Ground-Water Conditions in the Fernley-Wadsworth Area Churchill, Lyon, Storey and Washoe Counties, Nevada

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1619-AA

Prepared in cooperation with the Department of Conservation and Natural Resources, State of Nevada

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By W. C. SINCLAIR *and* O. J. LOELTZ

CONTRIBUTIONS TO HYDROLOGY OF THE UNITED STATES

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GROUND-WATER CONDITIONS IN THE FERNLEY-WADSWORTH AREA, CHURCHILL, LYON, STOREY, AND WASHOE COUNTIES, NEVADA

By W. C. SINCLAIR and O. J. LOELTZ

ABSTRACT

The Fernley-Wadsworth area is an irrigated farming district about 35 miles east of Reno, Nev. Part of it is in the valley of the Truckee River, but the major part is on the gently sloping plain north of the Virginia Range. About 20,000 acre-feet of Truckee River water is diverted annually from the Truckee-Carson Irrigation District canal to irrigate about 4,000 acres of land. The towns of Fernley and Wadsworth are local supply centers.

Precipitation at Fernley averages less than 5 inches a year, but in the bordering mountains it may be two or three times this amount. The average growing season is about 120 days.

Most of the rocks of the bordering mountains are of Tertiary age and are composed predominantly of volcanic rocks and some indurated lake sediments. The present bedrock topography is a result of block faulting during late Tertiary time. The consolidated rocks, which comprise the mountains and underlie the valleys, generally do not transmit ground water freely.

The valley fill is more than 1,000 feet thick in the vicinity of Fernley. It is composed mostly of lake sediments of Pleistocene age, which are predominantly silt and clay, interbedded with alluvium. Most of the upper 200 to 250 feet of the sediments were depositied in and along the shores of Lake Lahontan during late Pleistocene time and contain the principal aquifers in the Fernly area.

The principal source of ground water in the Fernley area is excess irrigation water that infiltrates to the ground-water reservoir. Ground water occurs in the valley fill under both unconfined (water table) and confined (artesian) conditions. The confined water generally occurs in the deeper aquifers. The altitude of the piezometric surface of the confined water generally is 10 to 20 feet below the altitude of the unconfined ground water.

The lake sediments contain much readily soluble material, and as a result the ground water in many areas is highly mineralized. The deeper aquifers contain water of good chemical quality along the south edge of the Fernley farm district, but north of this area they generally contain more highly mineralized water. The shallow aquifers generally contain water of good chemical quality, but locally they may contain highly mineralized water.

The beds of river gravel that underlie the Wadsworth area are recharged by the Truckee River and by ground water moving toward the Truckee River.

INTRODUCTION

PURPOSE AND SCOPE OF THE INVESTIGATION

This report is part of the statewide program of the U.S. Geological Survey in cooperation with the Nevada Department of Conservation and Natural Resources for evaluation of the ground-water resources of the State. The State is represented in the joint program by Hugh A. Shamberger, Director, Department of Conservation and Natural

Resources, and Edmund A. Muth, state engineer, Division of Water Resources, Department of Conservation and Natural Resources. The study was made under the supervision of Omar J. Loeltz, district engineer, Ground Water Branch, in charge of investigations in Nevada. Investigation of the Fernley-Wadsworth area was begun in June 1953 as a result of a request by residents of the Fernley area to the Governor of the State of Nevada for an appraisal of the ground-water resources of the area. Most of the available hydrologic data was collected in 1953 by O. J. Loeltz and J. L. Poole. An informal appraisal was given to the residents of the area at a local meeting, attended by the governor, within a month of the time the investigation was begun. Additional information, including periodic measurements of ground-water levels, was collected by C. P. Zones during 1953–56.

This report interprets and summarizes the data as they pertain to the occurrence, movement, chemical quality, and utilization of ground water in the Fernley-Wadsworth area. It also lists information on wells, selected logs, and chemical analyses, and shows the geographic distribution of these data. (See tables 1, 2, and 3, and pl. 1.)

PREVIOUS INVESTIGATIONS

Russell (1885) discusses the geologic history of Lake Lahontan, which once covered a large part of northwestern Nevada including the Fernley-Wadsworth area, and describes the lake sediments, which are exposed in the banks of the Truckee River north of Wadsworth. A soil survey of the Fernley farm district which was published in 1945 by the Soil Conservation Service, U.S. Department of Agriculture, includes a map of the soil types of the area and makes recommendations as to their use and limitations.

ACKNOWLEDGMENTS

The cooperation of the residents of the area in supplying well data and in allowing water-level measurements and pumping tests to be made during this investigation is very much appreciated. Pertinent data in the files of the Truckee-Carson Irrigation District in Fallon, the U.S. Bureau of Reclamation in Carson City, and the Soil Conservation Service of the U.S. Department of Agriculture in Reno, which were made available to the writers by these agencies, were most helpful in compiling this report.

NUMBERING SYSTEM FOR WELLS AND SPRINGS

The number assigned to a well or spring in this report is both an identification and a location number. It is referrenced to the Mount Diablo base and meridian of the General Land Office. A typical number consists of three units. The first unit is the number of the township north of the Mount Diablo base. The second unit, separated from the first by a slant, is the number of the range east of the Mount Diablo meridian. The third unit, separated from the other two units by a dash, is the number of the section followed by a letter which designates the quarter section and a second letter which designates the quarter-quarter section; thus, locating the well within a 40-acre tract. A number following the letters indicates the order in which the well or spring was recorded within the 40-acre subdivision. The letters *a*, *b*, *c*, and *d*, designate, respectively, the northeast, northwest, southwest, and southeast quarters of the section and quarter section. For example, well number 20/24–12dc2 designates the second well recorded in the SW¼SE¼ sec. 12, T. 20 N., R. 24 E., Mount Diablo base and meridian.

GEOGRAPHICAL SKETCH

Fernley and Wadsworth are neighboring towns, about 2 miles apart, in west-central Nevada, about 35 miles east of Reno (fig. 1). The two

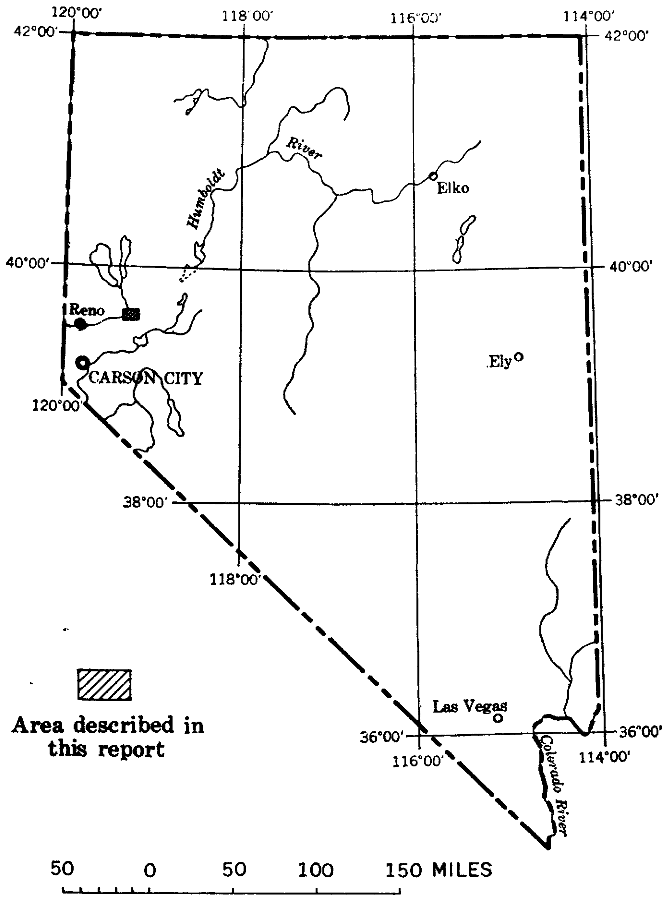

FIGURE 1.—Map of Nevada showing area described in the present report.

towns were developed along the Southern Pacific railroad, which was built along one of the early emigrant routes to California. In addition to the railroad, the area is now traversed by U.S. Highways 40, 95, and alternate 95.

The population of Fernley, according to the Nevada Industrial Commission, was 650 in 1957; Wadsworth is much smaller. The economy is based largely on an irrigated-farm district of about 4,000 acres, the railroad, highway traffic, and the processing of diatomaceous earth, which is quarried in the nearby mountains.

Fernley lies at an altitude of 4,153 feet on a plain, which occupies the gap between the Virginia Range on the south and the Truckee Range on the north. East of Fernley, between the Truckee Range and the Hot Springs Mountains, the gap widens into a northward trending valley which contains alkali flats and playa lakes fed mainly by excess irrigation water from the Fernley farm district.

Wadsworth is on a terrace of the Truckee River, which rises in the Sierra Nevada about 50 miles to the west. The river enters the study area a few miles southwest of Wadsworth through a gap between the Virginia and the Pah Rah Ranges. It turns northward at Wadsworth, and about 15 miles farther downstream it terminates in Pyramid Lake (fig. 1).

Since 1905, an average of about 300 cfs (cubic feet per second) of water has been diverted from the Truckee River into the Truckee Canal at Derby Dam, which is 11 miles upstream from Wadsworth. The canal trends eastward along the south edge of the Fernley farm district and thence to Lahontan Reservoir, about 20 miles southeast of Fernley. About 20,000 acre-feet of water is diverted from the canal each season for irrigation of the farm district at Fernley.

CLIMATE

The climate is semiarid. The average annual precipitation at Fernley, according to incomplete records of the U.S. Weather Bureau, is only about 4.7 inches, most of which occurs in the winter. Consequently, irrigation is necessary for successful farming. On the basis of a precipitation map prepared by Hardman (1936), it is estimated that precipitation in the surrounding mountains may be two or three times the precipitation at Fernley.

Recorded temperatures range from a maximum of 106°F to a minimum of −16°F. The average temperature for July is 73.7°F and that for January is 34.1°F. The average date of the last killing frost in the spring is May 25, and that of the first killing frost in the fall is September 25, indicating an average growing season of about 120 days. The relative humidity is low, and sunshine is abundant.

GEOLOGY

SUMMARY OF GEOLOGIC HISTORY

The rocks exposed in the mountain ranges surrounding the Fernley-Wadsworth area are mostly of Tertiary age. They are predominantly of volcanic origin, although they also include some indurated fresh-water sediments.

During the latter part of the Tertiary Period, block faulting raised the mountain ranges relative to the valley floors and outlined roughly the present bedrock topography. The displacement along the faults is known to exceed 3,000 feet, because the deepest well in the Fernley area, well 20/24–14aa3, at 1,026 feet in depth did not penetrate bedrock, and the bordering peaks are more than 2,000 feet above the valley floor.

Erosion of the uplifted blocks during and after the faulting has partly filled the valleys with sediments. The maximum thickness of the valley fill is unknown, but it is at least 1,026 feet.

The climatic fluctuations of the Pleistocene Epoch resulted in a series of lakes which intermittently covered a large part of western Nevada. The most recent of these, Lake Lahontan, was described by Russell (1885). The lake has recently been studied in greater detail by Roger Morrison (1963) of the U.S. Geological Survey who mapped more than 70 different lake stages. The Fernley-Wadsworth area was inundated during four major periods of high lake level, and the history of the lake is reflected in the complexity of the sediments and the shoreline features in the foothills.

The highest level of the lake is defined by a terrace, which is most noticeable along the north side of the Virginia Range south of Fernley, at an altitude of somewhat less than 4,400 feet. The last stage of high water in the Fernley-Wadsworth area was slightly less than 4,200 feet. Several other stages are represented by gravel deposits on the slopes south of Fernley, but the features of most of the lake stages, especially the lower ones, have been covered by the sediments of later stages.

Several periods of high water in Recent time raised the level of Pyramid Lake sufficiently to bring the lake to a point only a few miles north of Wadsworth. The gradient of the Truckee River was thereby decreased and caused the river to meander and widen its valley to its present extent. The reentrant in the valley bluff southeast of Wadsworth, through which U.S. Highway 40 passes, is the abandoned channel of a stream that drained part of the Virginia Range during the periods of more humid climate which caused the high lake levels. As the waters of Lake Lahontan receded for the last time, the base level of the Truckee River was again lowered and the river began to entrench itself into the older valley floor. Today the older valley floor in the vicinity of Wadsworth is a terrace about 20 feet above the bed of the river.

PHYSICAL CHARACTER AND WATER-BEARING PROPERTIES OF THE ROCKS

BEDROCK

The interstitial permeability of the volcanic rock and the older indurated lake sediments, which in large part compose the bedrock, appears to be very low. Furthermore, the springs and seeps in the mountains are small and issue almost entirely from fractures in the bedrock. The bedrock, therefore, will probably not yield water to wells at appreciable rates unless one or more permeable fracture zones are intercepted. The chances of intercepting such zones are so poor that the bedrock, whether in the mountains or buried beneath the valley fill, is not considered to be a practical source of ground water.

VALLEY FILL

ALLUVIUM

Most of the alluvium is of Pleistocene age and is composed of unconsolidated stream-laid debris, ranging in size from boulders to clay. Commonly it is poorly sorted and not very permeable. Where it is composed of well-sorted sand or gravel, however, it yields moderate to large amounts of water to wells.

Alluvial deposits are exposed along the flanks of the mountains. Wells drilled in these deposits generally are satisfactory for watering stock, although the water level may be a considerable distance below the land surface. In well 19/25–6cc1, for example, the depth to water reportedly is 195 feet (table 2).

In the floor of the valley, the alluvium is buried by lake sediments. During the periods between high lake stages, alluvium was transported farther into the valley and was reworked and sorted by the advancing waters of a later high-water stage which subsequently covered the alluvium with silt and clay. These reworked layers of alluvium probably are tapped by some of the wells in the Fernley area. Their increased permeability is due principally to the good sorting produced by wave action of the encroaching lake. Because these deposits were formed by wave action, they are more properly classified as lake sediments and are discussed under that heading.

LAKE SEDIMENTS

Fernley is underlain by a sequence of lake sediments which may be 1,000 feet or more thick. Most of these sediments in the upper 200 to 250 feet of the sequence were deposited in Lake Lahontan during

Pleistocene time, whereas the deeper sediments were deposited in lakes of earlier Pleistocene age and possibly even in lakes of late Tertiary age.

This great thickness of sediments is composed predominantly of silt and clay, which are deep-lake deposits, separated by layers of sand and gravel that accumulated during shallow stages of the lakes and during periods of desiccation.

As the lake levels rose, the valley fill was reworked by wave action along the encroaching shoreline. Where the lake stood at one level for an extended period, wave and current action formed beach deposits of sand and gravel, whereas farther offshore the finer materials, silt and clay, were deposited in the deep, still water. Further encroachment caused these beach deposits to be buried by younger deep-water sediments and caused new beach deposits to be formed farther up the alluvial slopes. As the water receded in a similar halting manner, it left the hillsides terraced with the history of its retreat.

The sand and gravel strata are the most important aquifers in the lake sediments. Many of the better wells in the area tap some of these strata. For example, well 20/24–24bb2, which furnishes the municipal water supply for Fernley, is finished in sand and gravel at the base of the Lahontan section and is reported to yield 1,000 gpm (gallons per minute) with a drawdown of only 35 feet.

The northwestward-trending gravel spit in secs. 14, 23, and 24, T. 20 N., R. 24 E., is an example of one of the better sand and gravel aquifers. This shore feature developed at the junction of the longshore currents of Lake Lahontan and the mouth of the stream whose dry bed now parallels the west side of the spit. The combination of factors that caused the formation of the spit was probably active throughout much of Lake Lahontan's existence, and, therefore, beds of well-sorted gravel similar to those exposed are probably present at depth along the trend of the spit.

Many of the strata reported as clay or sandy clay in the drillers' logs (table 3) are probably interlaminated layers of thinly bedded clay and sand similar to the sediments exposed in the face of the valley bluff east of Wadsworth. The sand strata form many small independent aquifers which may yield small amounts of water to properly constructed wells.

RIVER DEPOSITS

The terrace on which the town of Wadsworth is built is underlain by deposits of the Truckee River. The river deposits are of late Pleistocene and Recent age. Although the deposits range in size from silt to boulders, they contain many strata of well-sorted sand and gravel and thus should yield water at relatively high rates to properly constructed wells.

GROUND WATER

OCCURRENCE AND MOVEMENT

Most of the recoverable ground water in the Fernley-Wadsworth area is in the unconsolidated sediments of the valley fill. Where the valley fill consists either of fine-grained material, such as silt and clay or of poorly sorted alluvium, the permeability is very low, and only small yields can be expected from wells. In contrast, beach deposits and other well-sorted sand and gravel strata have moderate to high permeabilities and will yield water readily to wells.

Water in the uppermost, or shallow, aquifers of the Fernley area generally is under water-table, or unconfined, conditions. In the deeper aquifers, however, the water generally is under artesian, or confined, conditions. The altitude of the piezometric surface of the water in the deeper aquifers generally is 10 to 20 feet lower than the altitude of the water level in the overlying shallow aquifers. Example of exceptions to this general rule are the deeper aquifers at the south edge of the farming district near Fernley. These aquifers are not overlain by shallow aquifers, and the water in them apparently is not confined.

In the Wadsworth area the data are inadequate for determining where confined and unconfined conditions exist. However, the water in the uppermost aquifer probably is unconfined.

In moving from recharge to discharge areas, ground water flows in the direction of lower head just as surface water does. The movement, however, is much slower, the rate ranging from a few feet a year to several hundred feet or more a day. In the Fernley-Wadsworth area, the rate of movement undoubtedly covers a rather wide range because of the probable wide ranges in the permeability of the aquifers and the hydraulic gradients. Although the range is not known, the average rate probably is a few hundred rather than a few thousand feet a year. In the study area the principal area of recharge is the irrigated cropland south of Fernley. This is shown on plate 1 by the pronounced ground-water mound that underlies the irrigated area. The water moves from this recharge area to areas of discharge, of which the principal ones are the playa (alkali flat) areas north and east of Fernley and the valley of the Truckee River near Wadsworth (see pl. 1.).

Although the control is inadequate to extend the water-level contours more than about 1 mile east of Fernley, it is inferred that the shallow ground water beneath the irrigated lands east of the area shown on plate 1 is moving northward to the playa. The shallow water beneath the Wadsworth area also is moving northward, at a gradient controlled by the Truckee River.

The available data were insufficient to warrant drawing a piezometric surface for the artesian water in the Fernley area, but the data suggest that the artesian water also is moving northward to the playa and northwestward to the valley of the Truckee River.

RECHARGE

Ground-water recharge in the Fernley-Wadsworth area is effected by (1) infiltration of precipitation, (2) infiltration from streams and canals, (3) underflow from the surrounding highlands, and (4) infiltration of irrigation water.

INFILTRATION OF PRECIPITATION

Precipitation in the valley averages somewhat less than 5 inches a year (p. AA4), almost all of which is evaporated or transpired before reaching the water table. Thus the annual recharge to the ground-water reservoir from direct precipitation is negligible.

INFILTRATION FROM STREAMS AND CANALS

The water in the river deposits underlying Wadsworth probably is in hydraulic continuity with the Truckee River. The river is a source of recharge to the shallow ground water in the Wadsworth area only when the river stage is higher than the surrounding ground-water level. Although the historic recharge from this source is considered negligible, large withdrawals from the aquifers in the Wadsworth area could induce substantial recharge from the river.

Leakage from the Truckee Canal in the 31 miles between Derby Dam and Lahontan Reservoir has been estimated at about 35,000 acre-feet annually, nearly 16 percent of the total average flow of about 220,000 acre-feet per year.[1] The leakage in the immediate vicinity of Fernley probably is only a small fraction of this amount, principally because the underlying lake sediments are relatively impermeable; however, even if the leakage is only a thousand acre-feet a year, it is a significant source of ground-water recharge. Several of the distributary canals are filled with water most of the year, and leakage from these also is a source of ground-water recharge.

UNDERFLOW FROM THE SURROUNDING HIGHLANDS

Most of the underflow to the Fernley area results from the infiltration of recharge from precipitation in the drainage basin south of Fernley.

On the basis of the precipitation map prepared by Hardman (1936), it is estimated that the average annual precipitation in this drainage area is about 20,000 acre-feet; however, only a small percentage of the precipitation recharges the ground-water reservoir, because most of it either evaporates or is transpired before it reaches the water table.

[1] U.S. Bureau of Reclamation, 1949, Truckee Canal loss study: Carson City, Nev., open-file rept.

One method that has been used to estimate recharge to other ground-water basins in Nevada is to assume that a fixed percentage of the precipitation within each of the percipitation zones mapped by Hardman recharges the ground-water reservoir. Seven percent is used for the 12- to 15-inch zone and 3 percent for the 8- to 12-inch zone. It is assumed that the recharge is negligible in zones in which the precipitation is less than 8 inches. According to Hardman's map, approximately 6 square miles are in the 12- to 15-inch zone and about 12 square miles in the 8- to 12-inch zone. If one uses the percentages given above, the average annual recharge to the Fernley area as a result of precipitation is computed to be about 500 acre-feet.

INFILTRATION OF IRRIGATION WATER

The 4,000 acres under cultivation in the Fernley farm district receive an average of 20,000 acre-feet of surface water per year. Because the amount of water applied is about twice the average consumptive use of the crops that are commonly grown, half the water, or about 10,000 acre-feet, is available for evapotranspiration, runoff, and recharge to the ground-water reservoir. The proportion of this excess water that recharges the ground-water reservoir is not known, but the rise of ground-water levels under several sections of land during the irrigation season suggests that the average annual recharge is at least several thousand acre-feet. Excess irrigation water is thus the largest source of recharge to the ground-water reservoir.

WATER-LEVEL FLUCTUATIONS

Figure 2 shows the relation between monthly precipitation, monthly diversions for irrigation, and fluctuations of water levels in four selected wells for most of 1953 and 1954. The effects of precipitation, evapotranspiration, pumping, and other factors which in other areas generally cause the largest water-level fluctuations are overshadowed in the Fernley area by the response of water levels to the spreading of water for irrigation.

Periodic measurements of water levels were made at 14 other wells during this same period. These measurements show that in shallow wells fluctuations generally are greatest in the southern part of the farm district in the S½ sec. 14, and the SW¼ sec. 13, T. 20 N., R. 24 E., where the annual fluctuations may be as much as 15 feet. The annual fluctuations in shallow wells decrease to the east and north until, in the vicinity of Fernley and northward, they are only a few feet. Water levels in wells deeper than about 50 feet appear to fluctuate with and at about the same magnitude as the water levels in shallow wells in the southern part of the irrigated district, although the head in the deeper aquifers is 10 to 20 feet less than that in the shallow aquifers.

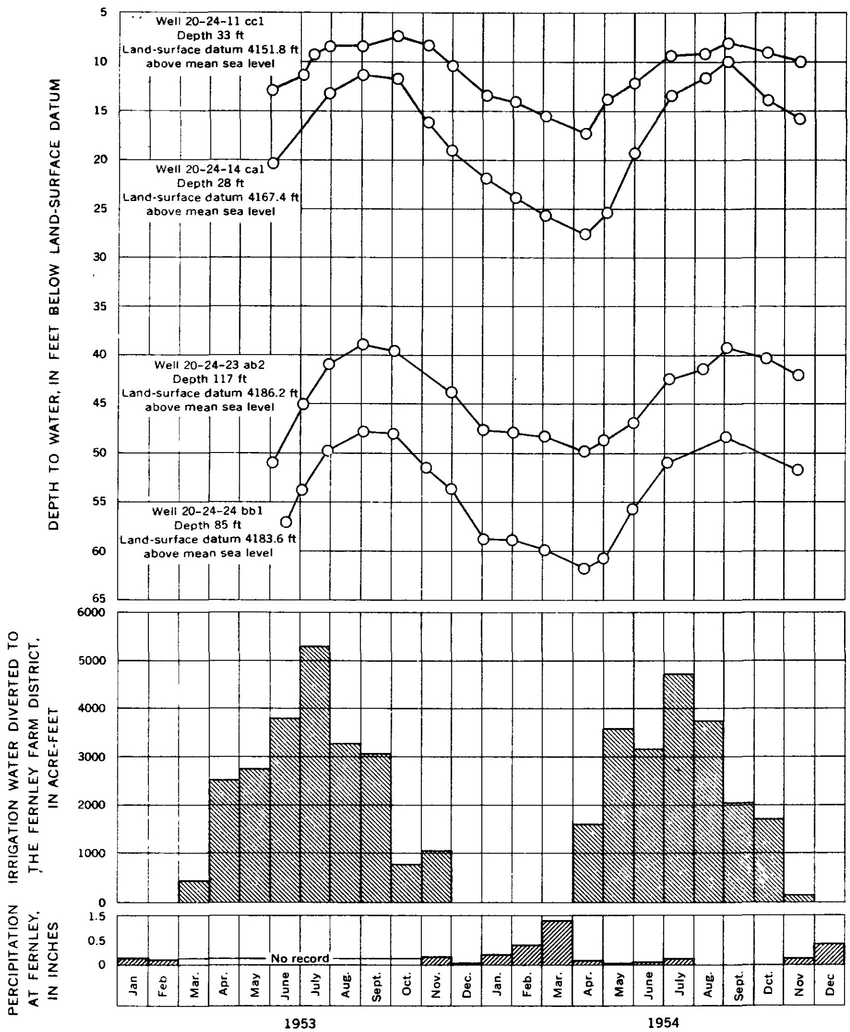

FIGURE 2.—Graphs showing the relation between monthly precipitation, monthly diversion of irrigation water, and fluctuations of water levels in four selected wells.

One plausible explanation for this pattern of fluctuations is that in the southern part of the irrigated area some of the shallow ground water is moving downward to the deeper aquifers through semi-impervious strata. Although the shallow water is in hydraulic continuity with the water in the deeper aquifers, it loses considerable head during its vertical movement. The strata of relatively low permeability that separate the shallow and deeper aquifers become less permeable to the north until movement of water between the shallow and deeper aquifers is negligible. As a result, north of about the middle of secs. 13 and 14, the water-level fluctuations in the two systems are relatively independent.

In the northern part of the district, along U.S. Highway 40, where the water in the deeper aquifers is confined, water levels respond quickly to changes in head of the water in the deeper aquifers near the south edge of the irrigated land. Consequently, beneath and north of the town of Fernley the water-level fluctuations in the deeper aquifers have several times the magnitude of water-level fluctuations in the shallow aquifers.

Water levels in the Wadsworth area evidently respond principally to changes in stage of the Truckee River. In 1953 and 1954 the water levels in wells 20/24–3bc2 and 20/24–3bc3 fluctuated only 1 or 2 feet, and they had no apparent relation to the water diverted for irrigation in the Fernley area.

QUALITY OF WATER

Most dissolved solids in ground water are acquired by the solution of constituents of the soil and rocks through which the water percolates. In general, the degree of mineralization of the water is determined by the solubility of the rock or soil, the area and duration of contact, and other factors, such as pressure and temperature.

Because Lake Lahontan and its predecessors had no outlet, continued evaporation caused the lake waters to become increasingly saline. When the concentration of minerals exceeded the saturation point, the minerals precipitated out of solution and eventually were buried in the lake sediments. Thus, the sediments in the Fernley area contain much readily soluble material that is capable of markedly increasing the mineral content of relatively fresh ground water as it percolates through them.

Chemical analysis of water from selected wells, springs, and surface-water sources in the Fernley-Wadsworth area are given in table 1. Sodium and sulfate ions commonly are the major constituents of highly mineralized water in the Fernley area. The degree to which fresh water can become mineralized as it passes through the sediments is shown by the increase in dissolved solids of relatively fresh canal water as it moves to discharge areas north of Fernley. Table 1 shows that the concentration of dissolved solids in the canal water is only 128 ppm (parts per million) before it is diverted but that by the time it reaches the pond in sec. 12, T. 20 N., R. 25 E., the concentration has increased to about 3,220 ppm.

The probability of obtaining water of satisfactory chemical quality in a given area can be predicted best on the basis of the quality of water from wells in the area. Wells south of Fernley, along the flank of the Virginia Range, yield water from the deeper aquifers that is generally of satisfactory chemical quality for most uses. Water from these aquifers becomes increasingly saline toward the north until, near

TABLE 1.—*Chemical analyses of water from the Fernley-Wadsworth area*

[Source of data: N, Univ. Nevada; Agr. Expt. Sta., Dept. Food and Drugs, Public Service Div.; S, Southern Pacific Co.; and U, U.S. Geol. Survey]

Well or spring or other source	Source of data	Date collected	Constituents, in parts per million												pH
			Dissolved solids	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Hardness as $CaCO_3$	
Ground water															
19/25-6cc1	N	8-29-39	320	85	Trace	42	10	11		160	0	41	40	146	--
20/24-3bb1	S	2- 4-39	318	--	--	--	--	--	--	--	--	--	--	--	--
3dd1	N	8-27-49	850	--	--	--	--	--	--	412	48	--	40	--	--
4aa1	N	(?)	434	--	--	--	--	--	--	149	--	23	0	--	--
9da1	N	2-13-47	232	--	--	--	--	--	--	--	--	--	--	--	--
10da2	N	4- 7-52	557	--	--	--	--	--	--	239	0	--	28	--	--
11cd2	N	9-14-46	655	43	Trace	68	23	119		295	24	185	34	264	--
11dc3	--	1-16-39	415	18	Trace	78	18	54		305	0	115	12	--	--
11dd4	N	4-24-50	1,240	--	--	--	--	--	--	472	0	--	80	--	--
11dd6	--	4-18-31	2,960	40	Trace	180	55	670		317	0	1,590	148	676	--
12cc1	N	4-25-49	681	--	--	--	--	--	--	307	6	--	31	--	--
13ad1	N	5- 4-49	483	--	--	--	--	--	--	246	3	--	44	--	--
13cc1	N	4-28-47	340	--	--	--	--	--	--	--	--	--	--	--	--
14aa1	N	6-15-49	2,720	--	--	--	--	--	--	--	--	--	--	--	--
14aa2	N	12-31-48	2,030	37	Trace	151	48	443		439	Trace	1,110	50	570	--
14ac1	N	4-17-51	678	--	--	--	--	--	--	332	7	--	26	--	--
14ba1	N	2- 4-47	312	60	Trace	48	13	22		283	0	74	21	--	--
14cd2	N	1-31-52	682	--	--	--	--	--	--	400	0	--	31	--	--
14dc1	N	2-20-57	362	--	--	--	--	--	--	295	22	--	13	--	--
23ab1	N	1-10-52	1,500	--	--	--	--	--	--	298	1	365	101	--	--
23ab2	N	1-12-53	582	--	--	--	--	--	--	322	7	--	27	--	--
24bb2	U	5-17-60	220	37	0.00	30	11	24	5.5	184	0	10	11	120	7.1
35cc1	U	5-17-60	324	32	.01	42	19	37	3.8	202	0	68	22	182	7.9
20/25-18ba1	N	6- 1-40	1,210	25	Trace	54	13	344		342	Trace	580	37	188	--
18ba2	--	11- 4-36	163	15	Trace	27	Trace	24		110	0	21	10	68	--
19bb1	N	9- 3-47	4,190	90	Trace	242	75	984		383	0	2,400	170	--	--
19bc1	N	4-24-50	2,410	--	--	--	--	--	--	367	0	--	252	--	--
19cb1	N	11- 1-49	1,420	--	--	--	--	--	--	320	26	--	182	--	--
19da1	N	11- 3-52	404	--	--	--	--	--	--	400	0	--	17	--	--
20bd1	N	3- 8-49	1,290	--	--	--	--	--	--	422	0	584	22	--	--
21ac1	N	12-24-51	737	--	--	--	--	--	--	476	0	140	60	--	--
Surface water															
Irrigation canal: NE¼ sec. 23 T20N R24E	U	5-17-60	128	21	.01	14	4.1	19	2.7	73	0	16	12	53	7.8
Pond; excess irrigation water: NW¼ sec. 12 T20N R25E	U	5-17-60	3,220	11	.03	72	61	922	46	450	0	1,440	445	430	8.1
Playa lake: NW¼ sec. 26 T21N R25E	U	5-17-60	101,000	8.3	.03	449	658	34,700	899	306	70	18,700	45,600	3,820	8.4

U.S. Highway 40, the chemical quality of water from most of the wells deeper than 50 feet is unsatisfactory for most uses.

In Wadsworth and along the Truckee River, moderate yields of water probably can be developed from aquifers at shallow to moderate depths in the underlying river deposits (pl. 1). The quality of the water in this area, however, may be impaired by the infiltration of nitrates from the Truckee River and by contributions of highly mineralized water from the bordering Lahontan sediments.

UTILIZATION OF GROUND WATER

In 1958 Fernley established its first municipal water-supply system. The successful completion of well 20/24–24bb2 whose site was selected on the basis of information obtained during the early part of the present study, in large part resulted in the establishment of the municipal water system. As a result, many of the privately owned wells (table 2) in the area served by the system are no longer in use. Beyond the limits of the municipal distribution system, privately owned wells are still used for domestic supplies and also, to some extent, for watering stock. Ground water is not used for irrigation and is not likely to be used for this purpose to any significant extent in the near future because: (1) much of it is not of satisfactory chemical quality, (2) adequate yields may not be obtainable in many areas, and (3) ample canal water is generally available.

The sand and gravel deposits, which compose the better aquifers within the Lake Lahontan sediments in the Fernley area, are irregular in areal extent, thickness, and depth. Because of this condition and because the water in much of the area is highly mineralized, it is desirable for anyone planning to develop ground water to have a basic understanding of conditions under which the ground water occurs. Otherwise, unnecessary risk may be taken in the search to obtain a supply whose yield and chemical quality are both satisfactory and are likely to remain so indefinitely.

One of the better areas for the future development of ground-water supplies probably is in the vicinity of the northwest-trending gravel spit in secs. 14, 23, and 24, T. 20 N., R. 24 E. (p. AA7).

In the Wadsworth area, water is obtained from wells that tap the river deposits although underflow of mineralized water from the surrounding Lahontan sediments, and nitrates from the Truckee River are sources of contamination.

CONCLUSIONS

The principal source of ground water in the Fernley area is water that infiltrates from irrigation in the farm district. This water has flushed the salts from the sediments to some extent and has made it possible in much of the area to obtain water of a chemical quality satisfactory for domestic use.

From the available evidence, water from the deeper aquifers is likely to be highly mineralized, except locally along the southern part of the farm district. Well 20/24–24bb2, which furnishes the municipal supply for Fernley, gives an indication of the quality and the yield that is obtainable from wells tapping the deeper aquifers in the more favorable areas.

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TABLE 2.—*Records of wells and springs*

Well or spring: See explanation on p. AA2-AA3.
Use: D, domestic; Ind, industrial; N, not used; P, public supply; S, stock; Irr, irrigation.
Depth to water: In feet below land-surface datum; M, measured; R, reported.
Altitude: Land-surface datum, in feet above mean sea level; E, estimated from U.S.G.S. topographic quadrangle, Two Tips, Nev., 1957, or Wadsworth, Nev., 1957.
Remarks: Log numbers are State Engineer of Nevada file numbers; L, log in table 3; analysis, chemical analysis in table 1.

Well or spring	Owner	Date drilled	Diameter (inches, at land surface)	Reported depth of well (feet)	Aquifer	Depth of intake (feet)	Altitude	Depth to water	Date	Use	Remarks
19/24-8aa1					Alluvium		5,160 E	0 M	5-17-60	S	Spring; no flow.
9dd1					Volcanic rock		5,020 E	0 M	5-17-60	S	Spring; flow ½ gpm.
19/25-6cc1	U.S. Bur. Land Management.	12-40	6	242	Sand and gravel	225-227	4,470 E	195 R	12-40	S	Analysis.
20/24-3bb1	Southern Pacific Co.		30	30			4,075 E			P	Do.
3bc1	F. J. Roberti		6				4,068.6	18.9 M	6-4-53	D	
3bc2	C. V. Hamlin		6	23			4,070 E	17.7 M	6-4-53	N	
3bc3	do		6	75	Gravel		4,068.7	17.4 M	6-4-53	D	
3cc1	Crosby		6	45						D	
3cc2	do	4-60	6	60	Gravel	43-60	4,070 E	21 R	4-12-60	D	Log 5196; L.
3dd1		Spring			Lake beds		4,094.9	0	6-15-53	N	Analysis.
4aa1	I. M. Stipes		6	33		30-33	4,100 E	31.5 R	4-49	D	Analysis; log 928.
4aa2	E. R. Short	12-56	6	53	Sand and gravel	40-53	4,100 E	42 R	12-10-56	D	Log 3610; L.
4dc2	Harold Depaoli	12-57	6	60	do	20-60	4,080 E	32 R	12-18-57	D	Log 3952; L.
8ca1	V. Cantlin	4-60	6	49	Gravel	32-48	4,120 E	18 R	4-14-60	D	Log 5195; L.
9da1	Truckee - Carson Irrig. Dist.		6	115			4,180 E	61.4 M	6-4-53	D	Analysis.
10da1	J. Randal		5				4,135.7	16.5 M	6-4-53	D	
10da2	John Day		4	40			4,142.1	15.2 M	6-4-53	D	Do.
11cc1	Nevada Dept. Highways.		6	33			4,151.8	12.8 M	6-3-53	Ind	
11cc2	Floyd Phillips	12-47	6	37	Sand	27-37	4,150 E	15 R	12-47	D	Log 330.
11cd1	Dr. Hartsock	10-46	8	220	Sand and gravel	156-220	4,145.2	27.4 M	10-9-46	N	Log 1071; L.
11cd2	Garden Motel		4	35			4,150.5	0.5 M	8-29-46	P	Analysis.
11cd3	do	3-54	6	32	Sand	20-30		12 R	3-8-54	P	Log 2494.
11cd4	Fred W. Braske	1-48	6	35	do	27-35		14 R	1-48	D	Log. 331.
11dc1	Autoyre Co.	9-52	14	672	do	36	4,150 E	12.0 M	6-4-53	N	Log 2045; temp. 64°F.
11dc2	A. Hanneman		6	38			4,150.2	4.4 M	6-19-53	D	
11dc3	A. Kramer	1932	8	28			4,150.5	5.0 M	6-18-53	D	Analysis.
11dc4	do		6	30		25-27	4,150.1	4.6 M	6-16-53	D	
11dc5	Wayne Davis	6-55	6	22	Sand	16-22	4,150 E	7 R	6-17-55	D	Log 3062.
11dd1	Chick Bed Co.	10-52	6	137	Sand and gravel	128-134	4,150.9	30 R	10-52	Ind	Log 2264.
11dd2	Marie Warren	1929	6	35			4,150.1	6.9 M	6-16-53	P	
11dd3	do	5-57	6	31	Sand	23-31		8 R	5-30-57	P	Log 3790.
11dd4	R. J. Jennings	4-50	6	42	Sand	38-42	4,149.7	4.8 M	6-30-53	P	Analysis; log 1692.
11dd5	do	6-53	8	45	do	31-43	4,150 E	5.4 M	6-16-53	P	Log 2265.
11dd6	G. F. Campbell		12	44				3.6 M	8-29-46	D	Analysis.
12ad1	C. A. Arnold		36				4,135 E	9.7 M	6-4-53	D	

12cc1	L. Garaventa		5	19			4,149.0	4.6 M	6- 4-53	D	Do.
12dc1	C. W. Smith		6	42			4,150 E	11.0 M	7-15-53	D	
12dc2	Mrs. A. E. Wilkins		6	44	Fine sand	0-44	4,150 E	10.0 M	7-15-53	D	Log 1605.
13aa1	R. F. Bunkett	2-59	6	31	Sand	25-31	4,150 E	5 R	2- 3-59	D	Log 4403.
13aa2	L. O. Bassham	4-59	8	26	do	12-16	4,150 E	5 R	4-28-59	D	Log 4539.
13aa3	Lee Shepard		6	21			4,130 E	2.1 M	6- 4-53	Irr	
13ad1	P. Abel	5-49	6	22	Sand	10-20	4,150 E	2 R	5-49	D	Analysis; log 930.
13ba1	Westerland						4,157.8	12.7 M	8- 5-60	P	
13cb1	A. B. Jackson		6	93			4,170.8	32.9 M	6-16-53	D,S	
13cc1	Jerry Olson			60			4,181.1	18.6 M	6-30-53	D	Analysis.
13db1	Carlo Ronegialli	1932	6	21			4,157.5	7.9 M	8- 5-60	D	
14aa1	David Williams		6	31	Sand		4,149.2	6.9 M	6-10-53	P	Analysis; log 1383.
14aa2	Joe Strauss		6	133	Sand and gravel	121-133	4,149.2	31.4 M	6-30-53	D	Analysis; log 646; L, temp 62°F.
14aa3	Fernley School	1953	24	1,026			4,149.5	40.0 M	6- 3-53	N	
14aa4	John Urrizar	1-48	6	150	Gravel(?)	115	4,150 E	32.4 M	7- 7-53	P	
14aa5	Marco Boscovich		6	65			4,159.9	10.3 M	6-16-53	N	
14aa6	do		6	26			4,160 E	9.3 M	6-30-53	D	
14ab1	James Johnson		6	30			4,153.7	4.6 M	6-16-53	D	
14ab2	Richfield Oil Co	9-53	6	45	Sand	25-45	4,150 E	4 R	9-29-53	P	
14ab3	J. S. Pray	4-56	6	17	Coarse sand	11-17	4,150 E	8 R	4-13-56	D	Log 3384.
14ab4	J. Kramer	3-48	6	37	Sand and fine gravel	30-37	4,150 E	3.6 M	7- 7-53	D	Log 415, temp 55°F.
14ac1	P. J. McCart	4-51	6	84	Sand	84	4,166.8	24.5 M	7- 6-53	D	Analysis; temp 60°F.
14ad1	P. J. Mortenson		6	23			4,163.9	6.2 M	6-36-53	D	
14ad2	do		6	32			4,167.8	3.2 M	6-30-53	P	
14ba1	D. D. Jackson		6	23			4,150 E	4.0 M	8-23-46	D	Analysis.
14ca1	Rudolf Miller		4	28			4,167.4	20.4 M	6- 3-53	N	
14ca2	do	1-52	6	79	Sand	69-79	4,170 E	18 R	1-52		Log 1884.
14cb1	do		5	36			4,170 E	7.6 M	6- 3-53	D	
14cd1	N. Carros	5-51	4	63	Fine sand	53-63	4,178.8	26.3 M	6- 3-53	D	
14cd2	Paul Witt	1950	4	80			4,180 E				Analysis.
14db1	D. Arechevaleta		4½	32			4,171.3	22.0 M	6- 3-53	N	
14dc1	C. Ferrel	2-57	8	76	Gravel	70-76	4,180 E			D	Analysis; log 3678.
15ad1	Jack Olson		6	35			4,176 E	15.2 M	6- 3-53	D	
23ab1	L. B. Lowe	6-51	4	74	Sand layers in clay	64-74	4,185 E	29 R	6-51	D	Analysis; log 1711; L.
23ab2	do	1-53	6	117			4,186.2	41.1 M	7-30-53	D	Analysis.
24aa1	C. Viaene	1932	6	45			4,147.9	2.9 M	6-19-53	S	
24ab1	Victor Viaene		4	20±			4,171.2	6.5 M	6- 4-53	D	
24bb1	Chris Gaaserud		6	85	Gravel		4,183.6	57.1 M	6-18-53	D	Temp 64°F.
24bb2	City of Fernley	3-58	20 to 10	207	Sand and gravel	90-207	4,180 E	60 R	3- 1-58	P	Analysis; log 4031; L.
24da1	M. L. Scott		4	26			4,150 E	9.4 M	6-15-53	N	
31dd1							5,400 E	0 M	5-17-60	S	Spring; no flow.
35cc1							4,480 E	0 M	5-17-60	S	Spring; no flow; analysis.
20/25-18ba1	F. Gillespie		12	37		37	4,140 E	4 R	8-29-46		Analysis.
18ba2	do			21			4,140 E			D	Do.
18bb1	T. Johnson		5	27			4,130 E	2.2 M	7-15-53	D	
18cc1	Chris Thuesen		6	28			4,133.8	3.2 M	6-15-53	D	
18cc2	do		10	200	Gravel	160(?)	4,135.2	9.0 M	6-15-53	Irr	
19ad1	John Haran		6	33			4,135 E	1.9 M	7-21-53	D	
19bb1	H. H. Emerson			57			4,140 E			D	Do.
19bb2	do		6	23			4,134.0	3.4 M	6-15-53	N	
19bc1	W. W. Overholser	5-49	6	44		24-44	4,140 E	3 R	5-49		Analysis; log 931.
19bd2	M. Schaub		5	17			4,135 E	6.3 M	7-22-53	D, Irr	Temp 57°F.

TABLE 2.—*Records of wells and springs*—Continued

Well or spring	Owner	Date drilled	Diameter (inches, at land surface)	Reported depth of well (feet)	Aquifer	Depth of intake (feet)	Altitude	Depth to water	Date	Use	Remarks
19cb1	McAllister		5	50			4,140 E			D	Analysis.
19da1	J. P. Picetti	10-52	6	60	Sand and gravel	60	4,150 E	26 R	10-52	D	Analysis; log 2159.
20bd1	A. M. Perry	8-48	6	164	Coarse gravel	144-164	4,135 E	3 R	8-48	D	Analysis; log 645; L.
20bd2	C. F. Fields	11-50	4	42	Fine sand	36-42	4,145 E	13.7 M	7-21-53	D	Log 1494.
20bd3	B. F. Stanley			35			4,145 E	12.4 M	7-21-53	D	
20db1	P. T. Anderson		6	104			4,155 E	13.6 M	7-21-53	D	
21ac1	J. D. Foley	12-51	6	212	Fine sand	202-212	4,145 E	5.5 M	7-22-53	D	Anaylsis; log 1840; L; temp 59°F.
21ad1	G. F. Stock		6	25			4,150 E	9.2 M	7-22-53	N	
21ad2	H. Thompson			180			4,150 E			D	
21bd1	R. L. Harris	5-48	6	143	Fine gravel	131-142	4,140 E	26 R	5-48	D	Log 503; L; temp 60°F.
22bd1	A. W. Rock		6	30			4,146 E	11.0 M	7-22-53	D	
23cd1	C. L. Davis		5	90			4,160 E	65.3 M	7-22-53	D	
24cd1	F. W. Brush	11-50	6	123	Coarse gravel	103-123	4,165 E	40.8 M	7-22-53	D	Log 1495; temp 58°F.
24dc1	J. H. Chatelle	1945	6	53			4,165 E			D	
24dd1	Sam Swartz		48	31	Medium-coarse sand		4,170 E	16.2 M	7-22-53	D	

TABLE 3.—*Selected drillers' logs of wells*

[See table 2 for additional information on the following wells]

	Thickness (feet)	Depth (feet)
20/24-3cc2		
Clay and broken rock	22	22
Gravel, tight (water)	36	58
Clay, gray	2	60
20/24-4aa2		
Gravel and small boulders	23	23
Sand and gravel	30	53
20/24-4dc2		
Sand, brown, coarse	23	23
Clay, tight, and gravel	6	29
Clay, sandy, tight	8	37
Sand, coarse, and gravel	23	60
20/24-8ca1		
Sand, gray, loose	18	18
Gravel, loose (water)	30	48
Clay and gravel	1	49
20/24-11cd1		
Sand, fine (water)	30	30
Sand and gravel (water)	20	50
Sand (water)	40	90
Clay, brown, sandy	6	96
Shale, blue	5	101
Clay, brown	9	110
Sand (water)	10	120
Sand	15	135
Clay, gray	12	147
Sand (water)	3	150
Clay, brown	24	174
Shale, blue	5	179
Clay, gray	11	190
Shale, blue	25	215
Gravel and sand (water)	5	220

TABLE 3.—*Selected drillers' logs of wells*—Continued

	Thickness (feet)	Depth (feet)
20/24-11dc1		
Sand	29	29
Gravel (water)	2	31
Clay, brown, heavy	12	43
Sand and clay	121	164
Sand and clay	66	230
Hardpan (cemented gravel?)	20	250
Clay, sand, and tough clay	40	290
Sand and gravel, tight (trace of water)	23	313
Clay and sand	48	361
Sand and gravel, tight (trace of water)	53	414
Gravel, cemented	20	434
Clay	9	443
Sand, hard	2	445
Clay, brittle	37	482
Gravel	34	516
Hardpan (cemented gravel?)	14	530
Clay, blue	5	535
Gravel, cemented	3	538
Clay, tough	4	542
Gravel, fine	14	556
Clay	10	566
Hardpan	2	568
Gravel, tight	6	574
Gravel	5	579
Clay	5	584
Gravel, loose	7	591
20/24-14aa2		
Silt, fine, and sand	19	19
Sand, fine (water)	11	30
Clay, brown, soft	10	40
Hardpan, brown, very hard	8	48
Clay, blue	12	60
Clay, blue, black, and brown	10	70
Clay, blue, black, brown, and gravel	30	100
Clay, blue, black, and brown	15	115
Gravel, small, and fine sand (little water)	10	125
Sand and small gravel	8	133
20/24-23ab1		
Existing dug well for which no log is available		43
Sand, soft, silt, clay, and gravel	10	53
Clay, hard, cemented sand, and gravel	10	63
Clay, hard, cemented sand, and gravel	4	67
Alternating layers of sand and brown clay	7	74

TABLE 3.—*Selected drillers' logs of wells*—Continued

	Thickness (feet)	Depth (feet)
20/24-24bb2		
Topsoil	8	8
Clay, blue, heavy	68	76
Sand	2	78
Clay, blue	8	86
Sand	2	88
Clay, blue	99	187
Soft, shattered rock with some sand and gravel	20	207
20/25-20 bd1		
Silt and sand (water)	3	3
Clay, gray	7	10
Clay, gray, and fine sand (water)	10	20
Sand, fine	10	30
Clay, light-pink	10	40
Clay, light-pink	20	60
Hardpan, sand, and gravel	10	70
Clay, light-brown	10	80
Sand, cemented	20	100
Clay, light-brown, sandy	10	110
Sand, cemented, and hard gravel	20	130
Clay, light-gray, and sand	28	158
Gravel, large (water)	6	164
20/25-21 ac1		
Sand and silt	25	25
Clay, blocky, and small layers of sand (water)	11	36
Rock, cemented, and gravel	4	40
Hardpan, sand, gravel, and clay	25	65
Rocks and boulders in cemented formation	7	72
Rock and gravel in brown clay	12	84
Gravel, very hard, cemented	2	86
Gravel in hard brown clay	9	95
Sand, cemented, small gravel, and clay	15	110
Clay, light-brown, hard, sand, and gravel	4	114
Rock, hard, cemented	1	115
Sand, hard gravel, and brown clay	5	120
Clay, pink, soft, sand, and small gravel	20	140
Clay, rusty-brown, hard, and small gravel	10	150
Clay, white, soft, gummy, sand, and small gravel	10	160
Clay, white, and fine-to-coarse sand (hot water)	10	170
Clay, gray, orange, brown, fine gravel, and coarse sand	5	175
Clay, gray, gravel, and hard sand	3	178
Clay, gray, hard strata, and fine sand	2	180
Clay, white, pink, brown, and sand	6	186
Clay, layers 4- to 6-in. thick	4	190
Clay, brown, hard, and sand	4	194
Clay, brown, hard, alternating with soft material	3	197
Sand, black, fine, and soft brown clay	3	200
Sand, black, fine (water)	8½	208½
Clay, brown, and sand	3½	212

TABLE 3.—*Selected drillers' logs of wells*—Continued

	Thickness (feet)	Depth (feet)
20/25-21 bdl		
Clay, brown, soft, silt, and sand	20	20
Sand, black (water)	15	35
Clay, light-brown, "rock," boulders, and compact gravel	15	50
Gravel, black, and brown clay	18	68
Gravel, black, and "rock" (little water)	1	69
Clay, brown, hard	3	72
Clay, brown, hard, cemented sand, and hardpan	3	75
Clay, brown	23	98
Sand, cemented, gravel, and clay layers	26	124
Gravel, small, and clay layers	19	143
20/25-24 cdl		
Silt, "rock," and gravel	8	8
"Conglomerate"	4	12
Sand	7	19
"Rock," gravel, and clay	16	35
Sand, cemented, gravel, and hardpan	10	45
Sand, cemented	5	50
Clay, gravel, and sand	20	70
Sand, cemented	10	80
Sand, cemented, and gravel	10	90
Sand, cemented, and hardpan	10	100
Sand, very fine, and clay	5	105
Sand, very fine, and clay	13	118
Sand, very fine, micaceous (water)	1	119
Hardpan	1	120
Gravel, coarse, and light-brown clay	3	123

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