60	60
Rock, broken	21	81
Undescribed	5	86
Rock, red	31	117
Tuff and boulders, yellow	18	135
Lava, water	7	142
Rock and tuff, white	20	162
Lava, water	11	173
Rock	12	185
Lava, water	7	192

6/4-35R1

[J. L. Healey. Drilled by O. J. Pearson. On hillside. Altitude 230 ft. Cased from 0 to 237 ft uncased from 0 to 382 ft]

	Thickness (feet)	Depth (feet)
Sonoma volcanics:		
"Surface boulders"	15	15
Volcanic rock, hard, red	155	170
Boulders	20	190
Lava rock, red	50	240
Lava rock, gray	25	265
Tuff, gray	15	280
Basalt	30	310
Basaltic conglomerate	25	335
Basalt	25	360
Tuff, hard gray	22	382

6/4-36C1

[Raahauge Dairy. Drilled by N. Miller. On younger alluvial plain. Altitude 55 ft]

	Thickness (feet)	Depth (feet)
Formations undifferentiated:		
Undescribed	140	140
Rock, blue	5	145
Clay, blue	17	162

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/4-36C1—Continued		
Formations undifferentiated:—Continued		
Gravel and rock, water	69	231
Clay, blue	9	240
Sandstone	47	387
Gravel and water, good flow	9	396
Rock, blue	4	400
Sand and gravel	5	405
Clay	42	447
6/4-36J1		
[R. Green. Drilled by McFarren. On hill top. Altitude 130 ft]		
Formations undifferentiated:		
Boulders and conglomerate	60	60
"Tule mud"	265	325
Gravel	3	328
Shale, blue, with gravel	104	432
6/4-36L1		
[E. McClendon. Drilled by J. W. Evans & Sons. On creek flood plain. Altitude 60 ft. Cased from 0 to 20 ft]		
Younger alluvium:		
Soil	3	3
Boulders and sand	22	25
Sonoma volcanics:		
Tuff and boulders; some water	90	115
Rock, hard	113	228
Lava, broken; some water	15	243
6/5-1C3		
[Sarah Moore. Drilled by J. W. Evans & Sons. On older alluvial plain. Altitude 115 ft. Casing perforated from 50 to 110 ft uncased from 110 to 125 ft]		
Older alluvium:		
Soil	3	3
Clay, boulders, yellow	39	42
Water	3	45
Clay, yellow	36	81
"Blue"	9	90
Water	2	92
Clay, yellow	33	125

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
7/4-30L1		
[A. Fagiani. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 112 ft. Uncased from 131 to 171 ft]		
Younger alluvium:		
Soil and boulders	21	21
Water	1	22
"Cement" and boulders	18	40
Sonoma volcanics:		
Tuff, gray	20	60
Tuff, brown	80	140
Tuff, green	28	168
Tuff, gray and water	3	171
7/4-31E1		
[A. Fagiani. Drilled by Lee O. Green. On younger alluvial plain. Altitude 90 ft]		
Younger and older alluvium, undifferentiated:		
Soil	7	7
Clay	33	40
Gravel	25	65
Clay	44	109
Clay and boulders	31	140
Clay	102	242
Gravel, small	30	272
7/5-14G1		
[H. Hopman. Drilled by O. J. Pearson. On younger alluvial plain. Altitude 139 ft. Casing perforated from 25 to 265 ft]		
Older and younger alluvium, undifferentiated:		
"Surface"	5	5
Clay, yellow	15	20
Clay and some boulders, yellow	30	50
Gravel, free	15	65
Clay, sand, and gravel, yellow	162	227
Gravel, free	5	232
Sonoma volcanics:		
Volcanic rock	23	255
Volcanic clay, red	10	265
7/5-15A1		
[R. E. Keig. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 143 ft. Casing perforated from 32 to 355 ft]		
Older and younger alluvium, undifferentiated:		
Soil	4	4
Clay, sandy	2	6
Clay, boulders; some water at 15 ft	26	32
Boulders and clay; some water	8	40
Clay and boulders	55	95
Boulders; some water	10	105
Boulders and clay	250	355

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
7/5-16L1		
[L. Tonnella. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 171 ft]		
Younger and older alluvium, undifferentiated:		
Soil	4	4
Soil and boulders	16	20
Clay, yellow; and boulders	37	57
Clay, yellow	13	70
Gravel and small amount of water	1	71
Clay and boulders	49	120
Gravel and water	1	121
Clay and boulders	97	218
Gravel and water	3	221
Blue "cement" and gravel		-
7/5-16N1		
[J. Ponti. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 173 ft. Casing perforated from 30-45, 140-155, 200-252 ft]		
Younger and older alluvium:		
Soil	6	6
Clay	29	35
Clay and gravel, water	5	40
Clay and boulders	100	140
Clay and gravel, water	10	150
Clay	63	213
Clay and gravel, blue, water	5	218
Clay, blue	7	225
Clay and gravel, blue, water	27	252
7/5-17J1		
[Beaulieu Vineyard. Drilled by J. W. Evans & Sons. On hillside. Altitude 200 ft. Casing perforated from 55 to 130 ft]		
Sonoma volcanics:		
Soil	4	4
Clay, yellow; and broken rock	51	55
Rock, broken, water	15	70
Basalt	16	86
Basalt, broken; water	44	130
Sandstone	60	190
Basalt	60	250
Sandstone, hard	90	340
Basalt	90	430
Sandstone	40	470
Shale and broken rock	10	480
Sandstone	54	534
Sand, gravel and water	3	537
Sandstone	27	564

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
7/5W-23L1		
[P. Lewis. Drilled by N. F. Keyt. On younger alluvial plain. Altitude 120 ft]		
Younger and older alluvium, undifferentiated:		
Soil	20	20
Clay, yellow	15	35
Clay, yellow; sand and gravel	2	37
Clay, sandy, yellow; and gravel	13	50
Sand and gravel, blue	9	59
Clay, sandy, yellow	18	77
Clay, sandy, blue and gravel	6	83
Gravel	6	89
Clay, blue	11	100
Clay, yellow and gravel	27	127
Clay, yellow	5	132
Clay, blue	2	134
Clay, yellow and gravel	16	150
7/5-27D1		
[Stalling. Drilled by J. W. Evans & Sons. On younger alluvial plain. Altitude 170 ft]		
Younger and older alluvium, undifferentiated:		
Soil	3	3
Clay	27	30
Gravel, water	10	40
Clay	60	100
Clay, gravel seams; some water	90	190
Clay, yellow	70	260
Sonoma volcanics:		
Mud, white; some water	3	263
Clay, white	22	285
Clay, brownish-gray	10	295
Clay, white	26	321
Clay, brown	14	335
Rock, red soft; some water	10	345
Rock, red, hard	15	360
Sandstone	50	410
7/5-36N1		
[B. H. Skilling. Drilled by J. W. Evans & Sons. On edge of older alluvial plain. Altitude 141 ft]		
Older alluvium:		
Soil	3	3
Clay, brown	9	12
Clay, hard	8	20
Gravel, water	6	26
Clay, hard	8	34
Sonoma volcanics:		
Clay, white	14	48
Tuff, brown, and gravel	49	97
Gravel, water	6	103
Tuff	1	104

Table 17.—*Drillers' logs of water wells in Napa Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
8/6-14R1		
[Schletti. Drilled by A. H. Word. At edge of younger alluvial plain. Altitude 360 ft]		
Younger alluvium:		
Soil	15	15
Gravel and boulders	10	25
Sonoma volcanics:		
Tuff, yellow	48	73
Tuff, gray	24	97
Rock, boulders, sand	10	107
Rock, boulders, sand, clay, yellow	16	123
Gravel and sand, fine	9	132
8/6-23M1		
[F. Delfino. Drilled by J. W. Evans & Sons. Near edge of younger alluvial plain. Altitude 285 ft]		
Younger and older alluvium, undifferentiated:		
Soil and boulders	4	4
"Hardpan" and boulders	51	55
Gravel, water	2	57
Clay and boulders	40	97
Gravel, water	3	100
Clay and boulders, blue	29	129
9/7-26C1		
[C. Tubbs Estate. Drilled by O. J. Pearson. Well destroyed]		
"Surface"	5	5
Clay, yellow and boulders	55	60
Sonoma volcanics:		
Tuff	25	85
Lava ash	65	150
Lava rock, gray	30	180
Basalt	40	220
Tuff	55	275
"Shale," hard, brown	35	310
Tuff	30	340
Basalt	25	365
Lava ash	20	385
Tuff	65	450
9/7-26G1		
[C. Tubbs Estate. Drilled by O. J. Pearson. On hillside. Altitude 425 ft]		
Slope wash:		
"Surface"	5	5
Sand and gravel	10	15
Boulders	15	30
Sonoma volcanics:		
Basalt, hard	10	40
Basalt, medium soft	15	55
Tuff	250	305

Table 18.—*Description of water wells in Sonoma Valley, Calif.*

Type of well is indicated by symbol as follows: Du, dug; Dr, drilled. For dug wells the diameter or dimensions are given in feet.
Type of pump is indicated by letter symbol as follows: C, centrifugal; J, jet; L, lift; S, suction; T, turbine; Ts, turbine submersible. Horsepower is the rated power of the motor if electric. Wind and hand power are shown by words.
Use of well is shown by symbol as follows: A, abondoned and destroyed; D, domestic; Dy, dairy; Ind, industrial; Irr, irrigation, more than 5 acres; irr, irrigation less than 5 acres; PS, public supply; RR, railroad; S, stock; U, unused. A few other uses are indicated by footnotes.
Other data available are factual information in the files of the Geological Survey, much of which is cited in this report. C, chemical analysis; Cp, partial chemical analysis; L, log; W, record of water-level fluctuations.

Well	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 4 N., R. 5 W.						
4/5- 1F1	....	....	67	78	Dr, 6	Mar. 16, 1950	9.91	....	....	U	....	
2Q1	Haire Ranches......	....	5	28.0	Du	.....do..........	1.70	....	S	U	....	
2Q2	Bisso Bros..........	1951	5	300	Dr, 8	March 1951	[1]24	....	L	D	L	
						Sept. 19, 1951	7.95	....	....	....	....	
3C1	John Lawler.........	1945	30	261	Dr, 7	....	....	....	J 3	Irr	C, L	
3C2	.....do..............	1951	40	110	Dr, 10	Aug. 16, 1951	72.29	....	T 3	Irr	C, L	
6P1	A. Souza............	1947	23	65	Dr, 6	Apr. 10, 1950	[1]6.16	....	J 1	D	L	Bailed at 600 gph; drawdown 34 ft.
6Q1	N. Shields, Jr......	1942	11	26.0	Dr, 6	Mar. 30, 1950	2.12	....	L, Wind	D	L	Bailed at 200 gph; drawdown 21 ft.
7R1	S. L. Abbott.........	....	27	....	Dr, 8	....	....	....	T 10	Irr	....	
12D1	J. Bisso.............	1915	1	200	Dr, 8	Mar. 16, 1950	6.11	....	L 3	S	....	
12D2	V. Leveroni.........	....	1	200	Dr	....	....	....	L	U	....	
14D1	U.S. Navy well 1....	....	0	540	Dr	Mar. 16, 1950	10.96	....	T 3	PS	C, Cp	Pumped at 43 gpm; drawdown 61 ft.
14D2	well 3..........	....	0	1,620	....	Sept. 13, 1951	[2]23	....	T	PS	C, L	Pumped at 395 gpm; drawdown 140 ft.
14L1	well 2..........	....	0	650	Dr	Mar. 16, 1950	1.35	....	T 3	PS	C, Cp	

32B1	Sonoma Ranch........	....	3	....	Dr	....	....	....	L, Wind	S	Cp	
32C1	.....do.............	....	3	....	Dr, 6	Feb. 17, 1950	Flowing	....	L, Wind	S	Cp	
34D1	.....do.............	....	3	200+	Dr, 6	Nov. 8, 1949	[3]3.34	....	L, Wind	S	Cp	
						T. 4 N., R. 6 W.						
4/6- 1R1	Anton Marcucci.....	1905	115	68	Dr, 6	Aug. 16, 1951	59.52	....	J 2	D, irr	....	
						T. 5 N., R. 5 W.						
5/5- 7A1	Sebastiani Winery.	....	130	575	Dr, 12	....	....	....	T 15	D, Ind	L	
7C1	W. Montini..........	1944	120	208	Dr, 10	March 1944	[1]27	....	T 10	Irr	L	Bailed at 350 gph; drawdown 63 ft.
						Apr. 14, 1950	56.72	....	....	....	....	
7D1	City of Sonoma.....	....	100	115	Dr, 10	Apr. 19, 1950	17.94	73	T 5	PS	L	Reported to pump 150 gpm.
7D2	.....do.............	1937	97	500	Dr, 10	.....do..........	10.80	....	....	D	L	Reported to pump 65 gpm.
7F1	.....do.............	1947	97	263	Dr, 12	May 1947	[1]19	....	T 15	PS	L	Reported to pump 200 gpm; drawdown 181 ft.
						Apr. 14, 1951	[3]56.64	....	....	....	....	
7G1	.....do.............	1944	95	221	Dr, 10	April 1944	[1]4	80	T 25	PS	L	Reported to pump 400 gpm; drawdown 171 ft.
						1947	[2]27	....	....	....	....	
						Mar. 20, 1950	[2]32	....	....	....	....	
						Apr. 19, 1951	18.54	....	....	....	....	
7J1	J. J. Mohr..........	1946	86	191	Dr, 6	Sept. 1941	[1]18	....	J 2	D	L	Bailed at 350 gph; drawdown 72 ft.
7P1	N. Sebastiani.......	1942	75	80	Dr, 6	Nov. 1942	[1]7	....	C	U	L	Bailed at 300 gph; drawdown 63 ft.
						July 6, 1951	12.42	....	....	....	....	
7R1	A. A. Coops.........	1940	82	90	Dr, 6	August 1940	[1]4	....	....	A	L	Bailed at 100 gph; drawdown 81 ft.
8A1	S. P. Dunn..........	1946	174.5	148	Dr, 6	Sept. 1946	[1]17	....	L 2	D, irr	L	Bailed at 700 gph; drawdown 83 ft.
						Apr. 11, 1950	11.50	....	....	....	....	
8B1	E. G. Hester........	1942	145	80	Dr, 6	Feb. 1942	[1]22	....	J 1/2	D	L	Bailed at 150 gph; drawdown 48 ft.
						Apr. 20, 1950	[3]51	....	....	....	....	
8C1	R. S. Davenport....	1941	122	170.0	Dr, 6	June 1941	[1]14	....	J 1	D	L	Bailed at 300 gph; drawdown 105 ft.
						Apr. 12, 1950	15.41	....	....	....	....	
8E1	Sebastiani Winery.	1946	112	235	Dr, 12	....	....	....	T 15	D, Ind	L	
8F1	A. H. Bell..........	1942	119	64.5	Dr, 6	Nov. 1942	[1]11	....	L 1	D	L	Bailed at 1,200 gph; drawdown 44 ft.
						Apr. 11, 1951	5.45	....	....	....	....	

See footnotes at end of table.

Table 18.—*Description of water wells in Sonoma Valley, Calif.*—Continued

Well	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 5 N., R. 5 W.—Continued						
5/5- 8F2	N. Schwaderer......	1946	119	47	Dr, 6	....	....	....	J 1/2	D	L	Bailed at 1,200 gph.
8F3	Margaret Schultz ..	1944	118	46	Dr, 6	May 1944	[1]13	....	J 3/4	D	L	Bailed at 900 gph; draw-down 27 ft.
8G1	E. Wassenarr.......	1942	128	37	Dr, 6	May 1942	[1]11	....	J 3/4	D	L	Bailed at 400 gph; draw-30 ft.
8G2	J. R. Brown	1942	123	65	Dr, 6	Nov. 1942	[1]12	....	J 3/4	D	L	Bailed at 500 gph; draw-down 48 ft.
						Apr. 20, 1950	28.67	....	....	....	....	
8G3	Seventh Day Adventist Church.	1946	120	87	Dr, 6	Apr. 11, 1950	14.19	....	J 1/2	D	L	Bailed at 2 gph.
8G4	W. C. Smith	1941	118	240	Dr, 6	June 1941	[1]7	....	L 2	D	L	Bailed at 500 gph; draw-down 113 ft.
						Apr. 12, 1950	15.13	....	....	....	....	
8H1	Auteri.................	1946	142	174	Dr, 8	October 1946	[1]20	....	J 3/4	D	L	
8H2	Stanely Prosser....	1946	170	159.0	Dr, 8	August 1946	[1]13	....	....	U	L	
						Mar. 31, 1950	4.56	....	....	....	....	
8H3	J. F. Day............	1946	131	40	Dr, 6	Sept. 1946	[1]14	....	J 3/4	D	L	
8J1	R. Reimer	1951	131	176	Dr, 8	Feb. 7, 1951	[1]2	....	....	D	L	
8K1	C. Berry	1946	109	96.0	Dr, 6	August 1946	[1]18	....	J 1 1/2	D	L	Bailed at 700 gph; draw-down 37 ft.
						Apr. 20, 1950	25.21	....	....	....	....	
6K2	Bowman	1946	109	121.5	Dr, 6	Nov. 1946	[1]19	....	J 1	D	L	Bailed at 400 gph; draw-down 81 ft.
						Apr. 20, 1950	8.50	....	....	....	....	
8L1	R. E. Coffin	1944	104	54	Dr, 6	Feb. 1944	[1]11	....	J 1/2	D	L	Bailed at 600 gph; draw-down 34 ft.
8L2	J. F. Wiegand.......	1944	104	29.5	Dr, 6	January 1944	[1]6	....	J 1/4	D	L	Bailed at 600 gph.
						Apr. 19, 1950	1.90	....	....	....	....	
8L3	C. Shadwell..........	1949	105	181	Dr, 6	May 1949	[1]11	....	J 1	D	L	Bailed at 700 gph.
						Apr. 27, 1950	[3]44.70	....	....	....	....	

5/5- 8P1	F. Forster	1947	91	421	Dr, 8	June 1947	12		J 2	D	L	Bailed at 3,000 gph;
						Apr. 4, 1950	[4]47.20					drawdown 88 ft.
8Q1	O. H. Thomas	1938	107	500	Dr, 8	Apr. 4, 1950	Flowing		T 7 1/2	Irr		Reported to pump 150
						Apr. 9, 1952	8.38					gpm.
8Q2	S. J. Willis	1951	107	320	Dr, 6	Feb. 19, 1951	[1]30	65		D	L	Bailed at 20 gpm; drawdown 90 ft.
9E1	W. Stellisch	1947	180	172	Dr, 8	Nov. 1947	[1]15			U	L	Bailed at 800 gph; draw-
						Apr. 11, 1950	Flowing					down 75 ft.
9E2	F. Bartholomew	1944	157	92	Dr, 6	Dec. 1944	[1]19		J 1/2	D	L	Bailed at 800 gph; draw-
						Apr. 20, 1951	13.70					down 51 ft.
9L1	E. A. Herzinger	1946	130	129	Dr, 6	August 1946	[1]18		L 1	D	L	
						Apr. 12, 1950	57.36					
9L2	C. Morgan	1949	150	126	Dr, 8	Spring 1950	[2]Flowing		J 1/2	D	L	
						July 9, 1951	10.46					
9M1	J. Paulis	1949	147	215	Dr, 6	January 1949	[1]27		J 1	D	L	Bailed at 800 gph; draw-
						July 6, 1951	14.12					down 27 ft.
9M2	H. Pillars	1951	140	257	Dr, 6	Jan. 5, 1951	[1]40			D	C, L	Bailed at 5 gpm; drawdown 60 ft.
9N1	R. Molesworth	1941	101	185	Dr, 5	Sept. 1941	[1]22		L 1	D	Cp, L	Bailed at 180 gph; drawdown 128 ft.
9N2	do	1947	101	285	Dr, 6	Nov. 1947	[1]Flowing		J 1	D	Cp, L	Bailed at 800 gph; draw-
						Aug. 14, 1951	Flowing					down 90 ft.
9P1	Louis Castagnetto	1940	130	95	Dr, 6	Sept. 1940	[1]9		J 1 1/2	D	L	Bailed at 700 gph; drawdown 81 ft.
10B1	W. Johnston	1948	630	435	Dr, 8	March 1948	[1]120		L	D		Bailed at 1,000 gph; drawdown 80 ft.
16D1	A. J. Bertini	1942	90	208	Dr, 8	May 1942	[1]14			U	L	Bailed at 600 gph; draw-
						Apr. 14, 1950	10.00					down 36 ft.
						Apr. 26, 1951	11.03					
16E1	F. LeNoir	1948	79	393	Dr, 8	June 1948	[1]21		J 1 1/2	D, irr	C, L	Bailed at 1,100 gph;
						July 6, 1951	37.53					drawdown 129 ft.
16N1	C. D. Goodrich	1945	62	61	Dr, 6	June 1945	[1]11		J 1/2	D	L	Bailed at 500 gph; drawdown 49 ft.
17B1	J. Widmer	1948	92	520	Dr, 12	Jan. 4, 1952	6.07			irr	L	
17C1	L. McNiel	1944	85	70	Dr, 6	August 1944	[1]6		J	D	Cp, L,	Bailed at 400 gph; draw-
						Jan. 18, 1950	13.34				W	down 54 ft.
17C2	N. P. Peterson	1943	81	75	Dr	Nov. 1943	[1]24		J 1	D	L	Bailed at 350 gph; drawdown 46 ft.

See footnotes at end of table.

Table 18.—*Description of water wells in Sonoma Valley, Calif.*—Continued

Well	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 5 N., R. 5 W.—Continued						
5/5-17C3	N. Cardell	1946	85	68	Dr, 6	Sept. 1946	[1]17		J 1	D	L	Bailed at 500 gph.
						Apr. 4, 1951	[4]17.94					
17C4	O. H. Teller	1949	93	265	Dr, 12	Aug. 15, 1951	59		T s	Irr	L	Bailed at 20 gpm.
17D1	A. St. Germaine	1946	73	63	Dr, 10	Feb. 1946	[1]4		J 1/2	D	L	Bailed at 150 gph; drawdown 39 ft.
						Apr. 13, 1950	4.44					
17F1	R. W. Best	1948	64	107	Dr, 8	Sept. 1948	[1]13		J 1/2	D	L	Bailed at 900 gph; drawdown 57 ft.
						Apr. 28, 1951	10.63					
17F2	L. H. Nielson	1951	75	260	Dr, 6	Feb. 1950	[1]9		J 1/2	D	L	Bailed at 10 gpm; drawdown 50 ft.
						July 17, 1951	18.32					
17J1	I. Wisnom	1950	70	285	Dr, 6	Sept. 1945	[1]14		J 3/4	D	L	Bailed at 975 gph; drawdown 66 ft.
						Apr. 20, 1951	[4]34.17					
17K1	Mary Batto	1880	66	50	Du, 6	Jan. 18, 1950	9.39		C	D		Bailed at 120 gph.
17L1	Batto	1947	57	57.5	Dr, 12	October 1947	[1]4			U	L	
						Apr. 5, 1950	.76					
17M1	L. Handu	1947	56	72	Dr, 8	October 1947	[1]12		J 3/4	D	L	
17N1	Roquie Brothers	1930	45	475	Dr, 8				J 1/2	D	L	
17N2	G. W. Stanley	1945	46	52	Dr, 6	May 1945	[1]Flowing		J 1/2	D	L	Bailed at 600 gph; drawdown 45 ft.
						Apr. 12, 1950	1.53					
17R1	W. Bartlett	1946	57	81	Dr, 6	Sept. 1946	[1]14		J 1/2	D	L	Bailed at 120 gph.
17R2	J. Jacobs	1948	58	359	Dr, 6	May 1948	[1]10		J 1	D	L	Bailed at 1,000 gph; drawdown 60 ft.
18D1	Cret	1942	63	90	Dr, 8	June 1942	[1]12		L 1	D	L	Bailed at 1,000 gph; drawdown 78 ft.
						Apr. 21, 1950	8.81					
18D2	J. Firmingac	1943	62	75	Dr, 8	Sept. 20, 1943	[1]14		J 3/4	D	L	Bailed at 3,000 gph; drawdown 36 ft.
						Apr. 21, 1950	14.43					

18D3	L. Johnson.........	1943	64	29.0	Dr, 6	Dec. 1943	[1]7	....	L 1/4	D	L	Bailed at 400 gph; drawdown 18 ft.
						Apr. 21, 1950	8.86	....	....	....	....	
18D4	A. L. Ahrendes....	1950	64	28	Dr, 6	May 1944	[1]7	....	J 1/3	D	L	Bailed at 350 gph; drawdown 16 ft.
						Apr. 21, 1950	9.11	....	....	....	....	
18F1	J. George	1947	59	85	Dr, 6	August 1947	[1]20	....	J 1/2	D	L	Bailed at 500 gph; drawdown 50 ft.
18G1	B. Perry............	1945	61	40	Dr, 8	July 1945	[1]4	....	J 1/2	U	L	Bailed at 1,200 gph; drawdown 31 ft.
18G2	W. F. Bland	1946	57	113	Dr, 8	October 1946	[1]14	....	J 1	D	L	Bailed at 900 gph; drawdown 46 ft.
						Apr. 4, 1950	10.81	....	....	....	....	
18H1	R. B. Gray.........	....	61	170	Dr, 10	Apr. 12, 1950	6.13	....	J 1 1/2	D	L	Bailed at 250 gph; drawdown 63 ft.
18K1	J. Von Dohlem.....	1947	49	128	Dr, 8	August 1947	[1]17	....	J 2	D	L	Bailed at 900 gph; drawdown 73 ft.
						Apr. 12, 1950	8.70	....	....	....	....	
18L1	P. Firpo............	1948	52	40	Dr, 6	Sept. 1948	[1]10	....	L 3/4	D	....	Bailed at 500 gph.
						May 18, 1950	14.82	....	....	....	....	
18M1	DeMare..............	1945	53	33.5	Dr, 8	May 1945	[1]9	....	L 1	D	L	Bailed at 800 gph; drawdown 21 ft.
18M2	J. T. Hatch	1946	54	37	Dr, 6	January 1946	[1]10	....	L 1/4	D	L	Bailed at 600 gph; drawdown 15 ft.
						Apr. 21, 1950	15.06	....	....	....	....	
18M3	J. F. Craig	1944	53	41	Dr, 6	Sept. 1944	[1]12	....	J 1/2	D	L	Bailed at 1,000 gph.
						Apr. 27, 1950	20.10	....	....	....	....	
18M4	P. Grosso...........	1951	53	62	Dr, 8	March 1951	[1]20	....	J 1	D	L	Bailed at 20 gpm; drawdown 40 ft.
18P1	W. Boni.............	1941	49	108	Dr, 6	July 1941	[1]13	....	J 3/4	D	L	Bailed at 600 gph; drawdown 67 ft.
18P2	W. Andrews	1943	50	45	Dr, 8	Sept. 1943	[1]11	....	....	D	L	Bailed at 900 gph; drawdown 29 ft.
18P3	G. Grande...........	1949	46	53	Dr, 12	July 1949	[1]19	....	J 3/4	D	L	
						July 6, 1951	19.07	....	....	....	....	
18R1	C. W. Stevenson....	1946	43	133.5	Dr, 8	June 1946	[1]3	....	....	U	L, W	Bailed at 500 gph.
						Mar. 29, 1950	2.58	....	....	....	....	
18R2	.....do...............	....	43	25.0	Du, 8	.....do..........	3.73	....	J 1/4	U	W	
18R3	R. W. Keiser	1951	44	61	Dr, 6	Jan. 13, 1951	[1]9	....	J 3/4	D	L	
19A1	H. C. Johnson	1942	38	58	Dr, 6	April 1942	[1]10	....	J	D	L	Bailed at 300 gph; drawdown 40 ft.

See footnotes at end of table.

Table 18.—*Description of water wells in Sonoma Valley, Calif.*—Continued

Well	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
T. 5 N., R. 5 W.—Continued												
5/5-19A2	C. W. Stevenson	1947	41	69	Dr, 8	August 1947	[1]19		J 2	D	L	Bailed at 900 gph; drawdown 31 ft.
						Mar. 29, 1950	9.90					
						Aug. 11, 1950	23.70					
						Aug. 25, 1950	24.50					
19A3	H. C. Johnson	1947	39	95	Dr, 8	April 1947	[1]Flowing		J 3	D	L	Bailed at 700 gph; drawdown 75 ft.
19A4	G. Grande	1940	40	50.0	Dr, 6	August 1940	14		Lc 1	D	L	Bailed at 700 gph; drawdown 46 ft.
						Apr. 28, 1950	12.79					
19B1	O. E. Thompson	1946	40	48	Dr, 6	May 1946	[1]15		J 1/2	D	L	
						Apr. 28, 1950	[3]16.49					Bailed at 1,800 gph; drawdown 25 ft.
19C1	E. R. Forse	1947	46	68	Dr, 6	August 1947	[1]17		J 1/2	D	L	Bailed at 700 gph; drawdown 33 ft.
						Apr. 12, 1950	23.00					
19E1	F. Wodekind	1948	43	62	Dr, 12	May 1948	[1]7				L	Reported to pump 200 gpm.
19E2	George Haughn	1941	45	53	Dr, 6	July 1941	[1]14		J 3/4	D	L	Bailed at 600 gph; drawdown 31 ft.
19J1	G. I. Silvera	1944	35	50	Dr, 6	Sept. 1944	[1]13		J 1/2	D, S	L	Bailed at 800 gph.
						Apr. 14, 1950	[4]16.91					
19L1	V. Sangiacomo	1948	40	150	Dr, 12	Nov. 1948	[1]10		T 15	D, Irr	C, L	Reported to pump 450 gpm; drawdown 80 ft.
						Aug. 15, 1951	21.10					
19L2	H. Smith	1947	41	40	Dr, 6	July 1947	[1]11		J 1	D	L	Bailed at 550 gph.
19L3	L. C. Eaton	1948	38	68	Dr, 6	May 1948	[1]12		J 1	D	L	Bailed at 900 gph; drawdown 38 ft.
						May 17, 1950	32.15					
19L4	L. C. Easton, Jr.	1948	39	47	Dr, 6	May 1948	[1]9		J 1	D	L	Bailed at 800 gph.
						May 17, 1950	21.13					

19L5	B. Colangelo	1942	40	65	Dr, 6	October 1942	[1] 21		J 1	D	L	Bailed at 950 gph.
20A1	P. Zepponi	1944	45	62	Dr, 6	Feb. 1944	[1] 9		J 1/2	D	L	Bailed at 800 gph; drawdown 31 ft.
20A2	C. E. Adams	1947	54	390	Dr, 8				J 3	irr	Cp, L	
20C1	C. Jackson	1949	45	125	Dr, 10	Dec. 1949	[1] 10		J 3	D, irr	C, L	Reported to pump 40 gpm; drawdown 90 ft.
20E1	Silva	1950	33	110	D, 10					Irr		
20J1	D. H. Peterson	1950	37	[5] 285	D, 6	March 1948	[1] 24		J 2	D	L	Bailed at 800 gph; drawdown 156 ft.
						Feb. 1950	[2] Flowing					
20L1	D. Cassidy	1946	30	66	Dr, 6	July 1946	[1] 5		L	D	L	Bailed at 150 gph.
20P1	J. Knolle	1943	24	35	Dr, 6	August 1943	[1] 9		L 1/4	D	L	Bailed at 1,800 gph; drawdown 21 ft.
						Mar. 29, 1950	6.40					
20Q1	Knolle Bros	1943	21	57.5	Dr, 8	August 1943	[1] 4			U	L	Bailed at 3,000 gph; drawdown 46 ft.
						Mar. 28, 1950	2.68					
20R1	L. Miglioretti	1947	37	504	Dr, 8	do.	2.48		J 5	D	L	Bailed at 350 gph; Reported to flow when drilled.
						Apr. 9, 1952	3.55					
21A1	do.	1948	90	786	Dr, 12	Mar. 28, 1950	10.14			U	W	
21B1	F. J. Miller	1946	60	100	Dr, 6					D	L	Bailed at 250 gph.
21E1	L. Miglioretti		40	250	Dr, 8	Apr. 6, 1950	4.60		T 7 1/2	D, Irr	L	
21F1	J. F. Smith	1947	55	113	Dr	July 1947	[1] 13		J 3/4	D	L	Bailed at 200 gph.
21L1	P. O'Donnell	1944	60	246	Dr, 8	Feb. 1944	[2] 30		J 3	D	L	
21M1	H. Pearson	1942	60	103	Dr, 6	July 1942	[1] 27		J 1	D	L	Bailed at 800 gph; drawdown 23 ft.
						July 19, 1951	[3] 50.12					
21N1	W. S. Bishop	1942	45	190	Dr, 6	Sept. 1942	[1] 12		J 1/2	D	L	Bailed at 500 gph; drawdown 88 ft.
21N2	R. P. Grithner	1948	50	150	Dr, 6	March 1948	[1] 24			D	L	
21Q1	Roy Worthy	1948	78	155	Dr, 6	May 1948	[1] 17		J 1	D	L	Bailed at 600 gph; drawdown 63 ft.
21R1	R. Tomessini	1948	80	242	Dr, 8	Nov. 1948	[1] 30		L 2	D	L	
						July 18, 1951	56.70					
22E1	Phil Iselin	1948	120	143.0	Dr, 8	Apr. 7, 1950	24.77		J 2	D	L	
22L1	L. Picetti		160	560	Dr, 8	March 1950	[2] Flowing		J 3	D	L	
22L2	do.		182	212	Dr, 12	Mar. 31, 1950	Flowing		T 5	Irr	L	
22Q1	B. Davitto		180	542	Dr, 12	Apr. 5, 1950	Flowing		T 25	Irr	L	
27H1	C. Stornetta		175	750	Dr, 12	Jan. 26, 1950	Flowing	80 1/2	T 15	Dy	Cp, L	
						Mar. 27, 1952	Flowing					

See footnotes at end of table.

Table 18.—*Description of water wells in Sonoma Valley, Calif.*—Continued

Well	Owner or user	Year completed	Altitude of land surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 5 N., R. 5 W.—Continued						
5/5-28A1	Beliveau Kennels...	1951	80	208	Dr, 8	Aug. 23, 1951	24.36	....	J 3	S	L	
28C1	N. B. Thomas	1946	34	210	Dr, 6	....	....	....	L 3	D	C, L	
28C2	.....do..............	1947	36	264	Dr, 8	Sept. 1947	[1] 20	....	....	U	L	
						May 28, 1950	40.62	....	....	....	....	
28D1	A. L. Guerne	1943	28	244	Dr, 6	June 1943	[1] 23	....	L 1	D	L	Bailed at 400 gph; drawdown 47 ft.
28F1	G. Meddows..........	1947	35	103	Dr, 6	Nov. 1947	[1] 12	....	....	....	L	Bailed at 600 gph; drawdown 73 ft.
28F2	P. Smith	1942	31	53	Dr, 6	June 1942	[1] 13	....	J 1/2	D	L	Bailed at 600 gph; drawdown 27 ft.
28N1	Mike Mulas	1948	11	130	Dr, 12	July 1946	[1] 12	....	T 10	Irr	C, L, W	Bailed at 1,800 gph.
						Jan. 18, 1950	11.41	....	....	....		
28P1	G. Lee................	1947	21	37.5	Dr, 6	Mar. 29, 1950	17.17	....	L, Hand	U	....	Bailed at 400 gph.
28Q1	L. Couso.............	1946	29	239	Dr, 8	March 1946	[1] 7	....	J 1/2	D, S	L	Bailed at 1,000 gph; drawdown 23 ft.
						Mar. 29, 1950	33.93	....	....	....	....	
28Q2	Tule Vista School ..	1951	25	102	Dr, 6	....	....	....	....	D	L	Pumped at gpm; drawdown 4 ft.
28Q3	C. Gioletti...........	1949	30	250	Dr, 8	June 1949	[1] 14	....	J 2	D	L	Bailed at 600 gph; drawdown 96 ft.
29J1	J. Pimental	1950	15	148	Dr, 8	July 17, 1951	15.23	....	....	U	L	
29M1	M. McKetchnie......	1947	21	50	Dr, 8	October 1947	[1] 7	....	J 1/4	D	L	Bailed at 3,000 gph; drawdown 33 ft.
29N1	S. Moll	1950	16	100	Dr, 10	Aug. 16, 1951	14.69	....	T 5	Irr	....	
29P1	Northwestern Pacific Railroad Co.	....	15	160	Dr, 10	....	....	....	L	RR.	....	

29P2	S. C. Mitchell	1927	6	110	Dr, 12	Apr. 9, 1952	2.64		T 20	Irr		Reported to pump 480 gpm.
						Dec. 1949	[1]17					
29R1	Mike Mulas	1949	10	63	Dr, 12	July 10, 1951	26.64		J 3	S	L	Reported to pump 90 gpm.
						Apr. 9, 1952	4.81					
29R2	.....do.	1945	10	27	Dr, 6	.....do.	7.06		J 1/4	D, S	L	Bailed at 700 gph.
29R3	.....do.	1949	11	[5]61	Dr, 12	July 1946	[1]12		J 1	irr	L	Reported to pump 90 gpm.
						July 1949	[1]9					
						Apr. 9, 1952	4.48					
29R4	.....do.	1949	5	118	Dr, 12	Dec. 1949	[1]8		T 25	Irr	L	Reported to pump 190 gpm.
						Apr. 9, 1952	1.94					
30E1	J. Scarafoni		25	755	Dr, 12	Feb. 1951	[2]Flowing		T 20	Irr	Cp, L	Reported to pump 300 gpm.
						July 15, 1951	[3]51.02					
						Apr. 9, 1952	4.03					
30J1	S. Moll	1945	17	92.0	Dr, 12	May 1945	[1]21		J 2	D, S	L	Bailed at 180 gph; drawdown 69 ft.
						Apr. 5, 1950	22.73					
30J2	O. Nielson	1944	20	52	Dr, 8				J 1/2	D	L	Bailed at 1,500 gph.
30Q1	J. Scarafoni	1951	16	122	Dr, 10				T 7 1/2	Irr	L	
31A1	Ben Meyer	1927	10	408	Dr, 8	Sept. 1927	Flowing			D, S	C, Cp, L	
						Mar. 29, 1951	Flowing					
						Apr. 8, 1952	Flowing					
31A2	.....do.	1951	10	100	Dr, 10				T 10	Irr	C	
31A3	.....do.	1951	10	56	Dr, 10			64	T 10	Irr, S	C, Cp	
31H1	Jack Meyers	1948	7	203	Dr, 6	October 1948	[1]9		J 1	D	L	Bailed at 450 gph; drawdown 116 ft.
31L1	M. Solen	1944	20	107	Dr, 8	August 1944	[1]14		J 1/2	D	L	Bailed at 350 gph.
31L2	L. Moran	1946	22	45	Dr, 8	October 1946	[1]15		J 1 1/2	D	L	Bailed at 400 gph.
						Apr. 5, 1950	11.44					
33A1	N. Theiodora	1947	50	110	Dr, 6	Dec. 1947	[1]20		J 1	D	L	Bailed at 700 gph; drawdown 30 ft.
33B1	M. Haller	1945	17	39.5	Dr, 6	Mar. 31, 1950	17.26		L 1/4	D	L	
33B2	Dewhurst	1951	17	45	Dr, 6	July 17, 1951	23.84		J 1/2	D	L	
33C1	Essner		13	286	Dr					D	L	
33D1	M. Mulas	1948	8	96	Dr, 12	May 1948	[1]9		T 7 1/2	Irr	L	Reported to pump 150 gpm; drawdown 51 ft.
						Apr. 9, 1952	15.88					
33K1	R. V. Masnada	1950	10	190	Dr, 10	Aug. 16, 1951	35.43		T 7 1/2	Irr	L	
						Apr. 9, 1952	11.44					
33K2	.....do.	1950	5	147	Dr, 10	.....do.	6.93		T 7 1/2	Irr	L	
33K3	.....do.	1949	7	135	Dr, 10	.....do.	8.26		T 7 1/2	Irr		

See footnotes at end of table.

Table 18.—*Description of water wells in Sonoma Valley, Calif.*—Continued

Well	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 5 N., R. 5 W.—Continued						
5/5-33K4			6		Dr, 6	Apr. 9, 1952	5.05		L, Wind	S		
33K5			5	52.5	Dr, 6	do.	8.39			U		
33K6			5	33.0	Dr, 6	do.	4.45			U		
35M1	John Lawler	1945	190	200	Dr, 8	Mar. 22, 1951	83.71		L, Wind	S		
						T. 5 N., R. 6 W.						
5/6- 1D1	Maroni	1940	118	150	Dr, 6	May 1940	[1]12		J 1/2	D	L	Bailed at 600 gph; drawdown 63 ft.
						June 28, 1951	12.90					
1D2	Sonoma Water and Irrigation Co.	1944	140	190	Dr, 8					PS	L	Reported to pump 250 gpm.
1F1	J. McDermatt	1948	134	48	Dr, 6	Sept. 1948	[1]19		J 3/4	D	L	Bailed at 500 gph.
1J1	Parrish	1940	120	55	Dr, 6	July 1940	[1]17		J 1	D	L	Bailed at 400 gph; drawdown 33 ft.
						Apr. 12, 1950	21.33					
1J2	Gates Ranch	1951	135	70	Dr, 6	Jan. 30, 1951	[1]40		J 3/4	D	L	
1K1	T. Iacomini	1943	129	70	Dr, 6	Sept. 1943	[1]19		L 2	D	L	Bailed at 900 gph; drawdown 31 ft.
1L1	D. F. Bowen	1944	130	75	Dr, 6	May 1944	[1]13		J 1/2	D	L	Bailed at 800 gph; drawdown 57 ft.
1R1	W. Reithmuth	1944	105	165	Dr, 8	July 1944	[1]7		J 3	Irr	L	Bailed at 3,000 gph; drawdown 93 ft.
						Apr. 13, 1950	13.30					
1R2	William Montini		100	200	Dr, 6				T 7 1/2	Irr		Reported to pump 200 gpm.
2A1	S. C. Cahill	1947	110	163	Dr, 6	October 1947	[1]22		J 1	D	L	Bailed at 900 gph; drawdown 78 ft.

2A2	Boyes Hot Springs.	1945	110	350	Dr, 8	....	....	110+	T 10	PS	C, Cp, L	
2A3	.....do.......	1940	110	450	Dr, 10	....	....	[2]140	T 7 1/2	PS	Cp, L	Bailed at 70 gpm.
2A4	.....do.......	1942	110	128	Dr	March 1942	[1]20	86	T 5	PS	Cp, L	Bailed at 300 gph; draw-down 70 ft.
2A5	.....do.......	....	110	80	Dr	....	....	74	T 7 1/2	PS	C, Cp	
2L1	S. Frisca.......	1947	135	101	Dr, 8	Sept. 1947	[1]14	....	J 1	D	L	Bailed at 450 gph; draw-down 31 ft.
2L2	W. W. Brown.......	1947	135	158	Dr, 8	.....do.......	[1]21	....	J 1	D	L	Bailed at 800 gph; draw-down 69 ft.
2N1	A. Thompkins.......	1949	137	54	Dr, 8	Dec. 1949	[1]20	....	J 1	U	L	Bailed at 800 gph.
2P1	K. Nelson.......	1940	115	77	Dr, 8	October 1946	[1]18	....	J 1	D	L	Bailed at 1,500 gph; drawdown 32 ft.
						July 6, 1951	14.32	....	....	....	....	
2Q1	P. Nonella.......	1949	115	60	Dr, 8	Sept. 1949	[1]20	....	J 1	D	L	Bailed at 1,000 gph; drawdown 30 ft.
3B1	L. Jordan.......	1946	250	92	Dr, 6	Spring 1946	[1]11	....	J 1 1/2	D	L	Bailed at 800 gph; draw-down 69 ft.
3D1	R. Ford.......	1948	310	103	Dr, 10	Sept. 30, 1948	Flowing	....	T 10	Irr	L	Flow reported as 60 gpm Sept. 30, 1948. Test pumped at 180 gpm; pumping level 90 ft.
						May 4, 1950	Flowing	....	....	....	....	
3G1	Sonoma Country Club.	....	220	....	Dr	June 10, 1952	100.55	....	T 20	Irr	....	
3J1	C. F. Keyes.......	1949	165	38	Dr, 6	October 1949	[1]9	....	J 3/4	D	L	Bailed at 500 gph.
3J2	Scardigli.......	1943	165	22	Dr, 6	Sept. 1943	[1]11	....	J 1/2	D	L	Bailed at 400 gph; draw-down 15 ft.
3K1	Wilkings.......	1943	175	135	Dr, 6	October 1943	[4]23	....	J 1	D	L	Bailed at 600 gph; draw-down 77 ft.
3R1	S. Caton.......	1945	150	76	Dr, 6	July 1945	[1]23	....	L 1	D	L	Bailed at 800 gph; draw-down 17 ft.
						May 4, 1950	29.98	....	....	....	....	
10A1	F. M. Lantz.......	1949	160	83	Dr, 8	June 1949	[1]20	....	J 1/2	D	L	Bailed at 800 gph; draw-down 40 ft.
						May 4, 1950	13.49	....	....	....	....	
10G1	E. Vezna.......	1951	195	240	Dr, 6	Jan. 10, 1951	[1]80	....	....	irr	L	Bailed at 600 gph; draw-down 60 ft.
10K1	W. J. Hillman.......	1949	200	239	Dr, 8	Dec. 1949	[1]28	....	J 3	D	L	Bailed at 900 gph; draw-down 112 ft.
11B1	B. Poncia.......	1948	107	53	Dr, 6	October 1948	[1]20	....	J 1/3	D	L	Bailed at 500 gph.

See footnotes at end of table.

Tsble 18.—*Description of water wells in Sonoma Valley, Calif.*—Continued

Well	Owner or user	Year com-pleted	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Tem-pera-ture (°F)	Type of pump and horse-power	Use	Other Data avail-able	Remarks
						T. 5 N., R. 6 W.—Continued						
5/6-11E1	W. Cliff	1942	137	75	Dr, 6	October 1942	[1]17		L 3/4	D	L	Bailed at 800 gph; drawdown 43 ft.
11G1	Picco	1946	105	40	Dr, 6	Sept. 1948	[1]18		J 1/2	D	L	Bailed at 500 gph.
11G2	G. DeMakas	1948	100	39	Dr, 6	May 1948	[1]10			D	L	Bailed at 350 gph.
11H1	A. Degen		95	39	Dr, 6	May 12, 1950	7.28		L 1	D	L	Bailed at 400 gph.
11K1	L. Fassio	1944	114	104	Dr, 8	October 1944	[1]19		J 2	D, S	L	Bailed at 1,000 gph; drawdown 71 ft.
						May 12, 1950	38.64					
11P1	R. Traynor	1942	115	92	Dr, 6	October 1942	[1]16		J	D	L	Bailed at 1,100 gph; drawdown 74 ft.
12A1	S. Kutner	1945	85	159	Dr, 8	Apr. 12, 1950	21.10		J 3	D	L	Bailed at 1,000 gph.
12A2	G. Burghardt	1949	84	132	Dr, 8	May 1949	[1]24		J 1/2	D	L	Bailed at 500 gph; drawdown 66 ft.
						May 18, 1950	19.83					
12B1	T. Ramponi	1941	100	110	Dr, 6	July 1941	14		L 1/4	D	L	Bailed at 600 gph; drawdown 66 ft.
						May 12, 1950	14.10					
12B2	F. Ramazzano	1942	97	145	Dr, 6	August 1942	[1]19		J 1	D	L	Bailed at 1,000 gph; drawdown 71 ft.
						May 12, 1950	[3]50+					
12D1	A. Dutil	1941	82	70	Dr, 8	July 1941	[1]23		J 1	D	L	Bailed at 800 gph; drawdown 37 ft.
12E1	Hoover	1948	80	39	Dr, 6	Nov. 1948	[1]12		J 1/3	D	L	Bailed at 350 gph.
						May 9, 1950	10.91					
12E2	.....do	1942	82	140	Dr, 6	Nov. 1942	[1]18		J 1	irr	L	Bailed at 700 gph; drawdown 102 ft.
						May 9, 1950	20.23					
12F1	.....do	1948	80	113	Dr, 6	October 1948	[1]20		J 1/2	D, S	L	Bailed at 700 gph; drawdown 60 ft.
						May 9, 1950	34.31					
12G1	G. Pardini	1947	90	47	Dr, 6	October 1947	[1]20		J 1/2	D	L	Bailed at 500 gph.

12G2	A. Bianchini	1948	95	[5]176	Dr, 8	July 1946	[1]20	...	...	U	L	Bailed at 1,000 gph; drawdown 149 ft.
						July 1948	[1]21	...	...	...	...	
						May 10, 1950	49.36	...	...	...	...	
12G3	L. Minelli	1946	90	194	Dr, 6	July 1946	[1]19	...	J 2	D	L	Bailed at 800 gph.
						Aug. 14, 1951	41.91	...	...	...	...	
12H1	L. Giiorgi	1946	84	79.5	Dr, 6	Apr. 12, 1951	13.66	...	J 1	D	L	
12K1	E. J. Corbett	1946	80	51	Dr, 8	June 1946	[1]11	...	J 1/2	D	L	Bailed at 3,000 gph; drawdown 29 ft.
12L1	.....do	...	78	...	...	...	...	...	J 3	D	...	
12Q1	J. Allard	1942	74	45	Dr, 6	May 1942	[1]9	...	J 1/2	D	L	Bailed at 600 gph; drawdown 31 ft.
						Apr. 13, 1950	11.04	...	...	...	...	
12Q2	R. Wicks	1946	75	44.0	Dr, 6	June 1946	[1]13	...	J 1/2	D	L	Bailed at 700 gph; drawdown 22 ft.
						Apr. 13, 1950	14.88	...	...	...	...	
13A1	J. Bell	1947	66	70	Dr, 6	Dec. 1947	[1]19	...	J 1/3	D	L	Bailed at 350 gph; drawdown 41 ft.
13A2	J. M. Colbath	1949	65	48	Dr, 8	March 1949	[1]14	...	J 3/4	D	L	Bailed at 600 gph.
						Apr. 27, 1950	21.40	...	...	...	...	
13A3	V. E. Poole	1948	66	64	Dr, 6	March 1948	[1]13	...	J 1	D	...	Bailed at 900 gph; drawdown 37 ft.
						Apr. 27, 1950	19.67	...	...	...	...	
13A4	L. Kappes	1948	65	46	Dr, 6	January 1948	[1]12	...	J 1	D	L	Bailed at 500 gph; drawdown 23 ft.
						Apr. 27, 1950	[3]33.02	...	...	...	...	
13A5	J. F. Wendling	1949	63	90	Dr, 6	April 1950	[1]18	...	J 1	D	L	Bailed at 900 gph; drawdown 52 ft.
						Apr. 27, 1952	16.01	...	...	...	...	
13A6	L. Dong	1949	67	70	Dr, 6	January 1949	[1]12	...	...	D	L	Bailed at 600 gph.
13A7	J. C. Jenson	1948	64	57	Dr, 8	March 1948	[1]11	...	J 1	D	L	Bailed at 700 gph.
						July 9, 1951	20.21	...	...	...	...	
13F1	V. Leveroni	1949	62	110	Dr, 14	Dec. 1949	[1]17	...	T 30	Irr	L	Reported to pump 500 gpm; drawdown 46 ft.
						Aug. 15, 1951	19.85	...	...	...	...	
13F2	.....do	1949	66	105	Dr, 14	Dec. 1949	[1]18	...	T 30	Irr	L	Reported to pump 400 gpm; drawdown 57 ft.
13H1	A. Looney	1944	60	55	Dr, 6	...	...	...	J 1/3	D	L	Bailed at 600 gph.
13H2	E. J. Buttrum	1945	58	54	Dr, 8	Apr. 21, 1950	13.80	...	J 3/4	D	L	
13H3	C. Hayes	1948	58	46	Dr, 6	June 1948	[1]12	...	L 3/4	D	L	Bailed at 500 gph.
						Apr. 27, 1950	20.80	...	...	...	...	
13J1	J. A. Hefron	1948	56	57	Dr	October 1948	[1]12	...	J 1	D	L	Bailed at 1,000 gph.
13J2	J. Durate	1949	55	40	Dr, 8	April 1949	[1]17	...	J 1/4	D	L	Bailed at 600 gph.
						May 18, 1950	18.56	...	...	...	...	

See footnotes at end of table.

Table 18.—*Description of water wells in Sonoma Valley, Calif.*—Continued

Well	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 5 N., R. 6 W.—Continued						
5/6-13K1	Vella	....	60	150	Dr, 10	....	....	....	T 5	Irr	C, Cp	
14B1	B. F. Keechler	1949	112	116	Dr, 14	Jan. 18, 1950	45.00	....	T 7 1/2	Irr	Cp, W	Reported to pump 120 gpm.
14B2	V. Leveroni	1947	95	200	Dr, 12	April 1947	[1]22	....	T 30	Irr	L	Reported to pump 365 gpm; drawdown 88 ft.
						Apr. 14, 1950	18.83	....	....	....	....	
14G1	C. Beffarini	....	92	48	Dr, 6	Jan. 18, 1950	31.10	....	L, Wind	D	Cp, W	
14Q1	W. S. Dawson	1949	93	56	Dr, 8	Nov. 1949	[1]20	....	J 1/2	D	L	Bailed at 1,000 gph.
						May 10, 1950	5.88	....	....	....	....	
14R1	S. Archer	1948	80	59	Dr, 12	May 1948	[1]9	....	J 2	Irr	L	Bailed at 2,000 gph.
15J1	Silvestro Ranch	1947	110	100	Dr, 8	Nov. 1947	[1]8	....	J 1	D	L	Bailed at 400 gph; drawdown 42 ft.
						July 10, 1951	19.63	....	....	....	....	
24G1	W. J. Wilson	....	40	30	Dr, 6	....	....	....	....	Irr	....	
24G2	.....do	1949	40	125	Dr, 12	....	....	....	T 5	Irr	....	
24G3	.....do	1949	40	100	Dr, 12	....	....	....	T 5	Irr	....	
24K1	M. Kiser	1949	41	151	Dr	May 17, 1950	8.61	....	T 15	Irr	L	
25N1	J Sorini	1942	42	33	Dr, 6	Sept. 1942	[1]9	....	J 1/4	D	L	Bailed at 100 gph; drawdown 21 ft.
25P1	Fisher	1946	36	171	Dr, 8	Oct. 5, 1946	Flowing	....	J 3	D	L	Flow reported 600 gph.
						Mar. 30, 1950	Flowing	....	....	....	....	
36C1	H. Ballert	1944	40	43	Dr, 6	May 1944	[1]13	....	J 1	D	L	Bailed at 600 gph; drawdown 27 ft.
						Mar. 30, 1950	19.71	....	....	....	....	
36Q1	B. Meyers	1949	60	223	Dr, 6	March 1949	[1]2	....	J 1	D	L	Bailed at 350 gph; drawdown 148 ft.
36Q2	D. Emparon	1948	33	120	Dr, 8	April 1948	[1]12	....	C 1/2	D	L	Bailed at 800 gph; drawdown 68 ft.
						July 26, 1951	7.60	....	....	....	....	

					T. 6 N., R. 5 W.						
6/5-31J1	H. L. Phinney......	1936	760	286	Dr, 8	1936	[1]180	....	L 5	D	L	
						Apr. 13, 1950	190+	....	....	....	....	
					T. 6 N., R. 6 W.						
6/6- 4J1	Heins and Foster..	1949	405	190	Dr, 10	May 22, 1950	20.06	[2]72	T 15	Irr	L	Reported to pump 280 gpm.
4Q1	J. W. Hicks.........	1950	375	56	Dr, 6	June 1950	[1]15	....	J 1	D	L	
9C1	J. Henno...........	1941	375	62	Dr, 6	August 1941	[1]14	....	J 1	D	L	Bailed at 350 gph; drawdown 41 ft.
9R1	I. Brown...........	1947	300	193	Dr, 8	Dec. 1947	[1]46	....	J 2	....	L	Bailed at 1,800 gph; drawdown 34 ft.
						July 27, 1950	49.5	....	....	....	....	
10F1	C. I. Murry.........	1947	335	350	Dr, 6	June 1947	[1]31	67	J 1	D	Cp, L	Bailed at 300 gph; drawdown 119 ft.
10G1	V. M. Alvord.......	1951	430	147	Dr, 8	Feb. 2, 1951	[1]10	....	J 1	D	Cp, L	Bailed at 20 gpm; drawdown 110 ft.
						June 26, 1951	23.03	....	....	....	....	
10L1	E. C. Smith.........	1947	335	23	Dr, 5	July 1947	[1]7	....	J 1/2	D	L	Bailed at 350 gph.
						June 26, 1951	.59	....	....	....	....	
10M1	Ben Van Vrankin..	1950	325	165	Dr, 6	....	....	....	J 1	D	C	
10N1	W. Schubert.........	1948	310	114	Dr, 6	January 1948	[1]21	....	J 2	D	L	Bailed at 600 gph; drawdown 69 ft.
15J1	E. Bennett..........	1944	305	75	Dr, 10	Apr. 9, 1952	36.24	....	T 15	Irr	C, L	Reported to pump 350 gpm.
15K1	D. Stover...........	1949	340	86	Dr, 10	June 1949	[1]22	....	J 1/2	D	L	Bailed at 600 gph.
						July 9, 1951	55.29	....	....	....	....	
16B1	I. Holt...............	1941	400	426	Dr, 5	October 1941	[1]40	73	L 2	D	Cp, L	Bailed at 400 gph; drawdown 123 ft.
						June 26, 1951	104.42	....	....	....	....	
16B2	J. G. Hamilton.....	1943	300	211	Dr, 8	Nov. 1943	[1]60	....	L 2	D	Cp, L	Bailed at 1,200 gph; drawdown 80 ft.
						Sept. 20, 1951	102.42	....	....	....	....	
16H1	Glen Ellen Water Works.	....	300	210	Dr	....	[2]27	....	L	PS	C	
16J1	Carback.............	1941	265	102	Dr, 6	Feb. 1941	[1]21	....	J 1/2	D	L	Bailed at 150 gph; drawdown 59 ft.
						June 22, 1951	28.31	....	....	....	....	

See footnotes at end of table.

Table 18.—*Description of water wells in Sonoma Valley, Calif.*—Continued

Well	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
					T. 6 N., R. 6 W.—Continued							
6/6-16J2	Panassie	1947	260	280	Dr, 6	May 1947	[2] Flowing	...	J 1/2	D	C, L	Reported flow 3 gpm.
						June 27, 1951	10.39	...	...	...	...	Bailed at 500 gph; drawdown 70 ft.
16J3	E. Massey	1946	235	101	Dr, 6	August 1946	[1]21	...	...	A	L	Bailed at 120 gph.
16J4	....do	1946	235	90	Dr, 6	August 1946	[1]20	...	J 1/4	D	L	Bailed at 120 gph.
16Q1	F. Steiger	1940	235	360	Dr, 6	June 22, 1951	48.00	...	L 1 1/2	D	L	Bailed at 250 gph.
16Q2	A. Berkland	1944	270	117	Dr, 8	July 1944	[1]18	...	J 1/2	D	L	Bailed at 250 gph; drawdown 42 ft.
						June 22, 1951	14.73	...	...	...	...	
21B1	C. Pagani	1940	225	125	Dr, 6	June 1940	[1]9	...	T 5	Ind	L	
21B2	W. Baker	1946	275	240	Dr, 6	...	...	...	J 2	D	L	Bailed at 600 gph; drawdown 65 ft.
21C1	H. C. Miller	1945	365	231	Dr, 6	...	...	...	L	D	...	
22A1	M. C. Blake	...	270	114	Dr, 12	May 22, 1950	[3]25.33	...	T 20	Irr	...	Reported to pump 250 gpm.
22J1	D. Tarvid	1949	190	...	Dr, 12	July 28, 1950	6.04	...	...	U	...	
22J2	E. Roach	1945	185	117	Dr, 6	...	...	...	J 1	D	L	
22P1	A. Gatch	1940	190	89	Dr, 6	January 1940	[1]16	...	J 1	D	L	Bailed at 500 gph; drawdown 54 ft.
22P2	Donaghy Water Co.	1946	195	135	Dr, 12	August 1946	[1]22	...	T 7 1/2	PS	L	Bailed at 150 gph.
22R1	Madrone vineyard.	1949	195	152	Dr, 10	June 27, 1951	25.56	...	...	U	L	
22R2	G. K. Smith	1944	230	175	Dr, 6	June 1944	[1]13	...	J 1	D	L	Bailed at 600 gph; drawdown 87 ft.
						July 3, 1951	Flowing	...	...	...	...	
						Apr. 9, 1952	Flowing	...	...	...	...	
22R3	Montmorency	1946	190	418	Dr, 8	...	...	...	J 2	D, irr	C, L	
23F1	H. A. Johnson	1947	245	452	Dr, 12	July 15, 1950	[2]16	75	T 5	Irr	Cp	Reported to pump 135 gpm.
						July 28, 1951	[3]100	...	...	...	...	

23L1	.....do	1950	225	40	Du	.....do	[2]12		C	Irr	L	
23M1	D. Tarvid	1947	208	255	Dr, 12	August 1947	[1]Flowing	74 1/2	J	D, Irr	Cp, L	Reported to pump 200 gpm; drawdown 150 ft.
						July 28, 1950	Flowing					
23M2	N. Tarvid	1942	220	233	Dr, 6	July 1942	[1]31		T 2	D	L	Bailed at 1,000 gph; drawdown 49 ft.
23M3	M. Kultzhall	1943	210	110	Dr, 6	Nov. 1943	[1]9		J 1 1/2	irr	L	Bailed at 800 gph; drawdown 56 ft.
26C1	R. Gilmore	1948	240	135	Dr, 8	January 1948	[1]27		J 1	D	L	Bailed at 500 gph; drawdown 73 ft.
						June 28, 1951	37.9					
26C2	G. Duncan	1949	220	81	Dr, 8	Nov. 1949	[1]10			D	L	Bailed at 800 gph.
26E1	D. Stamos	1948	180	304	Dr, 10	October 1948	[1]4			D	L	Reported to pump 100 gpm; drawdown 96 ft.
26G1	G. Nyce	1948	260	265	Dr, 10	Dec. 1948	[1]29		J 2	D	L	Bailed at 1,000 gph; drawdown 121 ft.
						June 27, 1951	46.10					
26G2	A. Baldocchi	1949	220	120	Dr, 8	July 1949	[1]22		J 1	D	L	Bailed at 1,000 gph; drawdown 68 ft.
						July 2, 1951	22.17					
26K1	C. J. Parker	1949	200	108	Dr, 8	April 1949	[1]7		J 1	D	L	Bailed at 700 gph; drawdown 63 ft.
27C1	P. Dixon	1949	195	200	Dr, 6	Sept. 1944	[1]27		J 1	D	L	Bailed at 1,000 gph; drawdown 73 ft.
						July 9, 1941	22.7					
27D1	J. R. Hooker	1951	375	780	Dr					A	L	
27F1	Fabbri	1941	195	43	Dr, 6	July 1941	[1]18		J 1	D	L	Bailed at 800 gph; drawdown 22 ft.
						June 28, 1951	21.48					
28E1	McClaran	1950	625	215	Dr, 8				T 20	Irr	Cp, L	
33K1	P. Davis	1949	500	101	Dr, 8	July 1949	[1]20		W	U	L	Bailed at 800 gph; drawdown 70 ft.
34A1	R. J. Ricks	1949	150	50	Dr, 8	June 1949	[1]17		J 1	D	L	Bailed at 1,000 gph.
						June 21, 1951	21.48					
34C1	P. Verdier	1949	200	500	Dr, 10	July 3, 1951	14.84		J 1	irr	L	
34G1	W. L. Murphy	1943	175	295	Dr, 6	Dec. 1943	[1]55			U	L	Bailed at 500 gph; drawdown 45 ft.
34G2	H. Arnold	1949	235	153	Dr, 8	Sept. 1949	[1]34		L 1 1/2	D	L	Bailed at 1,100 gph; drawdown 86 ft.
						June 21, 1951	66.43					
34N1	V. Jorgenson	1948	335	136	Dr	1948	[1]7			S	L	
34P1	C. Harmon	1948	265	350	Dr, 10	Feb. 1948	[1]60			D	L	Bailed at 1,000 gph; drawdown 90 ft.

See footnotes at end of table.

Tsble 18.—*Description of water wells in Sonoma Valley, Calif.*—Continued

Well	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well and casing diameter (inches)	Date of water-level measurement	Water level above (+) or below land-surface datum (feet)	Temperature (°F)	Type of pump and horsepower	Use	Other Data available	Remarks
						T. 6 N., R. 6 W.—Continued						
6/6-35G1	D. Lucci............	1945	132	76	Dr, 6	August 1945	[1]21	....	J 1 1/2	D	L	Bailed at 800 gph; drawdown 37 ft.
						June 21, 1951	14.83	....	....	....	....	
35G2	Linegren...........	1949	135	130	Dr, 8	Dec. 1949	[1]9	....	J 3	D	L	Bailed at 3,600 gph; drawdown 81 ft.
						July 9, 1951	13.19	....	....	....	....	
35G3	Crockett............	....	132	....	Dr	....	....	....	J 2	irr	....	
35L1	Martin..............	1942	125	85	Dr, 6	June 1941	[1]14	....	J 1	D	L	Bailed at 700 gph; drawdown 46 ft.
35L2	Ryan................	1940	125	90	Dr, 6	January 1940	[1]12	....	J 1/2	D	L	Bailed at 700 gph; drawdown 56 ft.
						June 22, 1951	15.92	....	....	....	....	
35M1	Knoblock...........	1946	160	86	Dr, 6	August 1946	[1]21	....	J 1	D	L	Bailed at 600 gph; drawdown 49 ft.
						June 22, 1951	23.26	....	....	....	....	
35M2	Hipkiss.............	1948	140	120	Dr, 6	June 1948	[1]12	....	....	D	L	Bailed at 250 gph; drawdown 78 ft.
35M3	W. Clanton.........	1944	140	59	Dr, 6	Dec. 1944	[1]13	....	J 3/4	D	C, L	Bailed at 800 gph; drawdown 37 ft.
35R1	M. Leixner........	1947	128	197	Dr, 8	October 1947	[1]13	....	J 1 1/2	D	L	Bailed at 800 gph; drawdown 67 ft.
						T. 6 N. R. 7 W.						
6/7-13J1	Sutherland..........	1946	....	500	Dr	....	....	....	J 1 1/2	D	L	

[1] Measured by driller.
[2] Measurement reported by owner.
[3] Pumping.
[4] Pumped recently.
[5] Well deepened.

Table 19.—*Water levels in Sonoma Valley, Calif.*

Date	Water level	Date	Water level	Date	Water level
		5/5-17C1			

[L. McNeil, Route 2, Box 117E. About 1.2 miles southeast of Sonoma City Hall, 0.14 mile west of Vineburg Road, 100 ft north of MacArthur Street, 40 ft southeast of stucco dwelling, 2 ft south of concrete block pumphouse. Domestic well, diameter 6 in., reported depth 70 ft. Measuring point, top of casing west side, 0.6 ft above land-surface datum which is 85 ft above sea level]

Jan. 18, 1950	13.04	July 7, 1950	24.78	Apr. 2, 1951	18.31
Feb. 3	12.38	Aug. 10	22.22	May 25	24.12
Mar. 3	8.59	Sept. 8	25.78	Oct. 9	25.20
30	8.03	Oct. 9	23.92	Nov. 6	21.82
May 3	14.60	Nov. 8	25.12	Dec. 7	14.55
June 6	28.78	Dec. 28	19.78	Mar. 27, 1952	10.66

5/5-18R1

[C. W. Stevenson, Route 2, Box 400. About 1.5 miles southeast of Sonoma City Hall, 0.22 mile south of Napa Road along 5th Street East, 400 ft east of 5th Street East, 60 ft north of northeast corner of shed, 48 ft northeast of pumphouse for well 5/5-18R2, 18 ft east of dirt access road, on concrete slab. Unused well, diameter 8 in., depth 133.5 ft. Measuring point, top of casing north side, 0.5 ft above land-surface datum which is 43 ft above sea level. Measurements from May 17, 1950 through Nov. 14, 1951 are selected noon readings from recorder charts]

Mar. 29, 1950	2.58	Oct. 20, 1950	9.09	Apr. 10, 1951	3.25
Apr. 6	2.91	25	9.07	15	3.38
May 3	4.14	31	8.91	20	3.45
17	4.81	Nov. 5	8.87	25	3.51
20	5.00	10	8.86	30	3.57
25	5.30	15	8.81	May 5	3.40
31	5.80	20	8.59	10	3.76
June 5	5.90	25	8.35	15	4.13
10	6.17	30	8.22	20	4.61
15	6.52	Dec. 5	7.9	25	4.80
20	6.66	10	2.2	31	5.26
25	6.99	16	1.80	June 10	5.85
30	7.19	20	2.13	15	6.08
July 7	7.51	25	2.19	20	6.31
10	7.70	31	2.36	25	6.55
15	7.88	Jan. 5, 1951	2.07	30	6.79
20	8.06	10	1.84	July 5	7.02
25	8.17	15	2.02	10	7.19
31	8.22	20	1.92	15	7.44
Aug. 5	8.32	25	1.95	18	7.57
10	8.41	31	2.27	Sept. 14	8.7
15	8.43	Feb. 5	1.50	19	8.9
19	8.48	10	2.13	Oct. 10	9.1
25	8.59	15	2.19	15	9.1
31	8.59	20	2.33	20	9.07
Sept. 4	8.62	25	2.42	25	9.07
10	6.68	Mar. 1	2.28	31	9.06
15	8.77	5	1.91	Nov. 6	9.06
20	8.86	10	2.15	10	9.04
25	8.91	15	2.38	14	8.97
30	8.96	20	2.60	Dec. 12	5.22
Oct. 5	9.01	25	2.77	Mar. 27 1952	2.36
10	9.05	31	3.05		
15	9.09	Apr. 5	3.19		

Table 19.—*Water levels in Sonoma Valley, Calif.*—Continued

5/5-18R2

[C. W. Stevenson. In pumphouse 48 ft southwest of 5/5-18R1. Domestic well, pit 6 ft by 8 ft, depth 25.0 ft. Measuring point, edge of U.S.G.S. copper washer on cross 4-in by 6-in support over top of pit, 1 ft above land-surface datum which is 43 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Mar. 29, 1950	3.73	Aug. 18, 1950	20.64	Nov. 24, 1950	9.42
Apr. 6	4.10	25	22.66	Dec. 8	2.65
May 3	5.06	Sept. 1	22.71	15	2.36
31	12.78	8	20.48	22	3.46
June 6	7.59	15	20.45	28	3.58
13	7.70	22	20.08	Jan. 5, 1951	3.25
21	8.16	29	20.55	19	2.74
28	8.80	Oct. 8	20.42	26	3.19
30	12.34	16	20.34	Feb. 15	3.42
July 7	9.33	20	20.30	21	3.25
14	10.06	27	19.64	Mar. 9	3.09
21	13.51	Nov. 3	19.55	Nov. 6	20.89
28	20.71	10	19.98	Dec. 7	6.15
Aug. 4	20.11	17	8.70	Mar. 27, 1952	3.59
11	23.70				

5/5-21A1

[L. Miglioretti. About 2.9 miles southeast of Sonoma City Hall, 0.42 mile east of Hyde Road along Napa Road, 470 ft S. 18° W. of third power pole east of large single gum tree on north side of road, 450 ft southwest of centerline of Napa Road. Unused well, diameter 12 in., reported depth 786 ft. Measuring point, top of casing northwest side, 0.5 ft above land-surface datum which is 90 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Mar. 28, 1950	10.14	Sept. 8, 1950	10.56	Apr. 2, 1951	9.61
May 3	10.12	Oct. 9	10.83	May 25	9.87
June 28	10.47	Nov. 8	11.06	Oct. 9	11.43
July 7	10.40	Dec. 28	9.97	Dec. 7	10.66
Aug. 10	10.73	Feb. 2	9.60	Mar. 27, 1952	9.25

5/5-28N1

[Mike Mulas. About 3.7 miles southeast of Sonoma City Hall, 0.35 mile east of railroad along State Highway 12 and 37, 385 ft south of road, in open field, on concrete slab. Irrigation well, diameter 12 in., reported depth 130 ft. Measuring point, top of casing east side, 0.4 ft above land-surface datum which is 11 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Jan. 18, 1950	11.41	Aug. 10, 1950	20.61	Nov. 6, 1951	22.48
Feb. 3	9.74	Sept. 7	21.26	Dec. 7	19.27
Mar. 3	8.22	Oct. 9	22.21	Mar. 27, 1952	6.97
30	7.83	Nov. 8	23.95	Nov. 21	22.10
May 3	8.42	Dec. 28	12.39		
June 6	21.21	Apr. 2, 1951	6.68		

Table 19.—*Water levels in Sonoma Valley, Calif.*—Continued

5/6-14B1

[B. F. Keechler. About 2.1 miles southwest of Sonoma City Hall, 0.75 mile north of Napa Road along Arnold Drive, 430 ft west of Arnold Drive, 300 ft south of access road to ranch, in open pasture. Irrigation well, diameter 14 in., reported depth 116 ft. Measuring point, top of casing north side, 0.6 ft above land-surface datum which is 112 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Jan. 18, 1950	44.40	June 6, 1950	43.99	Nov. 6, 1951	49.53
Feb. 3	40.92	Sept. 8	[1] 71.48	Dec. 7	46.90
Mar. 3	36.30	Nov. 8	48.28	Mar. 27, 1952	30.92
30	34.52	Dec. 28	39.77	Nov. 21	55.00
May 3	34.43	Apr. 2, 1951	31.46		

[1] Pumped recently.

5/6-14G1

[C. Bottarini. About 2.1 miles southwest of Sonoma, 0.42 mile north of Napa Road along Arnold Drive, 0.33 mile south of well 5/6-14B1, 100 ft west of Arnold Drive, 100 ft north of paved road south of ranch, 30 ft north of dwelling, 2 ft east of tank tower, under lift pump. Domestic well, diameter 6 in., depth 47 ft. Measuring point, hole in pump base south side, 1.0 ft above land-surface datum which is 92 ft above sea level]

Date	Water level	Date	Water level	Date	Water level
Jan. 18, 1950	31.10	July 7, 1950	29.48	Apr. 2, 1951	19.46
Feb. 3	27.92	Aug. 10	33.91	May 25	24.37
Mar. 3	23.82	Sept. 8	35.63	Nov. 6	35.87
30	22.16	Oct. 9	36.20	Dec. 7	30.51
May 3	22.63	Nov. 8	37.47	Mar. 27, 1952	18.80
June 6	28.39	Dec. 28	26.97	Nov. 21	40.98

Table 20.—*Chemical analyses of water in Sonoma Valley, Calif.*

Samples collected by the Geological Survey were analyzed by the Geological Survey's California, laboratory. Samples collected by the Sonoma County farm advisor were These are indicated by the symbol "UC." Samples collected and analyses made by other than the Geological Survey are given as reported and hence they have not been

Sum of determined constituents is the arithmetic total in parts per million of all con addition. For sodium and potassium, where no figure is given for potassium, the computed as sodium plus any error of analysis.

Well	Collector, analyst, and laboratory number	Depth (feet)	Geologic deposit from which water was withdrawn[5]	Date sampled	Specific conductance (micromhos at 25° C)	pH	Constituents, in			
							Sum of determined constituents	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)
4/5- 3C1	UC 8565	261	(1)	1- 9-51	3,190	8.1	....	......	......	.....
3C2	UC 8564	110	(1)	1- 9-51	3,000	8.1	....	......	......	.....
14D1	(3) (4)	540	Qh	7-26-49	957	7.4	636	78	0.15	0.19
14D2	(3) (4)	1,620	Qh?	9- 7-51	880	7.0	604	52	0	3.0
14L1	(3) (4)	650	Qh?	7-26-49	1,223	7.4	763	68	.57	.30
5/5- 9M2	S 2717	257	Qoal, Qh?	9-15-51	630	7.6	387	36	......	......
16E1	(4)	393	Qoal, Qh?	....	1,730	7.4	....	......	3.8	.25
19L1	S 2716	150	Qoal	9-21-51	208	7.8	226	72	......	......
20C1	S 2791	125	Qoal	9-19-51	395	7.6	233	16	......	......
28C1	UC 8719	210	Qoal? Qh	8-27-51	1,100	8.3	[2]610	......	......	......
28N1	S 2715	130	Qoal	9-20-51	455	7.6	318	91	......	......
31A1	S 4178	408	Qge?	4- 8-52	854	8.3	....	29	......	......
	S 4388	....	....	6-10-52	957	.....	....	......	......	......
31A2	S 4387	100	Qyal, Qoal?	6-10-52	5,380	.....	....	......	......	......
31A3	S 2718	56	Qyal	9-20-51	5,010	7.2	2,800	74	......	......
	S 4386	....	....	6-10-52	4,530	.....	....	......	......	......
5/6- 2A2	(2) (4)	350	Tsv	....	....	.....	845	76	0.93	......
2A5	(2) (4)	80	Tsv	....	....	.....	....	......	Tr.	Tr.
13K1	S 2792	150	Qyal, Qoal?	9-20-51	366	7.3	218	16	......	......
6/6-10M1	UC 8490	165	Qyal, Qoal?	8-23-50	250	6.2	135	......	......	......
15J1	S 2714	75	Tsv	9-19-51	344	7.7	252	90	......	......
16B2	S 2719	211	Qge	9-19-51	672	8.2	445	74	......	......
16H1	UC 8656	210	Qge	7- 3-51	550	8.3	314	......	......	......
16J2	UC 8252	102	Qge	10-25-49	550	8.6	308	......	......	......
22R3	S 2794	418	Qge	9-19-51	203	6.8	137	35	......	......
35M3	S 2793	59	Qyal	9-19-51	270	7.8	139	......	......	......

[1] Contaminated from nearby tidal slough.
[2] Calculated by U. S. G. S.
[3] Collected from owner or owner's agent.

Table 20.—*Chemical analyses of water in Sonoma Valley, Calif.*

Quality of Water laboratory. These are indicated by the symbol "S" for the Sacramento, analyzed by the University of California Division of Plant Nutrition at Berkeley, Calif. other individuals or agencies are indicated by special footnotes. Figures in analyses by rounded or corrected to conform with Survey standards.

stituents determined, except bicarbonate for which the figure is divided by 2.03 before concentration of sodium was computed by difference, and that figure includes potassium

parts per million												
Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Boron (B)	Fluoride (F)	Hardness as ($CaCO_3$)	Percent sodium
95	45	490	....	410	30	105	735	......	0.64	......	[2]422	72
110	90	375	....	340	5	40	800	......	.32	......	[2]644	56
10	10	197	....	310	....	45	140	0.8	....	......	67	87
12	18	175	....	275	....	92	120	0	....	2.5	104	79
25	19	222	....	327	....	44	220	.2	....	......	142	77
5.2	4.1	128	9	229	0	.6	90	0	1.0	.2	30	87
....	....	....	....	....	....	....	280	......	....	......	104	......
14	19	18	1.3	138	0	5.4	16	11	.09	.2	113	25
48	20	10	.7	241	0	11	6.2	0	.56	0	231	10
10	5	230	....	365	25	35	125	......	....	......	[2]46	91
12	18	49	2.2	90	0	4.8	86	10	.10	.2	[2]104	50
6.8	3.6	205	1.5	488	0	.7	65	.2	5.3	0	32	93
8.0	7.3	245	....	....	....	....	66	......	6.6	......	[2]50	......
159	192	848	....	....	....	....	1,580	......	.08	......	[2]1,190	......
204	261	430	8.1	285	0	199	1,480	2.9	.21	0	1,580	37
190	217	455	....	....	....	....	1,350	......	.20	......	[2]1,370	......
9	1.0	295	....	....	61	2.9	392	......	....	7.0	[2]27	96
5.0	2.0	195	....	....	128	17	150	......	....	......	[2]20	95
24	19	28	.8	204	0	9.1	15	.3	4.4	.1	138	30
15	15	15	....	90	10	15	20	......	0	......	[2]99	25
14	9.5	32	5.9	126	0	12	24	.6	.54	.5	74	46
3.7	4.6	134	9.0	300	0	.8	60	.5	7.7	.3	28	88
5	0	120	....	195	5	0	80	......	6.2	......	15	95
15	10	90	....	120	20	23	90	......	7.7	......	[2]79	70
12	8.0	14	.6	60	0	5.8	22	10	0	0	63	32
7.2	20	19	.2	138	0	6.3	17	0	.07	.1	100	29

[4] Analyses by International Filter Co., Chicago, Illinois, converted from hypothetical combinations in grains per gallon to ions in parts per million.

[5] For explanation of symbols see geologic map (pl. 2).

Table 21.—*Partial chemical analyses of water in Sonoma Valley, Calif.*

[Analyzed by Geological Survey except as indicated]

Well	Date of collection	Depth (feet)	Geologic deposit from which water was withdrawn[1]	Chloride (Cl) (ppm)	Hardness as $CaCO_3$ (ppm)	Specific conductance (micromhos at 25°C)
4/5-14D1	Mar. 16, 1950	540	Qh	121	59	957
14L1	.....do..........	650	Qh?	203	137	1,220
32B1	Feb. 17, 1950	....	Qyal, Qoal?	314	300	1,880
32C1	.....do..........	....	Qyal, Qoal?	896	380	3,400
34D1	Nov. 8, 1949	200+	Qyal, Qoal	632	400	2,870
5/5- 9N1	Aug. 14, 1951	185	Qoal	90	55	908
17C1	Oct. 9, 1950	70	Qoal	9.2	37	226
20A2	[2]1949	390	Qoal, Qh?	400	....	....
27H1	Jan. 26, 1950	750	Qh, Tsv	12	40	334
30E1	July 29, 1951	755	Qh	24	130	467
31A1	Apr. 8, 1952	408	Qge?	65	32	925
	May 22, 1952	....	....	87	30	920
	June 10, 1952	....	....	66	50	957
31A2	May 22, 1952	100	Qyal, Qoal?	1,160	880	4,390
	June 10, 1952	....	....	1,580	1,190	5,380
31A3	Apr. 8, 1952	56	Qyal	111	116	1,060
	June 10, 1952	....	....	1,350	1,370	4,530
31H1	Apr. 8, 1952	203	Qyal, Qoal	234	100	1,310
5/6- 2A2	June 20, 1951	350	Tsv?	378	30	1,550
2A3	.....do..........	450	Tsv?	273	35	1,220
2A4	.....do..........	128	Tsv?	208	....	1,050
2A5	June 20, 1951	80	Tsv?	132	30	901
13K1	Aug. 16, 1951	150	Qyal, Qoal?	16	160	317
14B1	Oct. 9, 1950	116	Qoal	90	85	218
14G1	.....do..........	48	Qoal	13	98	251
6/6- 10F1	June 26, 1951	350	Qoal, Qge	64	55	465
10G1	.....do..........	147	Tsv	164	395	1,310
16B1	.....do..........	426	Qoal	93	15	690
22R1	Apr. 8, 1952	152	Qt, Qge	121	12	653
23F1	July 28, 1950	452	Tsv	42	27	394
23M1	.....do..........	255	Qt, Qoal	97	77	558
28E1	Aug. 17, 1951	215	Tsv	7.2	115	246

[1] For explanation of symbols see geologic map (pl. 2).
[2] Collected from owner.

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*

[For wells having no perforated interval shown, customary practice is to pre-perforate all casing except the top few lengths]

	Thickness (feet)	Depth (feet)

4/5-3C1

[John Lawler. Drilled by J. W. Evans & Sons. On terrace. Altitude [illegible]0 ft]

Terrace deposit:		
Boulders	5	5
Huichica formation:		
Clay, yellow	10[illegible]	107
Gravel, tuff, water	3	110
Clay, gray	17	127
Clay, blue	15	142
Clay, gray	23	165
Clay, blue	9	174
Clay, gray	57	231
Blue and gray clay, gravel, water	27	258
Clay, yellow	3	261

4/5-14D1

[U. S. Navy No. 1. Drilled by N. F. Keyt. On tidal marshland. Altitude 0 ft. Casing cemented from 0 to 225 ft, perforated from 495 to 531 ft]

Formations undifferentiated:		
Soil	2	2
Clay, blue	10	12
Clay, blue	37	49
Gravel	6	55
Clay, blue	5	60
Clay, yellow	15	85
Clay, yellow, and gravel	5	90
Clay, blue	16	106
Clay, blue, and gravel	9	115
Clay, blue	70	185
Clay, yellow	23	208
Clay, blue	12	220
Clay, blue, and gravel	25	245
Clay, blue, sandy	2[illegible]	271
Clay, blue	2[illegible]	300
Clay, blue, and gravel	34	334
Clay, yellow	7[illegible]	412
Clay, yellow, sandy	8[illegible]	495
Clay, yellow, sandy, and gravel	7	502
Yellow sand and gravel	10	512
Yellow sand and gravel	2[illegible]	535
Yellow "cement" and gravel	2	537
Clay, yellow, and gravel	3	540

4/5-14D2

[U. S. Navy No. 3. Drilled by N. F. Keyt. Material logged by Geological Survey, formations undifferentiated. On tidal marshland. Altitude 0 ft. Well plugged at 620 ft. Casing cemented from 0 to 260 ft. Casing perforated for 252 ft between 260 and 620 ft]

Formations undifferentiated:		
Peat and adobe	10	10
Peat and silt	3[illegible]	48
Silt, sandy	12	60

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
4/5-14D2—continued		
Formations undifferentiated:—Continued		
Silt, coarse, sandy yellow	15	75
Silt	30	105
Sand, coarse and silt, yellow	47	152
Clay, blue	4	156
Clay, blue and peat in layers	44	200
Clay, blue	50	250
Silt, sandy	16	266
Clay, blue	9	275
Clay, blue and sand, coarse	45	320
Gravel, fine	10	330
Sand and gravel	8	338
Clay, sandy, yellow	27	365
Clay, sandy, yellow and gravel	5	370
Clay, yellow and silt	16	386
Clay, yellow and gravel	12	398
Silt, hard or clay, sandy, yellow	22	420
Silt, soft or clay, sandy, yellow	15	435
Silt, hard, yellow	9	454
Gravel and clay	10	464
Gravel, fine	10	474
Clay and sand	35	509
Clay and sand	11	520
Gravel	1	521
Sand and clay	23	544
Clay, yellow, tough, sticky	23	667
Gravel, pea size, and sand, coarse	16	683
Clay, blue, some fine gravel or coarse sand	27	710
Clay, blue, sticky	39	749
Clay, some sand and streaks of gravel	33	782
Clay, hard	3	785
Clay, blue	33	818
Clay, hard	1	819
Clay, blue, some fine gravel	101	920
Clay, yellow, silty, some sand	6	926
Clay, alternating yellow and blue with some angular rock fragments	42	968
Clay, yellow and blue	122	1,090
Clay, gray, some small sized gravel	4	1,094
Clay, alternating, blue, gray, yellow	127	1,221
Clay, hard	1	1,222
Clay, blue	70	1,292
Clay, gray-green, silty, soft	7	1,299
Clay, gray	66	1,365
Clay, blue	5	1,370
Hard zone. Change to rock bit necessary to continue drilling	1	1,371
Gravel, cemented, and clay	219	1,590
Clay, mostly blue, no gravel	30	1,620

4/5-14L1

[U. S. Navy No. 2. Drilled by N. F. Keyt. On tidal marshland. Altitude 0 ft. Casing perforated from 610 to 650 ft]

	Thickness (feet)	Depth (feet)
Formations undifferentiated:		
Dark "surface" mud and peat	58	58
Clay, tough light blue	8	66
Clay, tough brownish-yellow	20	86

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
4/5-14L1—Continued		
Formations undifferentiated:—Continued		
Clay, tough light blue	14	100
Clay, soft dark blue	35	135
Blue "tule bed"	16	151
Clay, blue	15	166
Black "tule bed"	4	170
Clay, blue	5	175
Sandy blue clay with small gravel	4	179
Clay, blue	23	202
Blue clay with small gravel	5	207
Clay, brown	14	221
Clay, blue	23	244
Black "tule bed"	2	246
Gray and blue clay with gravel	4	250
Sandy blue clay	2	252
Coarse blue and gray gravel and rocks	3	255
Blue clay with streaks of sand	30	285
Silty mud and "weed"	13	298
Dark sticky clay	2	300
Sand, silt, soft blue clay	16	316
Black tough mud and tule	11	327
Clay, blue, sand streaks	37	364
Hard blue clay with embedded boulders	7	371
Clay, blue	14	385
Clay, brown, and rocks	66	451
Tough dark gray-blue clay	15	466
Clay, brownish-yellow	24	490
Shale, gray	37	527
Clay, brownish-yellow, slightly sandy	38	565
Gray sticky clay	30	595
Gray sticky clay	15	610
Gravel and sand	35	645
Clay, yellow	15	660

5/5-7A1

[Sam Sebastiani. Drilled by O. J. Pearson. On hill slope. Altitude 130 ft. Cased from 0 to 160 ft]

	Thickness (feet)	Depth (feet)
Sonoma volcanics:		
"Surface" boulders	10	10
Clay, red and boulders	75	85
Volcanic ash, red	65	150
Lava boulders	10	160
Volcanic ash, red	35	195
Clay, brown, and cemented gravel	35	230
Tuff, white	95	325
Lava and lava ash	15	340
Tuff, white	20	360
Lava rock	115	475
Cemented sand with streaks of clay and sandstone	85	560
Clay, yellow, and sand	15	575

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/5-8A1		
[S. P. Dunn. Drilled by J. Larbre. On creek flood plain. Altitude 148 ft. Cased from 0 to 130 ft]		
Older alluvium:		
Soil	2	2
Boulder and clay	17	19
Huichica formation:		
Clay, yellow	35	54
Shale, blue	40	94
Sonoma volcanics:		
Rock, yellow, soft	30	124
Rock, red, some water	12	136
Rock, black and red	21	157
Rock, red	18	175
5/5-8B1		
[E. G. Hester. Drilled by J. Larbre. On older alluvial plain. Altitude 145 ft. Cased from 0 to 61 ft]		
Older alluvium:		
Dirt and gravel	43	43
Hardpan	20	63
Gravel cement	17	80
5/5-8E1		
[Sebastiani Winery. Drilled by J. Larbre. On older alluvial plain. Altitude 112 ft]		
Older alluvium and Huichica formation, undifferentiated:		
"Hardpan"	116	116
Sonoma volcanics:		
Rock, basalt	39	155
Rock, red volcanic, water bearing	15	170
Rock, soft, porous	42	212
Volcanic ash	23	235
5/5-8P1		
[F. Forster. Drilled by J. Larbre. On older alluvial plain. Altitude 91 ft. Cased from 0 to 388 ft]		
Older alluvium:		
Soil	8	8
Clay, yellow, and gravel	53	61
Huichica formation:		
Clay, yellow	173	234
Sand, brown, little water	2	236
Clay, blue	97	333
Shale, blue and sand	70	403
Sonoma volcanics:		
Rock formation, water bearing	18	421

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/5-9M1		
[J. Paulis. Drilled by J. Larbre. On older alluvial plain. Altitude 147 ft. Cased from 0 to 185 ft]		
Older alluvium:		
Soil	2	2
"Hardpan"	35	37
Huichica formation:		
Clay, yellow	70	107
Clay, blue	42	149
Clay, yellow	35	184
Sonoma volcanics:		
Rock drilling	31	215
5/5-9N2		
[R. Molesworth. Drilled by J. Larbre. On older alluvial plain. Altitude 101 ft. Cased from 0 to 285 ft]		
Older alluvium and Huichica formation, undifferentiated:		
Soil	2	2
Clay, yellow	75	77
Clay, blue, and sand	208	285
5/5-16E1		
[F. Le Noir. Drilled by J. Larbre. On older alluvial plain. Altitude 79 ft. Cased from 0 to 373 ft]		
Older alluvium and Huichica formation, undifferentiated:		
Soil	3	3
"Rock"	19	22
Clay, yellow	78	100
Sand, little water	1	101
Clay, blue	144	245
Clay, yellow	77	322
Clay, blue	14	336
Shale, blue	50	386
Shale and sand	7	393
5/5-17B1		
[J. Widmer. Drilled by J. Larbre. On older alluvial plain. Altitude 92 ft]		
Older alluvium:		
Soil	2	2
"Hardpan" and clay	28	30
Huichica formation:		
Clay, yellow	150	180
Clay, blue	530	710
Sonoma volcanics(?):		
Clay, reddish and some scoria	5	715
Clay, blue	5	720

532671 O—60——17

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*—Continued

5/5-17C4

[O. H. Teller. Drilled by J. Larbre. On older alluvial plain. Altitude 93 ft. Cased from 0 to 256 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
Soil	4	4
Gravel and clay	18	22
Huichica formation:		
Clay, yellow	57	79
Clay, blue	70	149
Clay, blue and yellow	100	249
Clay, blue	16	265

5/5-17J1

[I. Wisnom. Drilled by J. Larbre. On older alluvial plain. Altitude 70 ft. Cased from 0 to 284 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
Clay, sandy	42	42
Huichica formation:		
Clay, yellow	18	60
Clay, blue	79	139
Clay, yellow	11	150
Clay, blue	42	192
Clay, yellow	37	229
Clay, blue	52	281
Gravel	4	285

5/5-17N1

[Roquie Brothers. Drilled by O. J. Pearson. On older alluvial plain. Altitude 45 ft. Cased from 0 to 445 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
"Surface"	10	10
Clay, yellow, sand and gravel	155	165
Huichica formation:		
Clay, yellow	125	290
Clay, blue	155	445
Volcanic rock	10	455
Sand, fine	20	475

5/5-17R2

[J. Jacobs. Drilled by J. Larbre. On older alluvial plain. Altitude 58 ft. Cased from 0 to 359 ft]

	Thickness (feet)	Depth (feet)
Older alluvium and Huichica formation, undifferentiated:		
Soil	1	1
Clay, gray	140	141
Clay, blue	10	151
Clay, brown	10	161
Clay, gray	30	191
Clay, brown	15	206
Clay, blue	24	230
Clay, brown	16	246
Clay, blue	50	296
Clay, brown	4	300
Clay, brown	24	324
Gravel, cement	17	341
Undescribed	18	359

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*—Continued

5/5-18K1

[J. Von Dohlem. Drilled by J. Larbre. On older alluvial plain. Altitude 49 ft. Cased from 0 to 128]

	Thickness (feet)	Depth (feet)
Older alluvium:		
Dirt, gravel and clay, yellow-mixture	39	39
Clay, yellow and sand	45	84
Clay, blue	10	94
Clay, blue, sand and gravel	16	110
Sand, blue and gravel	18	128

5/5-19L1

[V. Sangiacomo. Drilled by J. Larbre. On older alluvial plain. Altitude 40 ft. Cased from 0 to 150 ft]

	Thickness (feet)	Depth (feet)
Older alluvium and Huichica(?) formation, undifferentiated:		
Soil	3	3
"Hardpan" and clay	70	70
Gravel	31	104
Clay, yellow	20	124
Gravel	26	150

5/5-19L5

[B. Colangelo. Drilled by J. Larbre. On older alluvial plain. Altitude 40 ft. Cased from 0 to 62 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
"Hardpan" and sand	37	37
Clay, yellow	23	60
Gravel and sand	5	65

5/5-20R1

[L. Miglioretti. Drilled by J. Larbre. At edge of older alluvial plain. Altitude 37 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
Sand and dirt	10	10
Huichica formation:		
Clay, yellow	90	100
Clay, brown-yellow	25	125
Water strata	2	127
Clay, green colored	73	200
Clay, blue	50	250
Clay, blue and sand	25	275
Clay, green colored	25	300
Clay, light blue	50	350
Clay, blue and gray colored	50	400
Clay, green colored	50	450
Clay, blue	25	475
Clay, blue	25	500
Clay, blue with sand	4	504

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/5-21E1		
[L. Miglioretti. Drilled by O. J. Pearson. At edge of creek. Altitude 40 ft. Cased from 0 to 250 ft]		
Huichica formation:		
Clay, blue	215	215
Gravel, free	6	221
Gravel, cemented and boulders	29	250
5/5-21R1		
[R. Tomassini. Drilled by J. Larbre. On older alluvial plain. Altitude 80 ft. Cased from 0 to 242 ft]		
Older alluvium:		
Soil	7	7
Clay, sandy	39	46
Huichica formation:		
Clay, yellow	70	116
Clay, blue	50	166
Clay, yellow	70	236
Clay, blue	6	242
5/5-22L1		
[L. Picetti. Drilled by O. J. Pearson. On hillside. Altitude 160 ft]		
Huichica formation:		
Soil	5	5
Clay, yellow	145	150
Gravel and sand	6	156
Clay, yellow	69	225
Clay, blue	55	280
Sand, blue	10	290
Sonoma volcanics:		
Lava rock, blue	40	330
Lava rock, red	70	400
Lava rock, blue	100	500
Undescribed	60	560
5/5-22L2		
[L. Picetti. Drilled by O. J. Pearson. On hill slope. Altitude 182 ft. Cased from 0 to 212 ft]		
Huichica formation:		
Soil	6	6
Clay, yellow	64	70
Sonoma volcanics:		
Lava rock, red	65	135
Volcanic ash, green	20	155
Lava rock, hard, black	45	200
Lava rock, brown	12	212

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/5-22Q1		
[B. Davitto. Drilled by O. J. Pearson. On hillside. Altitude 180 ft]		
Huichica formation:		
Soil	10	10
Clay, yellow	20	30
Clay, blue and sand	15	45
Clay, yellow, boulders	30	75
Clay, blue and sand	25	100
Clay, yellow and sand	30	130
Clay, yellow and boulders	85	215
Clay, brown and boulders	50	265
Clay, blue and boulders	35	300
Gravel and sand	15	315
Clay, brown	5	320
Clay, blue, sand, shattered rock	180	500
St. Helena rhyolite member:		
"Basalt"	42	542
5/5-27H1		
[C. Stornetta. Drilled by O. J. Pearson. On creek bank. Altitude 175 ft]		
Huichica formation:		
Soil	20	20
Clay, blue, some fine sand	30	50
Clay, blue, sticky	25	75
Clay, blue, some fine sand	35	110
Clay, blue, sticky	5	115
Clay, blue, fine sand, some gravel	53	168
Clay, blue, sticky	67	235
Clay, yellow, sticky	65	300
Sand and gravel	10	310
Clay, gray	50	360
Clay, blue	10	370
Clay, gray	10	380
Sonoma volcanics(?):		
"Tule mud," blue	43	423
Sand, blue, and shattered rock	42	465
Clay, red	5	470
Clay, blue	12	482
Sand, cemented and gravel	198	680
Sonoma volcanics:		
Basalt	70	750
5/5-30E1		
[J. Scarafoni. Drilled by O. J. Pearson. On creek bank. Altitude 25 ft. Casing perforated from 450 to 460, 525 to 540, 610 to 640 and 645 to 755 ft]		
Formations undifferentiated:		
Soil	10	10
Clay, blue	20	30
Gravel, free	20	50
Clay, yellow, sand and gravel	100	150
Clay, blue	75	225
Clay, yellow	125	350
Clay, yellow and sand	10	360
Clay, yellow	25	385
Sand and yellow clay	10	395
Sand and gravel	5	400
Clay, blue and sand	50	450
Gravel	10	460

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
5/530E1—continued		
Formations undifferentiated:—Continued		
Clay, blue, sand and gravel	15	475
Clay, yellow and sand	13	488
Clay, blue and sand	38	526
Gravel, free	12	538
Sand	17	555
Clay, blue and sand	5	560
"Tuff," white	17	577
Gravel, free	2	579
Clay, blue, sand and gravel	11	590
Clay, blue	15	605
Sand	5	610
Gravel, free and sand	20	630
Clay, blue and gravel	6	636
Gravel, free and sand	6	642
Gravel, cemented	3	645
Sand	5	650
Sand and gravel	5	655
Clay, blue	20	675
Clay, blue and sand	10	685
Gravel, free	12	697
Clay, blue and sand	8	705
Clay, blue	5	710
Sand and gravel	15	725
Clay, blue	5	730
Clay, blue, sand and gravel	10	740
Clay, blue	3	743
Sand and free gravel	12	755

5/5-31A1

[Ben Meyers. Drilled by J. W. Evans. On younger alluvial plain. Altitude 10 ft]

	Thickness (feet)	Depth (feet)
Formations undifferentiated:		
Undescribed	15	15
Gravel, water	2	17
Clay	25	42
Gravel, water	3	45
Rock and clay	4	49
Gravel, water	11	60
Clay, yellow	100	160
Clay, some water	7	167
Clay	28	195
Quicksand	10	205
Clay	20	225
Clay, gravel, some water	5	230
Clay, brown	15	245
Clay, white	103	348
Quicksand	4	352
Clay	28	380
Sand, flowing water	1	381
Clay	12	393
Sand, gravel, water	15	408

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)

5/5-31H1

[Jack Meyers. Drilled by J. Larbre. On younger alluvial plain. Altitude 7 ft. Cased from 0 to 153 ft]

Formations undifferentiated:		
Soil	7	7
"Muck," blue	41	48
Sand, salty water, cased off	3	51
Clay, blue	37	88
Clay, yellow	14	102
Clay, blue	100	202
Gravel	1	203

5/6-10K1

[W. J. Hillman. Drilled by J. Larbre. On older alluvial plain. Altitude 200 ft]

Older alluvium:		
"Hardpan" and boulders	70	70
Glen Ellen formation:		
Clay, yellow and boulders	85	155
Clay, blue	82	237
Sand, blue	2	239

5/6-13F1

[V. Leveroni. Drilled by J. Larbre. On younger alluvial plain. Altitude 62 ft. Cased from 0 to 105 ft]

Younger and older alluvium, undifferentiated:		
Clay	32	32
Gravel	16	48
Gravel and clay	20	68
Gravel	1	69
Gravel and clay	11	80
Gravel	20	100
Clay	8	108
Clay	2	110

5/6-13F2

[V. Leveroni. Drilled by J. Larbre. On younger alluvial plain. Altitude 66 ft. Cased from 0 to 105 ft]

Younger and older alluvium, undifferentiated:		
Clay	36	36
Clay, sandy	10	46
Gravel	16	62
Gravel and clay	3	65
Gravel	8	73
Gravel and clay	9	82
Gravel	12	94
Gravel and clay	4	98
Gravel	4	102
Clay	3	105

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*—Continued

5/6-14B2

[V. Leveroni. Drilled by J. Larbre. On older alluvial plain. Altitude 95 ft. Cased from 0 to 198 ft]

	Thickness (feet)	Depth (feet)
Recent alluvium:		
Soil	1	1
Topsoil and gravel	4	5
Gravel and boulders, water bearing	93	98
Older alluvium:		
Clay, yellow and boulders	49	147
Glen Ellen formation:		
Clay, blue	53	200

5/6-24K1

[M. Kiser. Drilled by J. Larbre. On younger alluvial plain. Altitude 41 ft]

	Thickness (feet)	Depth (feet)
Younger and older alluvium, undifferentiated:		
"Adobe" and sand	3	3
Gravel and rocks	19	22
Gravel	19	41
Gravel	10	51
Clay, yellow	41	92
Gravel	7	99
Clay, yellow	34	133
Gravel and clay	7	140
Clay, yellow	11	151

5/6-25P1

[Fisher. Drilled by J. Larbre. On older alluvial plain. Altitude 36 ft. Cased from 0 to 170 ft]

	Thickness (feet)	Depth (feet)
Older alluvium:		
Soil	3	3
Hardpan	19	22
Clay, yellow	47	69
Clay, blue	87	156
Clay, blue and sand	12	168
Sand	3	171

6/6-9R1

[I. Brown. Drilled by N. F. Keyt. On low hill top. Altitude 300 ft. Casing perforated from 65 to 170 ft]

	Thickness (feet)	Depth (feet)
Glen Ellen formation:		
Rock, brown	35	35
Clay, yellow and gravel	43	78
Clay, blue and gravel	94	172
Gravel	18	190
Clay, yellow and gravel	3	193

Table 22.—*Drillers' logs of water wells in Sonoma Vslley, Calif.*—Continued

6/6-16B1

[I. Holt. Drilled by J. Larbre. On hill slope. Altitude 400 ft]

	Thickness (feet)	Depth (feet)
Glen Ellen formation:		
Clay and rock	87	87
Clay, yellow	41	128
Clay, blue	22	150
Clay, yellow	34	184
Clay, blue	56	240
Clay, yellow	77	317
Shale, blue	35	352
Clay, volcanic red with gravel	74	426

6/6-16J2

[Panassie. Drilled by J. Larbre. On hillside. Altitude 260 ft]

	Thickness (feet)	Depth (feet)
Glen Ellen formation:		
Dirt	2	2
Hardpan, boulders	37	39
Boulders and clay	12	51
Boulders	5	56
Clay, yellow	37	93
Clay, blue	44	137
Clay, yellow	23	160
Shale, blue and gravel	40	200
No record	80	280

6/6-22R3

[Montmorency. Drilled by J. Larbre. On hillside. Altitude 190 ft]

	Thickness (feet)	Depth (feet)
Glen Ellen formation:		
Clay, yellow	90	90
Clay, blue	77	167
Quicksand	48	215
Clay, yellow	61	276
Clay, blue	40	316
Shale and rock	80	396
Sonoma volcanics:		
Solid rock	22	418

6/6-26E1

[D. Stamos. Drilled by J. Larbre. On terrace. Altitude 180 ft. Cased from 0 to 241 ft]

	Thickness (feet)	Depth (feet)
Older alluvium and Glen Ellen formation, undifferentiated:		
Soil	4	4
"Hardpan"	90	94
Gravel cement	14	108
Clay, yellow sandy	73	181
Gravel and clay	23	204
Sonoma volcanics:		
"Shale"	37	241
Rock drilling	63	304

Table 22.—*Drillers' logs of water wells in Sonoma Valley, Calif.*—Continued

	Thickness (feet)	Depth (feet)
6/6-34C1		
[P. Verdier. Drilled by J. Larbre. On cut terrace. Altitude 200 ft]		
Glen Ellen formation:		
Clay, yellow	23	23
Gravel and sand	2	25
Clay, yellow and gray	204	229
Clay, yellow	114	343
Clay, yellow and blue, slight mixture sand	157	500

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