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ARTESIAN-WATER LEVELS AND INTERFERENCE BETWEEN ARTESIAN WELLS IN THE VICINITY OF LEHI, UTAH

BY

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ABSTRACT

In the vicinity of Lehi, Utah, about 25 miles south of Salt Lake City, supplies of artesian water are obtained at depths of 75 to 750 feet from beds of sand and gravel of Pleistocene age. Individual beds are probably lenticular and irregular in shape, as is characteristic of the stream and lake deposits in many parts of the Lake Bonneville Basin. The artesian supplies are obtained from aquifers or groups of aquifers that are more thoroughly separated by impermeable materials than the artesian aquifers of some other ground-water areas in Utah. Most of the wells are between 130 and 200 feet deep. The artesian area in the vicinity of Lehi is only a small part of a ground-water unit that probably includes most of Utah Lake Valley.

The ground-water reservoir in Utah Lake Valley was seriously depleted after the years of subnormal precipitation that culminated in the drought of 1934. However, in the vicinity of Lehi the static levels in 1934 were about the same as during 1904, a year which marked the culmination of a previous drought period. The water levels in the summer of 1935 were about the same as in 1934, indicating that the recharge to the ground-water reservoir was again sufficient to balance the discharge; and during the following year there was a marked rise of the water level in all wells, commonly 5 to 10 feet in amount. The static levels in the vicinity of Lehi fluctuate each year through a range of as much as 15 feet and are ordinarily highest during March or April and lowest during August or September. This fluctuation is due in part to the closing of flowing irrigation wells during the winter.

A series of tests was made to determine the extent of interference between artesian wells. Among the wells that are between 130 and 200 feet deep, the operation of certain wells was found to cause a change in the static level in wells as much as 1½ miles distant. The operation of these shallower wells, however, had no apparent effect upon the static level in the wells more than about 200 feet deep, nor did the operation of these deeper wells appear to affect the static level in the shallow wells. The deep and shallow aquifers thus appear to be separated by fairly continuous beds of impermeable material.

INTRODUCTION

Lehi is at the north end of Utah Lake Valley, Utah County, and is east of the Jordan River, which is the natural outlet of Utah Lake into the Jordan River Valley. The area considered in this report is about 4 miles long, from east to west, and 2½ miles wide. The town of Lehi is in the central part of the area. A prosperous agricultural district surrounds the town, and most of the district is irrigated. Figure 4 is a map of the area, showing the location of observation wells.

The area lies within the basin of the Pleistocene Lake Bonneville and is underlain by stream and lake deposits of clay, sand, and gravel, which probably occur in more or less irregular, lenticular bodies. The strata are probably more continuous toward the southern and western part of the area; toward the northern and northeastern part the deposits have probably been reworked somewhat by shore currents of

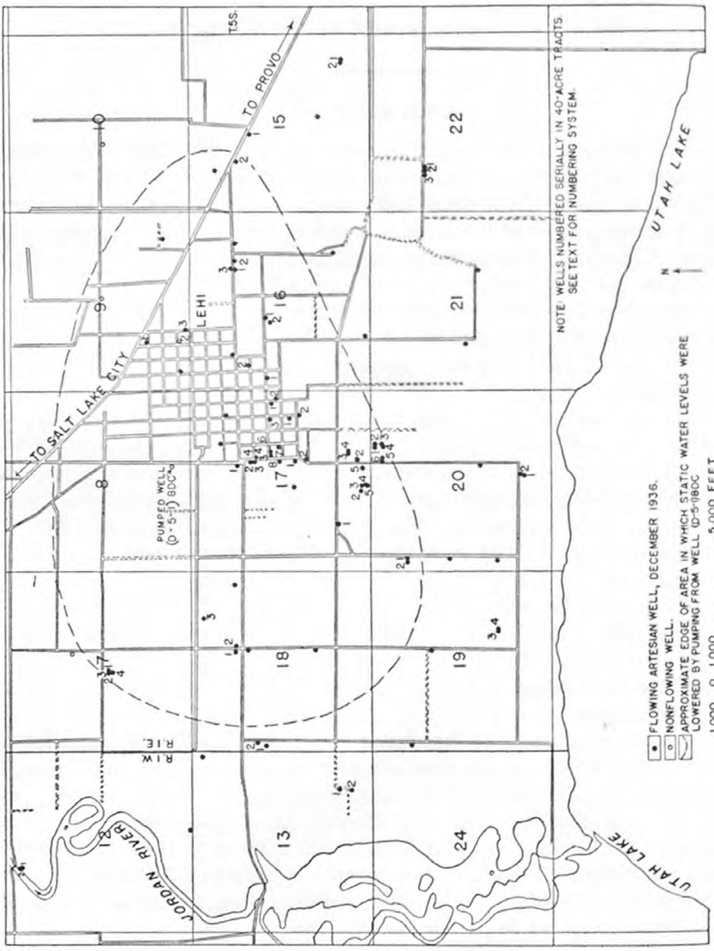


FIGURE 4.—Map of Lehi and vicinity, Utah County, Utah, showing wells measured during 1934, 1935, and 1936, and approximate area in which static water levels were lowered during pumping from well (D-5-1)8dc in September 1936.

the old lake. The geology of the area was not studied in detail but is undoubtedly similar in most respects to the geology of other nearby areas in the Lake Bonneville basin which have been studied more thoroughly.[1] The five well logs given on pages 135 and 136 are the

[1] Leggette, R. M., and Taylor, G. H., Ground-water supplies in the vicinity of Salt Lake City, Utah: U. S. Dept. Interior Press Mem. 64395, July 23, 1932; Geology and ground-water resources of Ogden Valley, Utah: U. S. Geol. Survey Water-Supply Paper 796-D, 1937. Taylor, G. H., and Thomas, H. E., Ground water in the vicinity of Woods Cross, Davis County, Utah: Typewritten report at offices of U. S. Geol. Survey at Washington, D. C., and Salt Lake City, Utah; State engineer and University of Utah Engineering Library, Salt Lake City, Utah. See also U. S. Dept. Interior Press Mem. 129943, Jan. 27, 1937.

only logs of wells in the area that had been collected when this report was written.

Ground water is important as a supplement to surface water for irrigation in the area, many of the farmers depending entirely upon wells. The municipal supply for the town of Lehi is derived principally from surface water, although many houses within the town are supplied by private wells. Outside the town practically all water for domestic and stock use is obtained from wells. Ground water is obtained almost entirely from flowing wells, which are commonly 1½ to 4 inches in diameter. Four pumped wells of large diameter have been developed in or near the area, but only one is used regularly during the irrigation season.

During the recent series of years of subnormal precipitation that culminated in the drought of 1934 the artesian pressure in the area is reported to have declined markedly, but records are not available to show the amount of decline. Particularly during 1934 many of the wells at higher altitudes ceased to flow, and the decrease in the flow from most other wells was so great as to become alarming to the well owners. Several of these owners drilled new wells in an attempt to compensate the diminished flow from existing wells, and the discharge from these new wells no doubt accentuated the decline of the static level. In particular, considerable controversy arose after the drilling of a large well to supplement the surface-water supplies of the Lehi Irrigation Co. This well was drilled near the edge of the area of artesian flow, where even a slight amount of interference would be noticeable to the owners of the many artesian wells nearby.

The purpose of this report is to assemble the available data gathered by previous investigators of the area and to present the data gathered during 1935 and 1936 by the Federal Geological Survey in cooperation with the State engineer of Utah. The field data gathered during the present investigation consist mainly of measurements in selected observation wells to determine the fluctuations of the static water level, the position of the piezometric surface, the area of artesian flow, and the interference between artesian wells in the area. To accomplish these purposes measurements of the static level were made in all observation wells during September 1935, September 1936, and December 1936; more frequent measurements were made on several observation wells to determine the seasonal fluctuations of the static level; and a series of tests of interference between wells was conducted during September 1936.

Acknowledgments are due to all the residents of the area for their helpful cooperation and assistance, especially to the officers and members of the Lehi Irrigation Co. for operating the pump on test well (D-5-1)8dc and to Messrs. J. G. Cox, S. F. Littleford, Ralph

Smith, Dean Van Wagoner, and Wayne Carson for furnishing wells on which recording gages were operated during the tests.

Throughout the report the well number indicates the location by land subdivision according to a well-numbering system used in the State of Utah.[2] The complete well number comprises a letter designating the quadrant in relation to the base point of the standard base and meridian system, number of township, number of range—a group enclosed in parentheses, which designates the township; the number of the section, a letter designating the quarter section, another letter designating the quarter of the quarter section, and a number designating the particular well within the 40-acre tract. By this system the letters A, B, C, and D designate, respectively, the northeast, northwest, southwest, and southeast quadrants of the standard base and meridian system of the General Land Office; and the letters a, b, c, and d the northeast, northwest, southwest, and southeast quarters of the section and quarter section. Thus, "(D-5-1)7ca1" designates well 1 in the NE¼SW¼ sec. 7, T. 5 S., R. 1 E. (the letter D showing that the township and range are south and east of the base and meridian lines).

PREVIOUS INVESTIGATIONS

INVESTIGATIONS IN 1904

What is believed to be the first published report on the occurrence and development of ground water in Utah County was prepared by G. B. Richardson, of the Geological Survey.[3] The field work for the report was done during 1904. A short section was devoted to the ground-water conditions in Lehi and vicinity, and as the observations made by Mr. Richardson are most pertinent in comparison with the present ground-water conditions in the area they are repeated here.[4]

> Lehi is situated in the main valley at some distance from the distinct terraces. Dry Creek lies adjacent to the town, but, as its name signifies, the creek, after supplying a number of irrigation ditches, usually carries little or no water in its lower course. There is no public water system in the town, and the supply for domestic purposes is derived from numerous wells. A few shallow dug wells tap ground water at depths of 5 to 30 feet, but the majority are deeper and reach water under pressure. The sugar-plant mill pond is fed by springs and is an important local source of supply.
>
> Lehi was one of the first towns where artesian water was found in the Bonneville area, flowing wells having been obtained there about 1880. Formerly a feeble first flow was found in gravel about 60 feet from the surface and a stronger supply at a depth of about 160 feet, but in recent years flows, even from the second horizon, have failed during part of the season in consequence of the increased use

[2] Taylor, G. H., Method adopted in Utah for numbering wells, springs, etc.: U. S. Geol. Survey Water Resources Bulletin (mimeographed), Oct. 10, 1935, p. 36. Humpherys, T. H., State engineer 20th Bienn. Rept. to the Governor of Utah for the biennium July 1, 1934, to June 30, 1936, pp. 87–89.

[3] Richardson, G. B., Underground water in the valleys of Utah Lake and Jordan River, Utah: U. S. Geol. Survey Water-Supply Paper 157, 1906.

[4] Idem, pp. 48–49.

of artesian wells in the area nearer the lake, and at times pumping has to be resorted to. However, when water does not actually flow it rises in the wells to within a few feet of the surface.

The general section in the vicinity of Lehi, as reported by H. C. Comer, shows blue clay to a depth of 50 or 60 feet. Below this is the first water bed, consisting of about 50 feet of sand and gravel, separated from the second water horizon by 40 feet of light clay. This section does not apply in the eastern part of the town, where the log of the San Pedro Railroad well shows coarse-textured material within 100 feet of the surface. In this well the main supply is derived from a depth of 330 feet, the water rising to within a few feet of the surface. These two logs illustrate the variability of adjacent sections.

The Utah Sugar Co.'s plant at Lehi has several 2-inch wells, and the following flows in gallons per minute are reported: 80 feet, 15 gallons; 120 feet, 25 gallons; 150 feet, 20 gallons. Logs of these wells were not kept. The Rio Grande Western Railway well near the sugar factory is 3 inches in diameter and 165 feet deep. The water is reported to rise in a pipe to a point 30 feet above the surface and to flow about 50 gallons a minute at the level of the ground.

Toward Utah Lake, below Lehi, there is a considerable development of flowing wells from which a number of square miles are irrigated. In this district there are several hundred flowing wells which average about 150 feet in depth. A close relationship has been established between the flow of the wells in the fields below Lehi and those in town. During the irrigation season, when the field wells are all flowing, those in Lehi practically stop, but during the winter it is a general custom to plug the wells used for irrigation, after which those in town begin to flow. Measurements have not been made, but the general facts are well established.

Northwest of Lehi the line separating the areas of flowing and nonflowing wells continues to Jordan River, reaching it 3 to 4 miles north of Utah Lake. The line extends about half a mile west of the river and approaches close to the northwest corner of the lake near Saratoga Springs. In the flood plain of Jordan River flows can probably be obtained continuing into Salt Lake Valley, but outside of the line indicated the surface elevation is too great.

The Salt Lake City authorities, about 1890, sank a number of wells in the flood plain of Jordan River in sec. 12, T. 5 S., R. 1 W., with the object of increasing the supply of the Jordan and Salt Lake Canal. These wells, about 130 in number, were mostly 2 inches in diameter, though a few were 6 inches, and are said to average 100 feet deep. Clay was encountered down to the bottom of the wells, which were in gravel. It is stated that water rose in pipes 30 to 40 feet above the surface, and that individual wells flowed 125 gallons a minute. It is also stated that the combined flow amounted to 3,000,000 gallons a day. These wells soon interfered with neighboring ones, stopping their flow, and suit was brought against the city, with the result that the municipality was compelled to plug up its wells. After these had been plugged for some time a number of them were temporarily opened, and in about 24 hours thereafter the water in one of the wells, the flow of which was interfered with, situated about half a mile above the city wells, had fallen 2½ feet. The city wells were then capped again, and in 5 hours the water in the well referred to had regained 7 inches of its lost level.

Near the northwestern end of Utah Lake there is a group of hot springs which occur both on shore and in the lake. On the shore there are several springs which support the Saratoga resort, where the water, having a temperature of 111°, issues through the lake deposits and is used for bathing and to a limited extent for irrigation. In the summer of 1904, during the survey of Utah Lake by G. L. Swendsen, of the Reclamation Service, three groups of springs were found beneath the water of the lake. Their existence was shown by the presence of depressions occupying areas of 100 square feet to 3 acres in extent and having depths of 20 to 80 feet. Since the prevailing depth of the lake is much less and the bottom is composed of slimy mud, a considerable discharge is thus indicated. Hot water that flowed above the lake surface was obtained by sinking pipes a short distance into the bottom.

About 5 miles up Dry Creek from Lehi is the town of Alpine, located near the mouth of the canyon on the dissected Bonneville terrace. The settlement is supplied with water from irrigation ditches, and possibly not more than half a dozen wells have been sunk. These are 25 to 80 feet deep, and the water level is reported to vary considerably between winter and summer. Springs occur in Dry Creek Canyon, but they have not been developed.

Attention is called especially to the second paragraph of the preceding quotation, in which Richardson notes that—

in recent years flows, even from the second horizon [the aquifer(s) at a depth of about 130 to 200 feet which now supply the greater number of wells in the area], have failed during part of the season in consequence of the increased use of artesian wells in the area nearer the lake, and at times pumping has to be resorted to.

According to the records of precipitation at Salt Lake City (fig. 5) the years 1904 and 1934 each followed a series of years having subnormal precipitation, with the consequent reduction of recharge to the ground-water reservoir.

Richardson reports a static level of 30 feet above the land surface in a well 165 feet deep belonging to the Rio Grande Western Railway, near the Utah Sugar Co.'s plant. Well (D–5–1)16dd, 158 feet deep, is near the Rio Grande Western Railway well and had a static level of 29 feet above the land surface on September 18, 1935; 33 feet on October 23, 1935; 38 feet on September 19, 1936; and 44 feet on December 22, 1936.

The static water level in well (D–5–1)9dd, owned by John W. Brown (see p. 140), was 3.4 feet below the land surface on September 18, 1935; 1.7 feet above the land surface on December 10, 1935; and 9.1 feet above the land surface on December 22, 1936. It is believed that this is the same well that is tabulated by Richardson, the sixth well from the bottom of page 69 in Water-Supply Paper 157, in which the static water level was below the land surface.

The sixteenth well from the bottom of page 69 in Water-Supply Paper 157 is probably the same as well (D–5–1)7ca3, 93 feet deep, owned by George Jacobs (State claim No. 1848). The depth of this well was reported to Kenneth Borg and John M. Neff as 175 feet in 1934. This well was reported as flowing in 1904 and had a pressure head of about 6.25 feet above the land surface on September 11, 1935.

The twenty-second well from the bottom of page 70 in Water-Supply Paper 157 is probably the same as well (D–5–1)18aa, owned by Eugene Webb, reported 195 feet deep in 1904 and 285 feet deep in 1935. The reported static level in this well was 3 feet above the land surface in 1904. The measured static level (see p. 149) ranged from

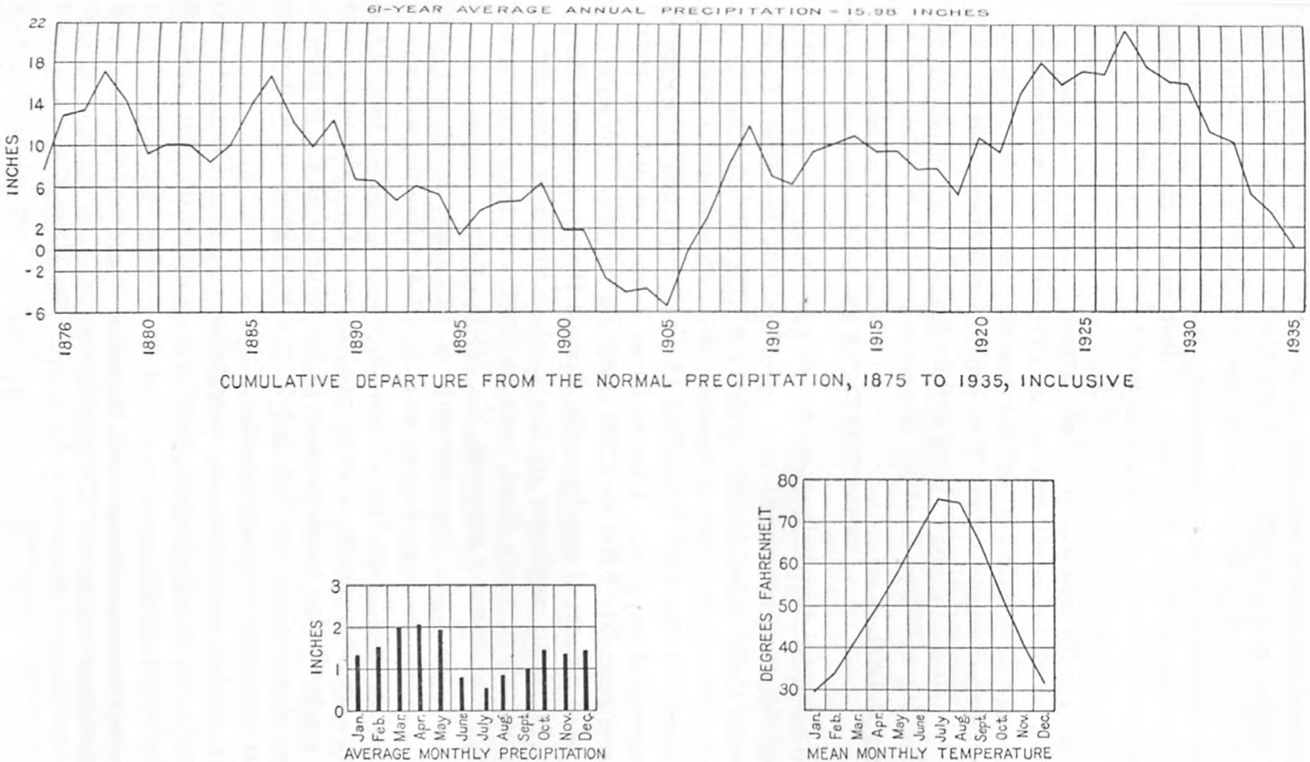


FIGURE 5.—Graph showing the cumulative departure from the normal precipitation, average monthly precipitation, and mean monthly temperature at Salt Lake City, Utah.

2.6 feet below the land surface on September 17, 1935, to 4.25 feet above the land surface on December 24, 1936.

Richardson gives a reported static level of 30 to 40 feet above the land surface in about 130 wells in the flood plain of the Jordan River in sec. 12, T. 5 S., R. 1 W., owned by the Salt Lake City Corporation, but the date when the measurements were made is not stated. The static level in one of these wells was 16 feet above the land surface on September 18, 1935, and in an adjacent well it was 19 feet above the land surface on September 11, 1936.

From the few comparative data available it may be concluded that the lowest static levels reached in 1934 and 1935 were not greatly lower—and in certain parts of the area may have been no lower—than those reached during 1904. This conclusion is supported by Richardson's statements quoted above and by his map,[5] showing the edge of the flowing-well area in about the same location in 1904 as it was in 1935 and 1936.

INVESTIGATIONS IN 1934

No records of ground-water levels have been found covering the period between 1904 and 1934. During 1934 the Utah Emergency Drought Relief Administration, charged with relieving the shortage of water caused by drought, authorized the drilling of a well on a project sponsored by the Lehi Irrigation Co. to supplement the company's surface-water supplies. This well was completed July 9, 1934, and pumped probably 1,000 to 1,200 gallons a minute. Because of complaints of owners of nearby wells, Roscoe Boden, Kenneth Borg, and John M. Neff, engineers of the Utah Emergency Drought Relief Administration, made short tests to determine the effect on nearby wells of pumping the new well, No. (D–5–1)8dc.

Mr. Boden made measurements of the static level and yield of several nearby wells on July 25 and 26, 1934, while the well was being pumped, and again on July 27 and 28, pumping having ceased at 8:20 p. m. July 26. Again, during September 1934, Messrs. Borg and Neff made similar measurements in the vicinity of the pumped well. These observations are included in the tabulation of well measurements accompanying this report.

Mr. Boden submitted his observations to the Utah Emergency Drought Relief Administration with no comments. Mr. Neff made the following report:

> The first measurements were made September 13 and 14, while the Emergency Relief Administration well [(D–5–1)8dc] was open. The Emergency Relief Administration well was closed at 3:40 p. m. September 14, after which three sets of measurements were made.
>
> Wells 27 [(D–5–1)17ad3], 28 [(D–5–1)16bd1], 13 [(D–5–1)18ab3], 29 [(C–5–1)13dd2], 18 [(D–5–1)20bc], and 14 [(D–5–1)19bb] were not materially affected by

[5] Richardson, G. B., op. cit. (Water-Supply Paper 157), pl. 8

the Emergency Relief Administration well, while the others measured were affected. Wells 27 and 28 are deep wells below water stratum reached by the Emergency Relief Administration well, and wells 13, 29, and 18 are too far from the Emergency Relief Administration well to be affected.

Tests indicate an underground body of water rather than an underground stream.

Mr. Borg's report was as follows:

There is a surface artesian basin running northeast and southwest, which includes most of Lehi City. The large Emergency Relief Administration well is located near the northwest boundary of this basin and without doubt is the cause of the drying up of the wells in Lehi to the south and east of the Emergency Relief Administration well.

It appears that the character of the basin is one of underground storage rather than a rapidly replenishable supply from an inexhaustible source, and that the water table, upon being lowered by the Emergency Relief Administration well, is responsible for underground movement, whereupon the adjacent wells cease to flow.

My conclusion is that the wells which were dried up are dependent upon the storage in a dead-end artesian basin.

During September 1935 most of the wells that had been measured by Messrs. Boden, Borg, and Neff during 1934 were again measured, and a number of other wells were selected for observation. The comparative measurements indicate that the static level in the vicinity was approximately the same during September 1935 as during September 1934.

OCCURRENCE OF GROUND WATER

In the vicinity of Lehi ground water occurs at relatively shallow depths under water-table conditions—that is, not under artesian pressure. This body of water overlies other water-bearing strata which are under artesian pressure and is separated from them by relatively impervious material, reported by H. C. Comer, a driller, to be a blue clay. This shallow ground water is obtained from a few dug wells for domestic use but is of very little economic importance. Artesian water is obtained from numerous aquifers at depths greater than about 50 feet. These aquifers may tentatively be arranged in zones, the aquifers within a zone being only incompletely separated by thin discontinuous beds of less permeable material, and the zones being rather thoroughly separated by thicker, more continuous beds of clay. Richardson reports that artesian water was obtained at depths of 50 to 100 feet in Lehi prior to 1904. At the present time only a few wells are known to obtain water at these depths, and the zone is presumed to be an unimportant source. Of the observation wells, Nos. (D–5–1)7ac and (D–5–1)9cd2 are, respectively, 58 and 57 feet deep, and the static level in these wells is appreciably lower than that in adjacent wells known to reach aquifers of greater depth. It is possible that the development of the next lower water-bearing strata has served to lower the pressure in this uppermost artesian aquifer.

Most of the artesian wells in the vicinity of Lehi obtain water from depths of about 130 to 200 feet (Richardson's "second horizon"). This aquifer yields fairly large quantities of water, even where the pressure head is only a few feet at the surface.

Several wells have been drilled to aquifers at depths of 275 to 350 feet below the surface, which is the second horizon of present importance in the vicinity of Lehi. The pressure head in these deep wells may be 10 to 25 feet greater than that of adjacent wells that obtain water from a depth of about 150 feet, but the yield is not proportionately greater.

One well, No. (D–5–1)9cd3, is reported by some residents to have been drilled to a depth of 750 feet—far below the aquifers that supply the other wells in the area. However, the official State claim for this well gives the depth as 300 feet. This well is outside the area of artesian flow as determined by the shallower wells, yet it has a pressure head of more than 33 feet, which indicates a depth probably greater than 300 feet. With this pressure head, the well yields only 16 gallons a minute.

The entire series of unconsolidated sediments presumably becomes coarser and more permeable toward the Wasatch Range, to the north and east, and the impermeable layers which exist in the artesian area probably become thinner toward the mountains. Hence the artesian and nonartesian water bodies probably merge, within 1 to 3 miles north and northeast of Lehi, into one more or less continuous water body that is not under artesian pressure and underlies the higher bench lands. The ground-water body beneath the bench lands lies at considerable depths below the ground surface, the depth increasing toward the base of the adjacent mountains. The artesian area in the vicinity of Lehi is only a part of a much larger ground-water area located around the edges of and probably extending under Utah Lake.

RECHARGE

The primary source of the water in the artesian reservoir is precipitation on the Wasatch Range east and north of the area. These mountains are drained by numerous canyons, of which the largest in the vicinity of Lehi are Dry Creek and American Fork. The flow in these larger canyons is perennial but rises to a peak during the spring because of run-off from melting snow. At the mouths of the canyons much of this water is diverted through irrigation canals, so that only a part of the yearly run-off continues down the natural channels to enter Utah Lake. Both the natural channels and the irrigation canals cross the gravelly bench lands, and a considerable amount of water is probably contributed to the water body under these bench lands by seepage from these channels and canals and from irrigated areas on the bench land. This water body is probably augmented somewhat by direct penetration of precipitation upon the bench land. The precipitation on the valley floor, however, contributes only to the shallow ground-water body and does not reach the artesian reservoir. The water underlying the bench lands moves down the gradient of the water table, which is more or less in the general direction of the slope of the land surface. When it reaches the point or points where the artesian and the shallow nonartesian water-bearing strata separate, a part or all of the recharge enters the several artesian aquifers and the remainder enters the shallow reservoir. The proportion that enters this shallow reservoir depends mainly upon the fullness of the artesian reservoir. The available data are not sufficient to determine whether all the artesian strata are fed from a common source; it is possible that the different strata are recharged from separate parts of the recharge area that parallels the base of the adjacent mountains.

DISCHARGE

Discharge from the artesian reservoir in the vicinity of Lehi occurs mainly from flowing wells. Only one pumped well, a short distance north of Lehi, is operated regularly each summer. Three other pumped wells in or near the area are seldom operated. Water is discharged from the shallow-water body mainly by evaporation and transpiration and by underground movement toward Utah Lake.

A large spring issues in sec. 15, T. 5 S., R. 1 E., the flow from which originates from either the artesian or the nonartesian reservoir, or possibly from both. There is also a possibility of the discharge of artesian water south and west of the area through springs and seep areas in the bed of Utah Lake and through a few springs that exist along the Jordan River.

Several warm springs occur near the north end of Utah Lake, some of which are used at the Saratoga Springs resort. The temperature of the water in these springs (111° F.) is considerably higher than that of the artesian water in wells less than 2 miles to the northeast. It is probable that these springs are of deep-seated origin, reaching the surface perhaps along a fault zone; they are not believed to be related to the water in the artesian reservoir.

Some wells in the area are reported to have only short lengths of casing or casing which is perforated opposite artesian aquifers at different depths. This permits the loss of some water from higher-pressure to lower-pressure strata and from the artesian reservoir into the shallow, nonartesian ground-water body. During past years much artesian water has been wasted from uncontrolled flowing wells. This discharge of ground water has been greatly curtailed during the last 2 years, but some wells are still uncontrolled. A few flowing wells in this area cannot be controlled until they have been repaired, because of leakage on the outside of the casing or because of deteriorated or insufficient casing. The water thus wasted from any well not only decreases the supply available to that well but also reduces the amount available to all other artesian wells in the area.

STATIC LEVEL

The quantity of water stored in an artesian reservoir will vary from day to day, from season to season, and from year to year in response to

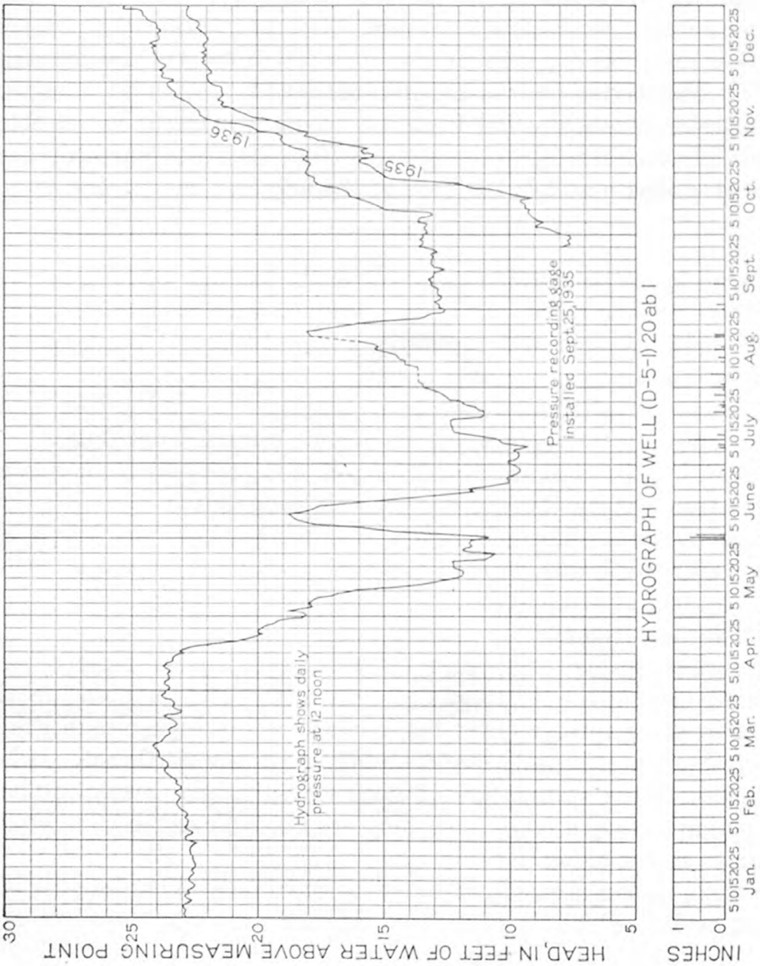


FIGURE 6.—Hydrograph of well (D-5-1)20ab1, Jacob G. Cox.

changes in the rates at which water is taken into or discharged from the reservoir. The static level, which is the level to which water will rise in a well under its full pressure head,[6] fluctuates in response to these changing conditions in a reservoir. Other factors being equal, the

[6] Meinzer, O. E., Outline of ground-water hydrology: U. S. Geol. Survey Water-Supply Paper 494, p. 37, 1923.

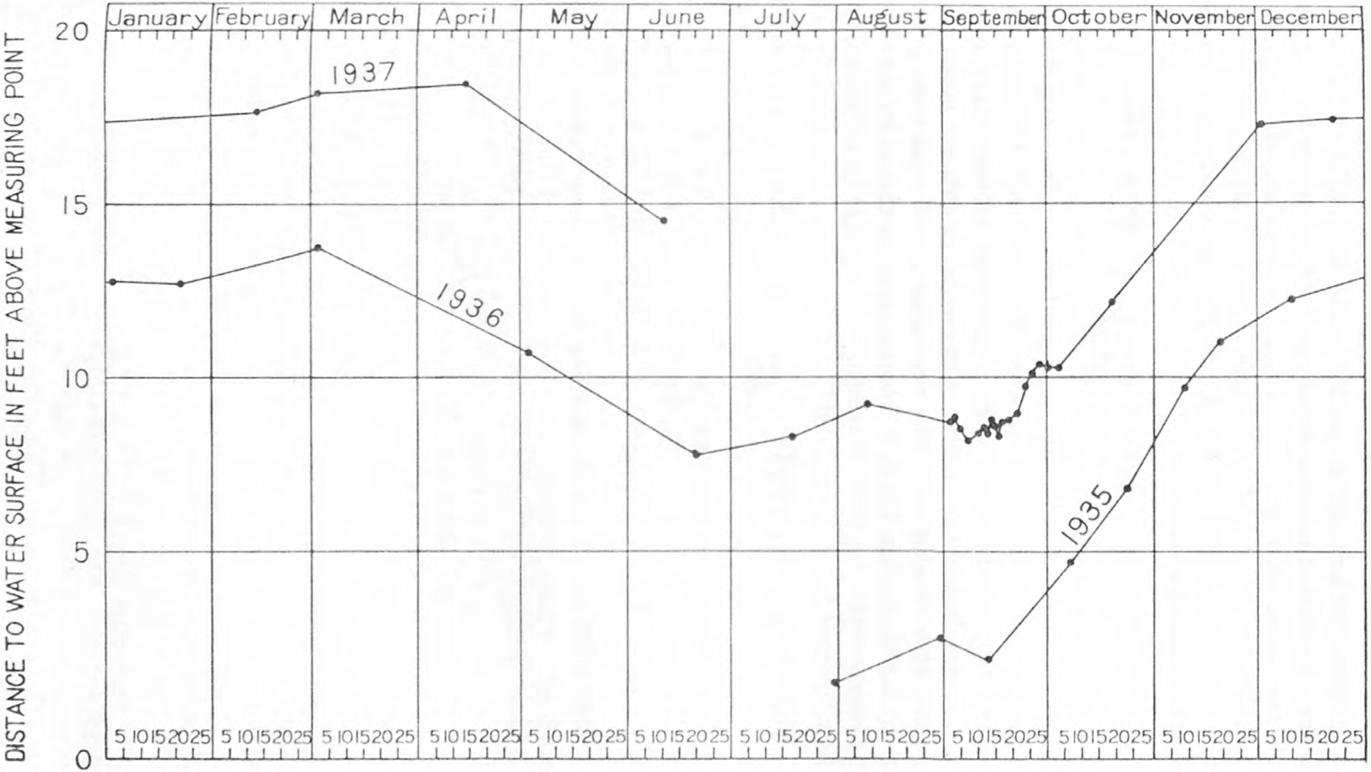


FIGURE 7.—Hydrograph of well (D-5-1)17ad2, M. S. Lott.

amount of water that can be discharged by a flowing well depends upon the pressure head at the point of discharge. Fluctuations of the static level in wells are also caused by changes in atmospheric pressure, interference from nearby wells, and other disturbances. Determination of the fluctuations of the static level and of the causes of the fluctuations is essential to an understanding of the ground-water conditions in the reservoir.

FLUCTUATIONS OF THE STATIC LEVEL IN WELLS LESS THAN 100 FEET DEEP

In two observation wells that are less than 100 feet deep the static level remained about the same between September and December 1936. Presumably the discharge by wells from these shallow strata, even in summer, is small, and the difference in discharge between summer and winter would be negligible. The completeness of separation of these strata from the aquifers 130 to 200 feet deep is suggested by the absence of any reflection in the shallow strata of the change in pressure head in the aquifers just below them.

FLUCTUATIONS OF THE STATIC LEVEL IN WELLS 130 TO 200 FEET DEEP

Several wells 130 to 200 feet deep were selected in the vicinity of Lehi during 1935 for periodic observations of the static level. A recording pressure gage has also been maintained on a typical well since that time. Figures 6 and 7 show the fluctuations of the static level in this well and in a well on which periodic observations are being maintained. These hydrographs show the annual fluctuation of the static level, which is evidently governed primarily by the opening and closing of flowing wells of similar depth used for irrigation in the area. The fluctuations of the static level during the summer are caused primarily by intermittent operation of certain irrigation wells and are especially marked when there is sufficient rainfall to make irrigation unnecessary for a few days. Field observations showed that many of the flowing wells in the vicinity are carefully regulated and are closed when not in use. Thus a local rainfall generally results in the closing of some of the flowing wells and an accompanying rise of static levels. A comparison of the fluctuations of the static level of well (D-5-1)20ab1 with the record of precipitation at Provo (fig. 6), the nearest precipitation station of the United States Weather Bureau, shows the marked rise in static level that follows summer storms.

So pronounced are the fluctuations of static level caused by the changes in discharge of wells that all other fluctuations seem unimportant by comparison. Thus, the effect of the annual spring recharge, which might be expected sometime between May and August, is totally obscured by the operation of wells, and all that can be said is that the static levels during that period would have been much lower had the recharge not occurred. Even the minor fluctuations during the winter may be due partly to intermittent operation of certain wells for stock watering, although it is likely that these fluctuations are at least partly due to changes in barometric pressure.

Most flowing wells are closed for the winter at some time during October and November of each year, and the static levels are probably in general equilibrium by December. Thus comparative data based on measurements made during January, February, or March of each year are probably the most reliable for use in determining the annual change of ground-water storage. The position of the static level in the hydrographs of figures 6 and 7 shows that the recharge to the area probably exceeded the discharge from the area between December 1935 and December 1936. The static level of well (D–5–1)20ab1 was about 2 feet higher and the static level of well (D–5–1)17ad2 was about 5 feet higher during December 1936 than during December 1935. Well (D–5–1)17ad2 is probably closer to the ground-water recharge area than well (D–5–1)20ab1, and the greater rise of the static level in the former well probably most nearly reflects the increased quantity of water stored in the recharge area feeding the artesian aquifer. However, an artificial recharging of the ground water, which was occurring in small amount through well (D–5–1)9db during December 1936, may have caused an abnormal rise of the static level in well (D–5–1)17ad2 and, presumably, in nearby wells.

FLUCTUATIONS OF THE STATIC LEVEL IN DEEPER WELLS

In wells about 275 to 325 feet deep the seasonal fluctuation of the static level is generally less than that in adjacent wells reaching shallower aquifers. For instance, the maximum recharge in the static level in deep well (D–5–1)20ab4 during 1936 was 9.3 feet, and in shallow well (D–5–1)20ab1, 180 feet to the north, 16.0 feet; in deep well (D–5–1)17ad3 the 1936 range was 9.3 feet, and in well (D–5–1)17ac2, 650 feet to the southeast, 10.7 feet. The seasonal fluctuation in the shallow wells has been attributed largely to the operation of other shallow wells; in the deep wells the operation of other deep wells may likewise be the prime cause of seasonal fluctuations, the smaller range being due to the smaller number of wells discharging from the deeper strata. The static levels in wells drilled about 275 to 325 feet deep are generally at least 10 feet higher than the levels in adjacent wells 130 to 200 feet deep, and during the summer, when there are heavy withdrawals from the shallower aquifers, the difference may be much greater.

The change in static level from December 1935 to December 1936 was considerably greater in the deep wells than in adjacent shallow wells, as shown by comparison of the same two pairs of wells. Thus, in this period the static level in shallow well (D–5–1)17ad2 increased about 4.8 feet; in deep well (D–5–1)17ad3, 8.2 feet; in shallow well (D–5–1)20ab1, 2.4 feet; and in deep well (D–5–1)20ab4, 7.4 feet. The greater increase in the deep wells may reflect conditions in the recharge area during the year: As recharge became greater than discharge the additional storage first affected the pressure head in the deeper wells; further additions to storage raised the water table above the upper edge of the impermeable layer separating the aquifers and created additional pressure head in the shallower wells.

Well (D–5–1)9cd3 is reported to be between 300 and 750 feet deep, and thus penetrates below the aquifers reached by most other wells in the vicinity of Lehi. The static level in this well was practically the same on December 22 as on September 11, 1936. In this deep aquifer, not known to be penetrated by other wells, the major causes of the large seasonal fluctuation in shallower wells are absent. Changes in draft upon the shallower aquifers seem not to affect the static level in this deep well.

PIEZOMETRIC SURFACES

The piezometric surface is an imaginary surface to which water under hydrostatic pressure will rise under its full head. Figures 8 and 9 show the approximate position of contours on the piezometric surface for the group of aquifers about 130 to 200 feet below the surface, which are the principal source of ground water in the vicinity of Lehi. All points on each contour line have approximately the same static level, and the contour line represents the approximate height to which the ground water will rise in feet above mean sea level. The altitudes of all static levels were computed from a topographic map of the area. In drawing these contours the static levels for practically all the observed wells reaching this depth were used. One notable exception is the pumped well (D–5–1)8dc.

Tests of this well indicate that pumping from it interferes mainly with wells 130 to 200 feet deep, and the log of the well shows that the aquifers most likely to yield water are between 99 and 207 feet in depth. Nevertheless, the static level in this well appears to be 10 or 15 feet lower than the level in nearby wells reaching one or another of the aquifers between 130 and 200 feet. This lower static level is believed to result from underground leakage to unsaturated strata above the aquifer or from higher-pressure to lower-pressure aquifers, as the casing in the well is reported to have been perforated through all aquifers that are more than 100 feet below the surface. The static level of wells less than about 130 feet or more than about 200 feet deep was not used in the construction of the contours on the piezometric surface because these aquifers have a lower or higher piezometric surface than the aquifers between about 130 and 200 feet deep.

The direction of movement of ground water can be deduced from these contours, the direction being down gradient and at right angles to the contour lines. Thus, ground water in the vicinity of Lehi, according to figures 8 and 9, moves in a general southwesterly direction from a source east and northeast of the area. Local variations in the direction of movement are to be found near points of discharge

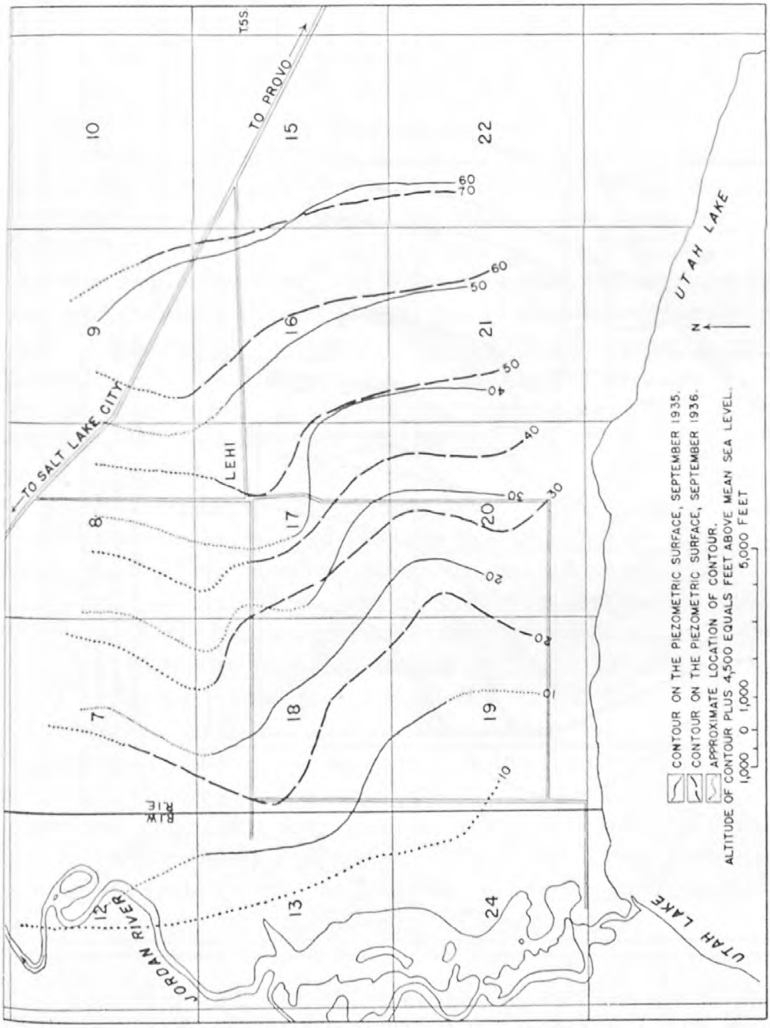


FIGURE 8.—Map of Lehi and vicinity, Utah County, Utah, showing contours on the piezometric surface during September 1935 and September 1936.

or of recharge. Thus the irregularities of the contour lines during September 1935 and September 1936 are caused chiefly by withdrawals from the aquifer by wells. The up-gradient bulge of the contour lines south and west of Lehi shows that withdrawals in this vicinity are greater than in adjacent areas. This is most clearly illustrated in September 1935. The contour lines for December 1936 are fairly straight and regularly spaced, no doubt because most of the flowing wells were then capped, and withdrawal of ground water was at a minimum. The reduction of the up-gradient bulge of the contours south and west of Lehi during December 1936 verifies the

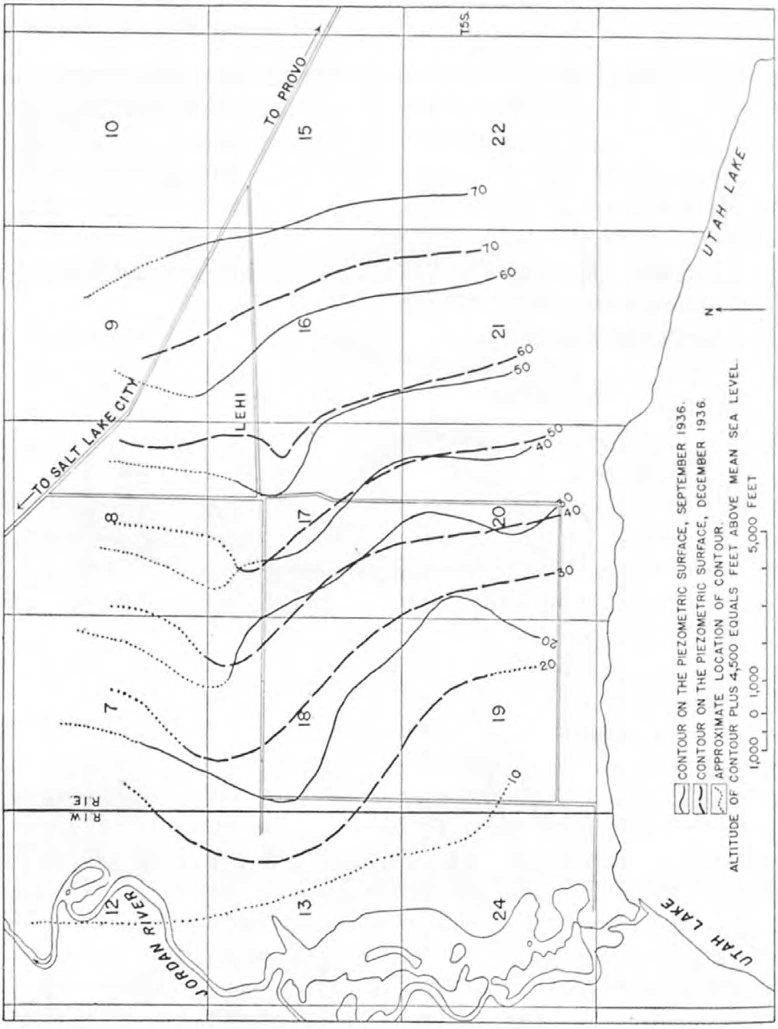


FIGURE 9.—Map of Lehi and vicinity, Utah County, Utah, showing contours on the piezometric surface during September and December 1936.

location of the greatest ground-water discharge as indicated by the September contours.

Contours bulging down gradient may indicate either greater ground-water discharge in the area along the sides of the bulge, greater ground-water recharge in the vicinity of or above the bulge, or less permeable material in the aquifer underlying the bulge, which maintains a high static level by retarding the movement of ground water through the aquifer and reducing the discharge through wells. The three sets of contours in figures 8 and 9 show a down-gradient bulge north and northwest of Lehi, although the control for the contours is not as good as desired, because of the sparseness of wells in this area. The bulge is caused partly by ground-water withdrawals south and west of Lehi, which greatly exceed the withdrawals north and northwest of Lehi. It is likely that the relatively low permeability of the aquifer in this area is the cause of the down-gradient bulge, as well as of the small number of wells and their poor yields.

The changes that occur in the position of the piezometric surface from time to time are indicative of the change of conditions throughout the entire basin. The contour lines in figures 8 and 9 furnish a basis for deducing the change in conditions at any point in the basin, rather than merely at the locations of the wells whose static levels were observed.

Between September 1935 and September 1936 the contours shifted down gradient, indicating a general rise of the altitude of the piezometric surface, which in turn denotes a general increase in pressure head of the wells and an increase in the amount of water available over the entire area. In general, the amount of shift ranged from about one-half to one contour interval, increasing from the southwest toward the northeast. Thus it is shown that the rise of static level was general, increasing the pressure head of individual wells about 5 feet in the western part of the area and as much as 10 feet in the eastern part. The contours represent ground-water conditions 1 year apart and during periods of similar ground-water demands. The increase of artesian pressure between September 1935 and September 1936 was probably caused by a combination of several factors. The year 1936 was not so dry as 1935, which probably resulted in less withdrawal from the artesian basin for irrigation. The regulation of flowing wells by State authorities to prevent wastage was probably more effective during the year prior to September 1936 than it was during the year prior to September 1935, which would result in higher artesian pressures. Furthermore, the ground-water recharge was probably greater during the year prior to September 1936 than it was during the year prior to September 1935.

Between September and December 1936 (fig. 9) the southwestward shift in contours indicates a further rise of head. Lines of equal rise are shown in figure 10. The greatest rise occurred in the area just south and west of Lehi. As this rise occurred during the fall of the year, when there was little ground-water recharge, it was undoubtedly caused by the seasonal closing of flowing wells. The rapidity with which the pressure head in wells in this area increases when nearby wells are made to cease flowing is illustrated by figure 6 and plate 14. Field observations have also shown that a general closing of flowing wells occurs in this area each year after the summer irrigation season.

The foregoing discussion pertains entirely to wells ranging in depth from about 130 to 200 feet. The piezometric surfaces for the deeper

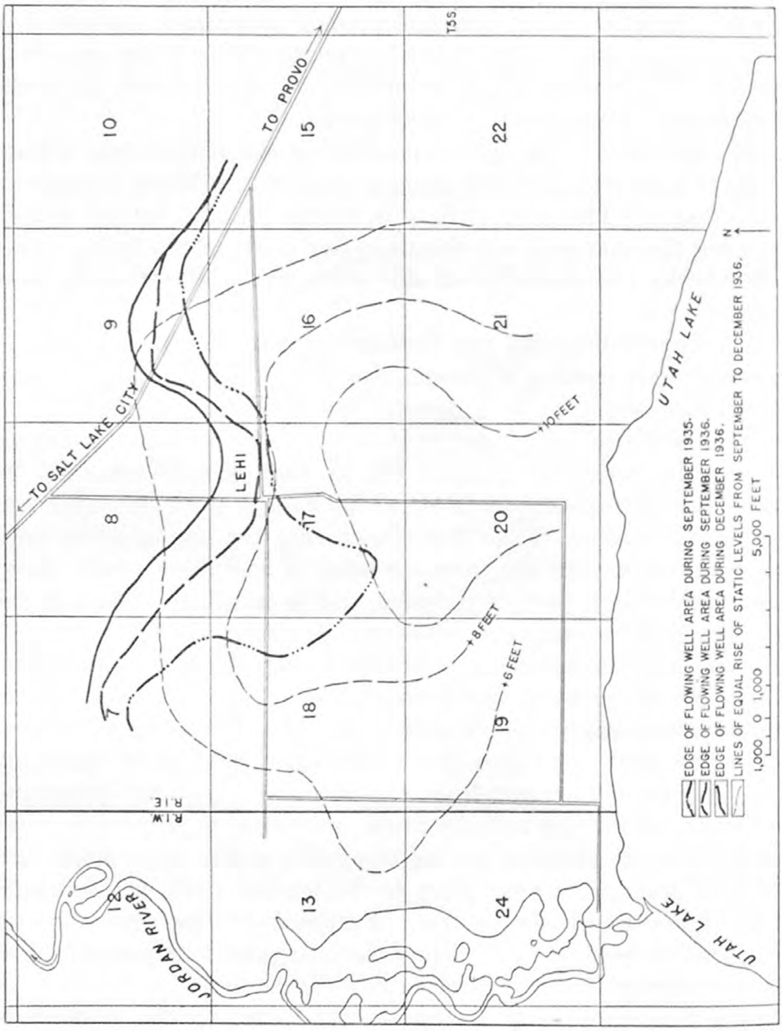


FIGURE 10.—Map of Lehi and vicinity, Utah County, Utah, showing edge of flowing-well area in 1935 and 1936 and lines of equal rise of static levels from September to December 1936.

aquifers could not be determined because of the small number and irregular distribution of the observed wells of these depths.

It has been pointed out that the seasonal fluctuations in deep aquifers are different than those in the shallow aquifers, and the annual change in static level may likewise be considerably different. Because of these differences, the piezometric surfaces of the two groups of aquifers would not necessarily be parallel, nor would changes in the position of one surface imply similar changes in the position of the other. Presumably, however, the piezometric surfaces on the deeper aquifers would have the same general southwestward slope in the vicinity of Lehi.

AREA OF ARTESIAN FLOW

The area of artesian flow is the land or water surface that lies below the piezometric surface, or, in other words, the area under which an artesian aquifer exists with sufficient pressure to bring water above the surface. Artesian conditions may and generally do exist beneath adjacent land lying at higher altitudes, but there the pressure within the aquifer is insufficient to lift the water above the land surface.

The area of artesian flow is largest when the artesian reservoir is full and the piezometric surface is high and smallest when the piezometric surface is low. In the vicinity of Lehi the area of artesian flow is largest during the winter and early spring and smallest during the summer and fall. Figure 10 shows the approximate edge of the area of artesian flow during September 1935, September 1936, and December 1936. This area was smallest during September 1935 and may have been even smaller during the fall of 1934, although available data indicate that it was about the same. Between September 1935 and September 1936 the area was increased about 535 acres, mainly as a result of an increase in ground-water storage during the period. Between September and December 1936 there was a further increase of about 245 acres, caused mainly by the closing of flowing wells and the subsequent rise of the piezometric surface.

INTERFERENCE TESTS

When water is withdrawn from a well, either by pumping or by artesian flow, the static level or pressure head is reduced a certain amount, which is termed the "draw-down." Because of this draw-down there is movement of water toward the well and a consequent lowering of static level or artesian pressure for some distance around the well. The area in which the static level is appreciably lowered is termed the "area of influence." This area ordinarily increases with a longer period of withdrawal and is also dependent upon the rate of withdrawal. If there is another well within the area of influence of a discharging well, there will be a lowering of the static level or pressure head in the adjacent well, and the first well is said to interfere with the second.[7] Furthermore, if the areas of influence of two wells overlap, the wells are said to interfere with each other, even though the operation of one well does not lower the static water level in the other well. This interference, although apparent in some places, may not be recog-

[7] Meinzer, O. E., Outline of ground-water hydrology: U. S. Geol. Survey Water-Supply Paper 494, p. 63, 1923.

nizable in others except by accurate measurements of the fluctuations of the static level in the wells.

Changes in the barometric pressure cause minor changes in the static level of artesian wells, but the changes in pressure during September 1936 (see pl. 13) were in general not sufficient to cause material changes in the results of the interference tests made during that month. No corrections have been applied to the measurements of static water level to compensate for changes in barometric pressure, but due consideration has been given to the possibility of barometric interference in making the interpretations shown on plate 13.

Data gathered during the operation of interference tests in the vicinity of Lehi consisted of frequent measurements of the static level in 29 selected observation wells, frequent checking to note any changes in the discharge of large wells in the vicinity other than those being tested, and the operation of recording gages on wells (D–5–1)16bd2, (D–5–1)17ac5 (see pl. 12–A), (D–5–1)17ca, (D–5–1)18ab1, and (D–5–1)20ab1. A few measurements were made of the static level in other wells. The manual measurements made during the interference tests are given in the following section. The complete record from the recording gages is available at the office of the Geological Survey at Salt Lake City.

Plate 13 shows the hydrographs of all wells in the vicinity of Lehi in which observations of the static level were made during the tests of interference between wells. The recording gages provide a continuous record of the changes in position of the static level. For the other wells, the positions of the static level at the time of periodic measurements are shown by circles, and these circles are connected by straight lines, although it is evident that the static level in these wells may have fluctuated considerably during the intervals between measurements. Measurements were made, so far as possible, to show the position of the static level before interference commenced, during the time of greatest interference, and after recovery from interference. In certain tests, especially where a well was operated by the owner for irrigation, it was not possible to make measurements at the most propitious time, and hence the hydrograph may not show the total amount of interference or the exact duration of the period in which this interference occurred. Also, in any well an apparent absence of effect in a certain test may really be the result of lack of measurements during the time the interference occurred. A few of the wells used for observation were allowed to flow intermittently for irrigation while the tests were being made. However, precautions were used to obtain an approximately true static head in those wells. A few wells were not closed during the entire series of tests, except for 10 minutes before each measurement of static level was made.

Plate 13 shows, by patterns or shading on the hydrograph of the wells believed to have been affected, the probable amount and extent of the interference with the static level in the wells caused by withdrawals from another well. Interference is clearly shown in nearby wells, but at greater distances it becomes less in amount until, near the limits of the area of influence of the operated well, it may be so small as to be confused with the effects of various other factors that may influence the static level in wells. Furthermore, the contemporaneous or overlapping operation of two or more wells makes the interference of individual wells largely a matter of interpretation. Thus the shaded or patterned areas shown on the hydrographs in plate 13 represent only our best interpretation of the interference caused during the tests.

The duration and rate of pumping from well (D-5-1)8dc was not as great as desired for a complete interference test of this well, and the maximum rate of discharge was only about half that reported as pumped during previous operations. A longer duration and greater rate of pumping would probably have caused greater interference than that which was obtained during the test made in September 1936. However, the pumping from the well apparently lowered the static water level in 18 of the 34 wells being observed, and the interference occurred over about 4.75 square miles. The greatest interference was in a southwesterly direction from the pumped well, although it extended in all directions in which observation wells were located. The test showed that the interference caused by pumping this well occurred chiefly in those wells which are between 130 and 200 feet deep.

Interference caused by the operation of seven other individual wells, spaced over the entire area investigated, was observed. These tests showed considerable interference from every well operated, and, in several instances, areas of influence of tested wells overlapped. Interference was apparent as far as 1.5 miles from one well and may have extended as far as 2 miles.

The operation of wells between about 130 and 200 feet in depth affected the water level in all nearby wells of similar depths, the amount and extent of the effect depending mainly upon the rate, continuity, and period of withdrawal of water. The operation of wells between about 130 and 200 feet in depth apparently does not interfere with wells of greater or less depths. The operation of wells about 300 feet in depth did not interfere with wells less than about 250 feet in depth. One observation well, about 400 feet deep, was apparently not affected by the operation of any of the test wells, all of which were less than 335 feet deep. These tests tend to verify the completeness of separation of the water-bearing strata at different depths, previously discussed. A disturbing factor affecting the interpretation of the data on interference tests is the conflicting reports on the depth of some of the wells.

TEST OF WELL (D-5-1)8dc

(Utah Emergency Drought Relief Administration and Lehi Irrigation Co., owners)

Well (D–5–1)8dc is 14 inches in diameter and is reported to have been drilled to a depth of 240 feet and the casing perforated opposite each aquifer between depths of 100 and 240 feet. Thus the artesian strata are connected and there is probably loss of water from the higher-pressure to the lower-pressure strata when the well is not discharging at the land surface.

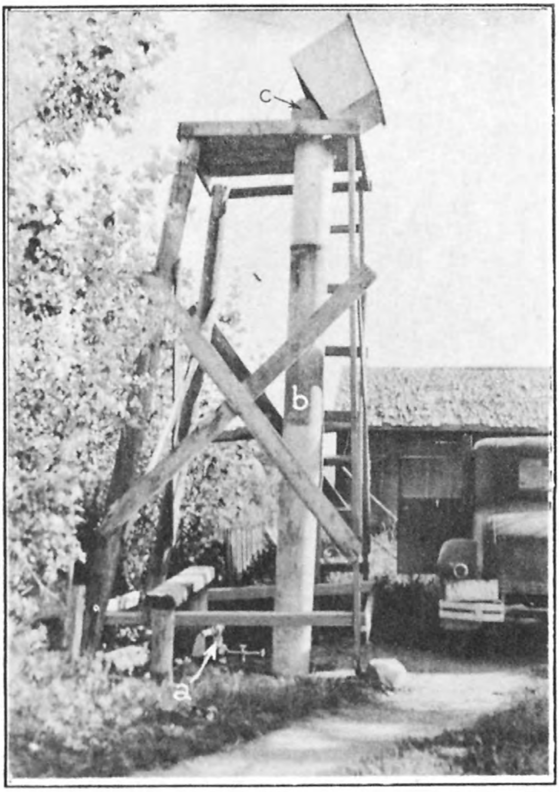
This well was pumped from 2:15 p. m. September 12 to 4:45 p. m. September 13, 1936; from 10 a. m. September 15 to 7:30 a. m. September 16; and from 10:10 a. m. to 8:50 p. m. September 16 (see pl. 12, *B*). The discharge from the well during these periods ranged from about 200 to 650 gallons a minute, and probably averaged about 350 gallons a minute. It was rather difficult to maintain a continuous flow from the well, as the well had partly filled with sand since it was last operated. Considerable sand had to be pumped and the well essentially redeveloped. The well could not be developed to its reported capacity—1,000 to 1,200 gallons a minute,—and the test had to be abandoned sooner than intended because of the settlement of the land surface at the well and a resulting settlement of the pump and pump-house floor.

The pumping from well (D–5–1)8dc visibly affected the static level in no observation well of greater depth than 200 feet with two exceptions. The indicated effect on the static level of well (D–5–1)18aa (pl. 13), which is reported as 285 feet deep, is problematical because of the contemporaneous operation of other wells, especially well (C–5–1)12dc. It is also uncertain whether the reported depth of this well is correct. The effect on the static level of well (D–5–1)9db is more apparent. The depth of this well was originally reported to be 207 feet, but the official State claim gives 265 feet as the correct depth; thus, the depth is questionable. Whatever the correct depth may be, it is probable that the well casing is perforated to draw upon aquifers between depths of 130 and 200 feet.

The interference between the pumped well and the observation wells was partly obscured by the operation of well (C–5–1)12dc, which interfered with many of the wells affected by pumping from well (D–5–1)8dc. Thus the effects of interference of the two wells are superimposed on the hydrographs of plate 13. In a few instances the discrimination of the interference caused by well (D–5–1)8dc alone is indefinite but, in general, its effect is believed to have been identified with reasonable certainty.

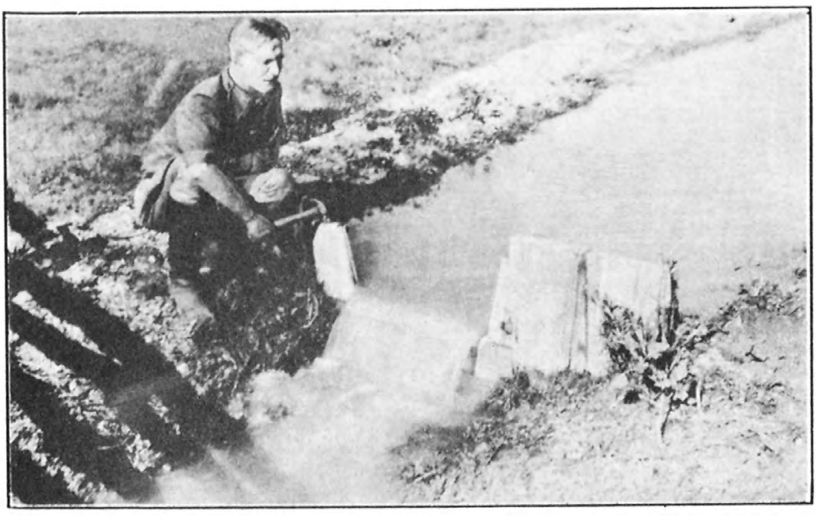
The area in which the static level in all observation wells, except those greater than about 250 feet deep, was affected by pumping from well (D–5–1)8dc is shown on figure 4. The area is elliptical, with the long axis about at right angles to the gradient of the piezometric surface, and the interference becomes less pronounced as the edge of the indicated area is approached. The recovery of the static level was apparently more rapid in the wells east, or up-gradient, than in the wells west, or down-gradient, from the pumped well.

Plate 14 shows the records for the week ended September 17, 1936, from recording gages operated on wells (D–5–1)17ac5 and (D–5–1)18ab1. Several factors other than the operation of well (D–5–1)8dc influence the two hydrographs. The passage of trains near the well caused the short vertical lines shown on the hydrograph of well (D–5–1)17ac5; this is especially apparent during September 10, 11, and 12. The operation of other flowing wells in the vicinity probably slightly affected the hydrographs of both wells; thus, the marked rise in the hydrograph of well (D–5–1)17ac5 during the nights of September 10–11, 11–12, and 14–15 and the cessation of the drop in the hydrograph for a time during the night of September 12–13 are probably caused by the daily operation of nearby flowing wells. The vertical lines extending downward on the hydrograph of well (D–5–1)-

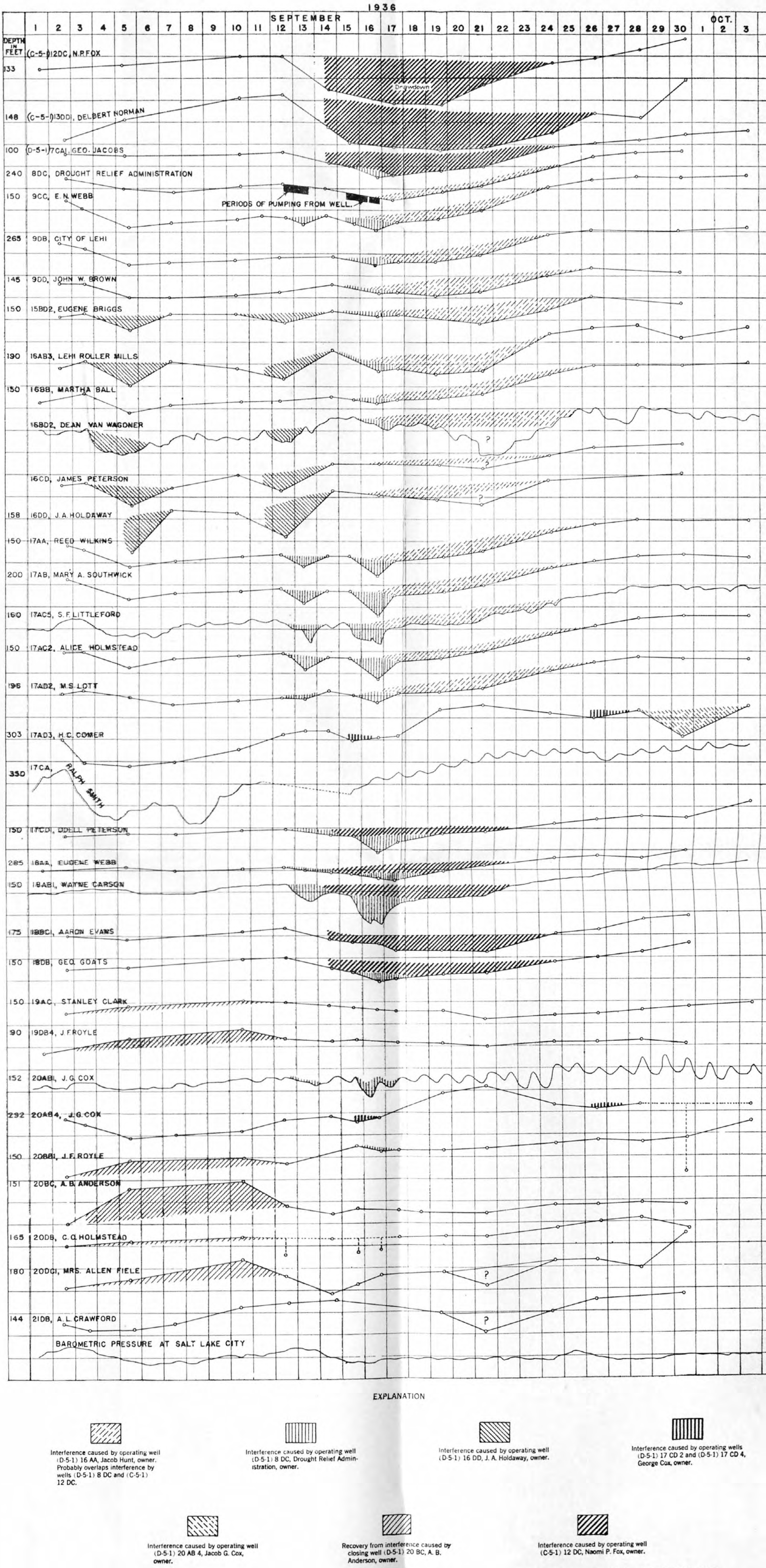


A. INSTALLATION OF AN AUTOMATIC WATER-STAGE RECORDING GAGE ON FLOWING WELL (D-5-1)17ac5.

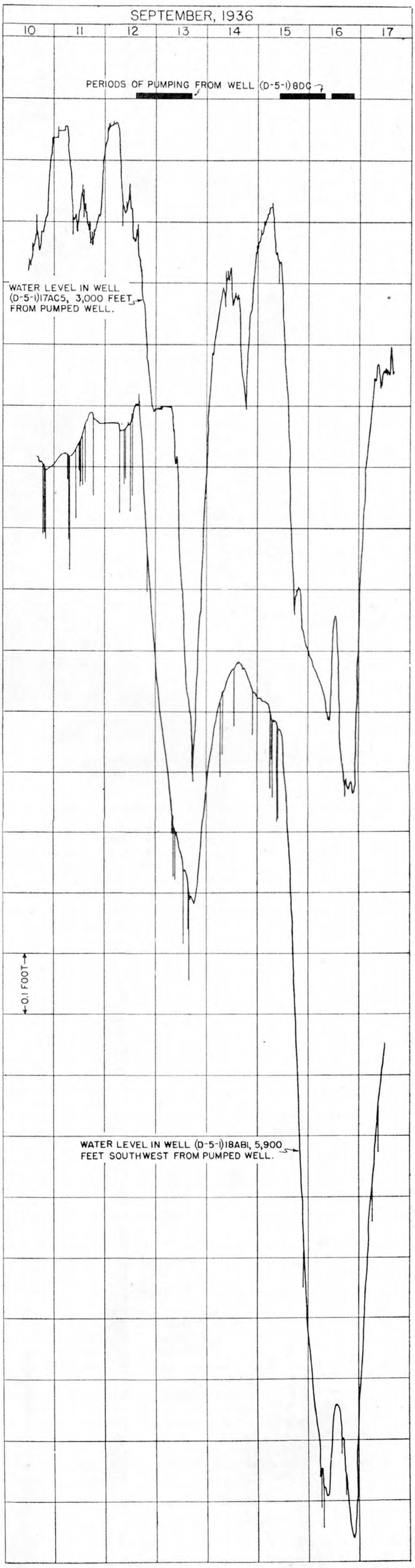
a, 3-inch flowing well; *b*, 10-inch riser pipe to accommodate a 7-inch float; *c*, automatic water-stage recording gage.



B. MEASURING THE DISCHARGE FROM WELL (D-5-1)8dc DURING A TEST OF INTERFERENCE WITH OTHER WELLS.



HYDROGRAPHS OF 34 WELLS IN THE VICINITY OF LEHI, UTAH COUNTY, UTAH, SEPTEMBER AND OCTOBER 1936.



FLUCTUATIONS OF WATER LEVELS IN WELLS (D-5-1)17ac5 AND (D-5-1)18ab1 MEASURED BY RECORDING GAGES.

18ab1 were caused by a momentary opening of a faucet on the well to draw water for the domestic use of the well owner.

The static level in wells adjacent to the pumped well (D–5–1)8dc began to change a short time after the beginning and ending of each period of pumping. Usually the lag of the draw-down and subsequent recovery of the water level in wells interfered with will increase as the distance from the operated well increases. Plate 14 shows a lag, ranging from about 1 to 2½ hours, of the draw-down and recovery of the water level in well (D–5–1)17ac5; and a similar lag, ranging from about 1 to 3 hours, in well (D–5–1)18ab1. However, the close relation between the wells is particularly shown on September 16, when the cessation of pumping from well (D–5–1)8dc for about 2½ hours caused a sharp rise of the static level in both wells. Although well (D–5–1)18ab1 is about twice as far from the pumped well as well (D–5–1)17ac5, the static level in well (D–5–1)18ab1 was lowered about twice the amount that it was lowered in well (D–5–1)17ac5. As no good producing wells have been developed between the pumped well and well (D–5–1)18ab1, this may indicate an irregular lens or channel of rather permeable material between the pumped well and well (D–5–1)18ab1 which has not been penetrated at intermediate locations.

The static level in wells (D–5–1)17ac5 and (D–5–1)18ab1 continued to decline markedly throughout each of the short periods of pumping. Had pumping continued indefinitely, it is presumed that the rate of decline would have become gradually less until eventually an approximate equilibrium of the static level in each well would be reached, after which the static level would remain fairly constant during the remainder of the period of pumping. It is safe to predict, however, that if this pump were operated continuously during an entire irrigation season, the decline of static levels before equilibrium is reached in nearby wells would be considerably greater than the decline observed in these tests. Furthermore, it is likely that in several wells that appeared to be unaffected by these short tests the static level would decline appreciably during a longer period of operation and thus the area of influence would be greater than that shown in figure 4.

TEST OF WELL (D–5–1)20bc

(A. B. Anderson, owner)

Well (D–5–1)20bc was flowing about 80 gallons a minute during the entire month of September except from September 3 to 11 (a. m.), inclusive, during which time the owner kept the well closed. The hydrographs on plate 13 show that closing well (D–5–1)20bc raised the static level in five adjacent wells of approximately the same depth. The area of influence of well (D–5–1)20bc apparently extends farther west than east of the well. The two wells east of the tested well are reported to be 14 and 29 feet deeper than the tested well, and the interference between these wells is not as definite as it is between the other three wells affected. The State claim for well (D–5–1)19db4 gives the depth of this well as 90 feet, although the depth reported at the time of gathering the data for this report was 150 feet. The maximum distance from the tested well to which probably interference was observed was about 3,400 feet. Interference with observation wells about the same distance northeast of the tested well was not detected.

TEST OF WELL (D–5–1)16dd

(J. A. Holdaway, owner)

Well (D–5–1)16dd was closed during September 1936 except between 4 p. m. September 3 and 5 p. m. September 5 and between 2 p. m. September 11 and 10 p. m. September 12. During these periods the well discharged about 600 gallons a minute. The hydrographs of observation wells on plate 13 show that interference probably occurred with all observation wells within a radius of 4,000 feet of the operated well when the well was open. The depth of two of the wells that were affected is unknown; one is about the same depth and one is about 32 feet deeper than the operated well. The interference appeared to extend about equally in all directions from the operated well. Between September 3 and 5 the change in barometric pressure may have exaggerated the interference of the operated well but similar interference was again observed on September 11 and 12, when the changes in barometric pressure were negligible.

TEST OF WELL (C–5–1)12dc

(N. P. Fox, owner)

The operation of well (C–5–1)12dc between 10 a. m. September 14 and 11 a. m. September 21 was necessitated by irrigation demands although it conflicted with the interference test of well (D–5–1)8dc. During this period well (C–5–1)12dc flowed about 400 gallons a minute. Although the interference with the static level in the observation wells caused by the operation of this well and well (D–5–1)8dc is superimposed in the hydrographs shown on plate 13, the effects can be more or less definitely separated in most instances.

The operation of well (C–5–1)12dc affected the static level in all observation wells within a radius of 1.5 miles from the operated well. The fluctuations of the static level in wells (D–5–1)19ac, (D–5–1)19db4, (D–5–1)20bbl, and (D–5–1)20bc, located between 1.5 and 2 miles from the operated well, suggest some interference. The static level in well (D–5–1)17cd1, about 2 miles distant, was definitely lowered during this test period, but a part of the lowering may have been caused by the interference of other wells, located east of this well, which were being operated. The same overlapping of effects may also apply to well (D–5–1)18aa. The discharge from this well was presumably about the same as that from well (D–5–1)8dc during the periods of tests described on page 130. The greater area of influence of well (C–5–1)12dc here indicated is attributed chiefly to the longer period of operation.

The reported depths of the observation wells affected by the operation of well (C–5–1)12dc, which is 133 feet deep, ranged from 100 to 285 feet. The operated well is located in the western part of the area investigated, and no observations were made of the static level in wells west or north of the operated well.

TEST OF WELL (D–5–1)16aa

(Jacob Hunt, owner)

During September 1936 well (D–5–1)16aa, reported depth 140 feet, flowed at a rate of about 150 gallons a minute from about noon September 16 to the afternoon of September 22. This well was operated by the owner for irrigation, and the period of operation coincided with the period during which other wells were being operated.

The effect on the static levels of the observation wells caused by pumping well (D–5–1)8dc was sufficiently apparent to be distinguished from the operation of well (D–5–1)16aa in most instances. The interference caused by well (C–5–1)12dc during about the same period probably extended into the area affected by the operation of well (D–5–1)16aa, and discrimination of the two effects is not possible in the part of the area that lies about midway between the two wells. Another well, owned by the Lehi Irrigation Co. and located a short distance north of Lehi, had been pumped continuously during the summer and was shut down at 8 a. m. September 21. The cessation of pumping from this well may have caused a rise in several of the observation wells and account for part of the interference attributed to well (D–5–1)16aa. This is suggested by the record from well (D–5–1)17ac5, which showed a marked rise in the static water level on September 21, followed by a more gradual rise over a period of about 6 days.

Plate 13 indicates that the interference by well (D–5–1)16aa probably extended to all observation wells within a radius of about 1¼ miles from the operated well. A lowering of the static level in wells (D–5–1)8dc and (D–5–1)21db, about 1.3 and 1.35 miles distant, is suggested by their hydrographs. Because of the complications created by operation of other wells the figures for the extent of interference may be considerably in error. The depths of the wells probably affected by operating well (D–5–1)16aa ranged from 145 to 265 feet, and the interference extended about equally in all directions from the operated well.

TEST OF WELLS (D–5–1)17dc2 AND (D–5–1)17dc4

(George Cox, owner)

One or both of these wells were operated during the days of September 15 and 26. These wells are 334 and 328 feet in depth, respectively, and are the deepest wells tested. The operation of these wells apparently did not affect any of the observation wells between the depths of 130 and 200 feet. The hydrographs on plate 13 show, however, that the static level in two wells of similar depth, Nos. (D–5–1)17ad3 and (D–5–1)20ab4, was lowered when the operated wells were open. These wells are about 2,500 and 1,000 feet, respectively, from the operated wells. Well (D–5–1)18aa, 285 feet deep and about 1 mile distant, was apparently not affected; neither was well (D–5–1)17ca, 400 feet deep and about 2,100 feet distant.

TEST OF WELL (D–5–1)20ab4

(J. G. Cox, owner)

Well (D–5–1)20ab4 is 292 feet deep and discharged about 120 gallons a minute from 1:20 p. m. September 28 to 1:50 p. m. September 30. The only observed interference caused by this discharge was on well (D–5–1)17ad3, 303 feet deep and about 3,400 feet distant. The static level in this well was lowered about 1.25 feet during the operation. Apparently the operation of this well affects the static level only in other wells of similar depth and does not interfere with most of the wells in the area which are between about 130 and 200 feet in depth.

SUMMARY

Ground water occurs in the vicinity of Lehi as shallow water not under artesian pressure and artesian water in aquifers lying at depths between about 75 and 400 feet. Deeper aquifers are probable. The artesian and nonartesian water bodies are separated by a clay bed of variable thickness under the area considered in this report; the two bodies probably merge into one body having water-table conditions under the higher bench lands adjacent to the mountains north and east of Lehi. Ground-water recharge probably occurs to some extent by direct penetration of precipitation and irrigation water but chiefly by seepage from surface streams and irrigation canals on the permeable bench lands. Ground-water discharge from the shallow water body occurs mainly by evaporation, transpiration, and movement toward Utah Lake; discharge from the artesian-water body

probably occurs mainly through flowing wells, most of which are between 130 and 200 feet in depth. There is doubtless some natural discharge occurring from the artesian aquifers by upward movement through the clay confining beds. The artesian strata are separated by more or less continuous clay layers, their continuity and the isolation of the artesian aquifers probably becoming less pronounced as the adjacent mountains are approached.

Available data indicate that the artesian head was about the same in 1934 as in 1904. No information has been found concerning the head between 1904 and 1934. Measurements made during September 1934 and September 1935 show similar head. Measurements made during September 1936 show that the rise of water levels in artesian wells between 130 and 200 feet deep since September 1935 ranged between 5 and 10 feet. The rise was greatest in the eastern part of the area and least in the western part. The rise of the groundwater levels between September 1935 and September 1936, at which times the conditions of discharge from flowing wells were similar, indicate that the amount of recharge to the artesian reservoir probably exceeded the amount of discharge during that period. The groundwater withdrawals may have been less during 1936 than during 1935; and better control of artesian wells to prevent wastage probably existed during 1936 than during 1935. Measurements show a rise of the water levels ranging between 5 and 10 feet between September and December 1936. This rise was caused mainly by the closing of flowing wells when irrigation ceased and was greatest in an area just south and southwest of Lehi, indicating this as the area of greatest seasonal ground-water discharge. Thus the benefits resulting from strict artesian well control are obvious.

During the period of observation, between September 1935 and January 1937, the static water level was generally highest during March or April and lowest during August or September. The time of occurrence and the altitude of the lowest annual water level is governed mainly by the demand for irrigation water from wells, which in turn depends to some extent upon the amount of precipitation during the summer. The maximum fluctuation of the static level in a well in the intensively developed area south of Lehi was about 16 feet and occurred during 1936.

The area of artesian flow varies from time to time, depending upon the altitude of the piezometric surface. This factor, which also controls the rate and quantity of water recoverable through flowing wells, is in turn governed by the relative amounts of ground-water recharge and discharge. Thus, with similar rates and quantities of discharge, the altitude of the piezometric surface and the area of artesian flow are directly related to the amount of annual precipitation, which regulates the ground-water recharge.

A series of tests of the interference between artesian wells shows that the operation of any well in general lowers the static level in other wells of similar depth in the vicinity. No interference appeared to exist between wells about 130 to 200 feet in depth with the static level in wells more than 275 feet deep, indicating a general separation of the artesian aquifers. A decrease of the static level in wells up to 1.5 miles from an operated well was observed and, in one test, interference with the static level in a well about 2 miles distant from an operated well was suggested. The amount of interference between wells and the distance to which the interference will extend from an operated well depend, within limits, upon the rate, continuity, and period of withdrawal of water.

WELL LOGS

Log of well (C-5-1)13dd1, State claim No. 11090, Delbert F. Norman, owner

[From owner's memory]

	Thickness	Depth		Thickness	Depth
	Feet	*Feet*		*Feet*	*Feet*
Clay, blue	60	60	Sand, small flow of water	1±	121
Sand, small flow H_2S water	15	75	Clay and sand, yellow	16	137
Clay and sand, yellow	23	98	Sand, small flow of water	1±	138
Gravel, coarse, flowing water	2	100	Clay and sand, yellow	8±	146
Clay and sand, yellow	20	120	Gravel, flowing water	2±	148

NOTE.—Well cased to 148 feet; casing perforated (shot) at depths of about 98 and 123 feet.

Log of well (D-5-1) 8dc, State claim No. 8367, Utah Emergency Drought Relief Administration and Lehi Irrigation Co., owners

[From driller's record]

	Thickness	Depth		Thickness	Depth
	Feet	*Feet*		*Feet*	*Feet*
Gravel	3	3	Clay, yellow	34	142
Sand and gravel	4	7	Clay and gravel, water	9	153
Clay, light	13	20	Gravel, good water	21	174
Clay and gravel, some water	5	25	Clay, yellow	4	178
Clay, brown	12	37	Gravel, good water	12	190
Sand and gravel, some water	3	40	Clay, yellow	5	195
Clay, sandy, blue	39	79	Gravel, good water	12	207
Gravel, water	7	86	Clay	8	215
Clay	4	90	Sand, water	19	234
Clay and boulders, some water	9	99	Clay, sandy; entered blue clay	6	240
Gravel, coarse, good water	9	108			

NOTE.—Well cased 240 feet; casing perforated nearly the entire depth.

Log of well (D-5-1)10ca, unclaimed, Utah Emergency Drought Relief Administration, owner

[From driller's record]

	Thickness	Depth		Thickness	Depth
	Feet	*Feet*		*Feet*	*Feet*
Soil	8	8	Gravel and clay	12	284
Sand	40	48	Clay	23	307
Clay, sandy	15	63	Clay and gravel	15	322
Gravel, and sand, fine	11	74	Clay	18	340
Clay	20	94	Sand and clay	4	344
Clay and sand	8	102	Clay	8	352
Gravel and boulders	47	149	Sand and clay	6	358
Clay, yellow	17	166	Boulders and clay	20	378
Clay and sand	43	209	Clay, yellow	2	380
Gravel and clay	36	245	Boulders and clay	2	382
Gravel, water	8	251	Clay	2	384
Clay	3	254	Clay and sand	12	396
Gravel, water	18	272	Clay	4	400

NOTE.—Drilled with solid tool drilling machine by F. G. Farris. Depth to water, about 60 feet below surface Sept. 18, 1935. Reported as cased with 140 feet of 12-inch casing and 170± feet of 10-inch casing.

Log of well (D-5-1)15dd2, State claim No. 1151, Heber Barratt, owner

[From driller's report]

	Thickness	Depth		Thickness	Depth
	Feet	*Feet*		*Feet*	*Feet*
Soil	3	3	Gravel	50	90
Gravel	12	15	Clay and sand	95	185
Clay	25	40	Gravel, water-bearing	14	199

NOTE.—Flowing 90 gallons a minute July 12, 1935; pressure head 11.5 feet above land surface July 12, 1935; well casing perforated between 193 and 199 feet.

Log of well (D-5-1)17ad3, State claim No. 11174, Heber C. Comer, owner and driller

[From State claim]

	Thickness	Depth		Thickness	Depth
	Feet	*Feet*		*Feet*	*Feet*
Soil	4	4	Clay	50	160
Gravel	16	20	Sand and clay	100	260
Clay	30	50	Gravel, stratified and water-bearing	43	303
Sand and gravel	60	110			

NOTE.—Pressure head 22.5 feet when drilled in spring of 1933; well cased to 303 feet; casing perforated (shot) at about 270 feet.

MEASUREMENTS OF THE STATIC WATER LEVEL IN WELLS

In the following tabulation the wells measured are arranged in numerical order, following the well-numbering system described on page 110. The well number is followed by the owner's name and by the number assigned by the State engineer to the owner's claim for underground water. The depth and diameter of the well are then shown, followed by a description of the point from which the measurements of static water level were made. The altitude of the measuring point, or land surface, is then given in feet above sea level, United States

Geological Survey datum, as obtained from the office of the State engineer. Measurements of the depth to water were made to the nearest hundredth of a foot. Measurements of pressure head, if less than 4.0 feet, were made to the nearest hundredth of a foot; if over 4.0 feet, the measurements were made by a mercury manometer pressure gage and are believed to be accurate to the nearest five-hundredths of a foot. If a well was found flowing, the measurements of static level by the Geological Survey were made after the flow from the well had been stopped 10 minutes. The method of other agencies for measuring the static level in flowing wells is not known.

For wells on which recording gages were maintained, only the manual measurements of the static level and the first and last noon measurement obtained by the recording gage are given. The hydrographs from the recording gages are shown on plate 13, and the complete gage records are available at the office of the Federal Geological Survey at Salt Lake City.

Depth to water level (−) or pressure head (+), in reference to measuring point

(C-5-1)**12ba1.** Salt Lake City Corporation No. 46U. State claim No. 1762. Depth, 70 to 90 feet; diameter, 2 inches. Measuring point, top of casing, 1.0 foot above land surface. Altitude of surface, 4,491.2 feet, by Salt Lake City Corporation. Pressure head: September 18, 1935, 15.0 feet. Found plugged with concrete in 1936.

(C-5-1)**12ba2.** Salt Lake City Corporation No. 45U. State claim No. 1761 Depth, 70 to 90 feet; diameter, 2 inches. Measuring point, top of casing, 1.0 foot above land surface. Altitude of surface, 4,490.0 feet, by Salt Lake City Corporation. Pressure head: September 11, 1936, 17.9 feet.

(C-5-1)**12dc.** Naomi P. Fox. State application No. 11868. Depth, 133 feet; diameter 5 inches. Measuring point, top of casing, 1.0 foot above land surface.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 17, 1935	12:50 p. m.	[1] +10.45	Sept. 19, 1936	4:40 p. m.	[1] +13.8
Sept. 1, 1936	2:30 p. m.	+15.4	Sept. 21, 1936	11 a. m.	([3])
Sept. 5, 1936	10 a. m.	+15.6	Do	3:30 p. m.	+14.7
Sept. 10, 1936	3:40 p. m.	+16.0	Sept. 24, 1936	5:20 p. m.	+15.7
Sept. 12, 1936	12:20 p. m.	+16.0	Sept. 26, 1936	3:30 p. m.	+15.9
Sept. 14, 1936	10 a. m.	([2])	Sept. 28, 1936	4:15 p. m.	+16.3
Do	3:10 p. m.	[1] +14.5	Sept. 30, 1936	4:45 p. m.	+16.8
Sept. 15, 1936	1:20 p. m.	[1] +14.25	Dec. 23, 1936	3:30 p. m.	+20.1
Sept. 17, 1936	1 p. m.	[1] +13.85			

[1] Found flowing (385 gallons per minute on Sept. 17, 1935).
[2] Well opened by owner.
[3] Well closed by owner.

(C-5-1)**13aa.** Blanch E. Evans. State claim No. 11006. Depth, 100 feet, diameter, 2 inches. Measuring point, top of casing, at land surface; altitude of surface, 4,503.80 feet. Pressure head: September 17, 1935, 8.4 feet (found flowing); September 11, 1936, 12.25 feet.

(C-5-1)**13dd1.** Delbert Norman. State claim No. 11090. Depth, 148 feet; diameter, 5 inches. Measuring point, top of 5-inch ell, 1 foot above land surface; altitude of surface, 4,499.00 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 17, 1935	12:15 p. m.	[1] +9.50	Sept. 17, 1936	1:15 p. m.	+10.9
Oct. 23, 1935	1:10 p. m.	+13.25	Sept. 19, 1936	4:15 p. m.	+10.75
July 18, 1936	4 p. m.	+9.9	Sept. 21, 1936	3 p. m.	+10.85
Aug. 9, 1936	4:15 p. m.	+12.1	Sept. 24, 1936	5 p. m.	+11.5
Sept. 2, 1936	5 p. m.	+11.2	Sept. 26, 1936	3:50 p. m.	+12.4
Sept. 5, 1936	10:30 a. m.	+12.1	Do	4 p. m.	([2])
Sept. 10, 1936	3:10 p. m.	+13.1	Sept. 28, 1936	4:30 p. m.	([3])
Sept. 12, 1936	12:45 p. m.	+13.25	Do	4:40 p. m.	+12.2
Sept. 14, 1936	2:45 p. m.	+11.8	Sept. 30, 1936	5 p. m.	+13.95
Sept. 15, 1936	1:45 p. m.	+11.1	Dec. 24, 1936	2:30 p. m.	+19.5

[1] Flow measured 180 gallons per minute.
[2] Well opened.
[3] Well closed; in operation 48½ hours; found flowing 250 gallons per minute.

(C–5–1)13dd2. Bank of American Fork. State claim No. 11822. Depth, 165 feet; diameter, 2 inches. Measuring point, top of ell, 1.25 feet above land surface; altitude of surface, 4,499.58 feet. Pressure head: September 17, 1935, 8.75 feet; October 23, 1935, 12.50 feet.

(D–5–1)7ac. Stenia Radmal. Depth, 58 feet; diameter, 1½ inches. Measuring point, top of coupling on casing, 1.2 feet above land surface.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 18, 1935	3:15 p. m.	−9.65	Sept. 19, 1936	5 p. m.	−5.97
Sept. 11, 1936	10:15 a. m.	−5.64	Sept 21, 1936	2:10 p. m.	−6.02
Sept. 14, 1936	3:20 p. m.	−5.91	Sept. 24, 1936	5:40 p. m.	−6.09
Sept. 15, 1936	1 p. m.	−5.95	Sept. 26, 1936	3:10 p. m.	−6.14
Sept. 16, 1936	7:30 p. m.	−6.03	Sept. 28, 1936	3:50 p. m.	−6.16
Sept. 17, 1936	12:30 p. m.	−6.05	Dec. 23, 1936	4:10 p. m.	−5.50

(D–5–1)7ca1. George Jacobs. State claim No. 1847. Depth, 100 feet; diameter 2 inches. Measuring point, top of casing at land surface; altitude of surface, 4,522.90 feet. Found flowing prior to all measurements during 1936.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Oct. 5, 1934		[1] +2.75	Sept. 16, 1936	7:30 p. m.	+0.10
Sept. 11, 1935	4:50 p. m.	−2.44	Sept. 17, 1936	12:40 p. m.	+.22
July 21, 1936	2:30 p. m.	+.55	Sept. 19, 1936	5 p. m.	+.38
Aug. 9, 1936	4:40 p. m.	+.85	Sept. 21, 1936	2:15 p. m.	+.58
Sept. 2, 1936	5:20 p. m.	+1.13	Sept. 24, 1936	5:30 p. m.	+1.48
Sept. 5, 1936	9:50 a. m.	+1.05	Sept. 26, 1936	3:20 p. m.	+1.65
Sept. 10, 1936	4 p. m.	+1.15	Sept. 28, 1936	3:50 p. m.	+1.83
Sept. 12, 1936	1:15 p. m.	+1.27	Sept. 30, 1936	4:30 p. m.	+2.05
Sept. 14, 1936	3:20 p. m.	+.77	Oct. 3, 1936	1:30 p. m.	+2.25
Sept. 15, 1936	1:05 p. m.	+.65	Dec. 23, 1936	4 p. m.	+5.7

[1] Measured by Kenneth Borg and John M. Neff, probably from top of ½-inch pipe, 1.0 foot above land surface.

(D–5–1)8dc. Drought Relief Administration. State claim No. 8367. Depth, 240 feet; diameter, 14 inches. Measuring point, bottom of inspection opening in pump, 1.1 feet above land surface. Altitude of surface, 4,555.00 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 12, 1935		−22.77	Sept. 13, 1936	4:45 p. m.	(1)
Oct. 23, 1935	2:15 p. m.	−20.07	Sept. 14, 1936	10:40 a. m.	−19.01
July 21, 1936	5:15 p. m.	−19.47	Sept. 15, 1936	10 a. m.	(2)
Aug. 9, 1936	5:30 p. m.	−18.93	Sept. 16, 1936	7:30 a. m.	(3)
Aug. 18, 1936	11 a. m.	−18.11	Sept. 17, 1936	12 m.	[4] −19.53
Aug. 28, 1936	5:40 p. m.	−18.92	Sept. 19, 1936	6 p. m.	−18.94
Sept. 2, 1936	6 p. m.	−18.57	Sept. 21, 1936	12:30 p. m.	−18.65
Sept. 5, 1936	9:15 a. m.	−19.04	Sept. 26, 1936	12:50 p. m.	−17.35
Sept. 7, 1936	3:30 p. m.	−19.09	Sept. 28, 1936	11:45 a. m.	−17.14
Sept. 10, 1936	4:30 p. m.	−18.91	Sept. 30, 1936	1:15 p. m.	−17.09
Sept. 12, 1936	1:30 p. m.	−18.81	Dec. 22, 1936	4:50 p. m.	−12.25
Do.	2:15 p. m.	(5)			

[1] Pump shut off.
[2] Pump started; 6-inch valve nearly closed; pumping about 200 gallons per minute; 3 p. m., 6-inch valve opened wide; pumping estimated as 500 to 550 gallons per minute.
[3] 7:30 a. m., pump shut off. 10:10 a. m., pump started with 6-inch valve half open; pumping estimated at 200 to 300 gallons per minute. 12 m., 6-inch valve opened wide; pumping estimated as 500 to 550 gallons per minute. 3 p. m., 6-inch valve removed, 9-inch pipe open; pumping (measured) 600 to 650 gallons per minute. 8:50 p. m., pump shut off on account of caving.
[4] Measuring point has probably sunk 0.1 to 0.2 foot.
[5] Pump started. Pumping about 200 gallons per minute; considerable sand.

(D-5-1)9cc. E. N. Webb. Depth, 150 feet; diameter, 1½ inches. Measuring point, top of casing, 0.5 foot below land surface; altitude of surface, 4,562.07 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 18, 1935	9:30 a. m.	−10.42	Sept. 10, 1936	11:30 a. m.	−4.02
Sept. 27, 1935	5 p. m.	−8.68	Sept. 11, 1936	2:10 p. m.	−3.86
Oct. 23, 1935	10:15 a. m.	−6.85	Sept. 12, 1936	9:20 a. m.	−3.93
Nov. 9, 1935	4:30 p. m.	−4.64	Do.	4:25 p. m.	−3.95
Nov. 19, 1935	12:10 p. m.	−3.98	Sept. 13, 1936	10:50 a. m.	−4.23
Dec. 10, 1935	2:45 p. m.	−3.05	Sept. 14, 1935	11:30 a. m.	−3.85
Jan. 2, 1936	4:25 p. m.	−2.55	Sept. 15, 1936	5:45 p. m.	−4.21
Jan. 22, 1936	12:45 p. m.	−2.62	Sept. 16, 1936	5:40 p. m.	−4.51
Mar. 2, 1936	11:40 a. m.	−1.50	Sept. 17, 1936	4:10 p. m.	−4.14
May 2, 1936	4:10 p. m.	−3.55	Sept. 19, 1936	1 p. m.	−4.01
June 20, 1936	1:30 p. m.	−4.33	Sept. 21, 1936	12 m.	−3.62
July 6, 1936	8:30 p. m.	−5.74	Sept. 24, 1936	12:40 p. m.	−2.50
July 18, 1936	10:05 a. m.	−4.35	Sept. 26, 1936	11:40 a. m.	−2.20
Aug. 9, 1936	10:20 a. m.	−3.85	Sept. 28, 1936	11:30 a. m.	−2.05
Aug. 18, 1936	11:10 a. m.	−2.05	Sept. 30, 1936	12 m.	−2.11
Aug. 28, 1936	5:30 p. m.	−4.10	Oct. 3, 1936	11:10 a. m.	−2.03
Sept. 2, 1936	5:45 p. m.	−3.16	Oct. 19, 1936	12:50 p. m.	−.90
Sept. 3, 1936	11:30 a. m.	−3.53	Dec. 1, 1936	4 p. m.	+2.51
Sept. 5, 1936	2:30 p. m.	−4.36	Dec. 22, 1936	3:30 p. m.	+2.65
Sept. 7, 1936	11 a. m.	−4.18			

(D-5-1)9cd1. Hiram Gray. State claim No. 4949. Depth, 250 feet; diameter, 1½ inches. Measuring point, top of tee on casing, 0.5 foot above land surface. Depth to water level: September 18, 1935, 4.36 feet; reported start of flow in June 1936. Pressure head: September 11, 1936, 3.57 feet; December 22, 1936, 6.2 feet.

(D-5-1)9cd2. Wm. Racker estate. Depth, 57 feet; diameter, 2 inches. Measuring point, top of horizontal outlet of tee, 2.2 feet above land surface. Altitude of surface, 4,556.36 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 18, 1935	9:45 a. m.	−5.49	Sept. 11, 1936	2:10 p. m.	−3.43
Oct. 23, 1935	10:10 a. m.	−4.68	Sept. 16, 1935	5:40 p. m.	−3.45
July 18, 1936	do.	−2.83	Sept. 19, 1936	1 p. m.	−3.50
Aug. 9, 1936	10:30 a. m.	−2.80	Dec. 22, 1936	3:20 p. m.	−2.62
Aug. 29, 1936	11:30 a. m.	−3.29			

(D–5–1)9cd3. City of Lehi and Lehi Irrigation Co. State claim No. 10991. Depth, 300 (?) feet; diameter, 4 inches. Measuring point, top of casing, 1.5 feet above land surface; altitude 4,553.40 feet. Pressure head: September 11, 1936, 32.0 feet (found flowing); December 22, 1936, 32.5 feet.

(D–5–1)9db. City of Lehi. State application No. 11684; State claim No. 11083. Depth, 265 feet; diameter, 12 inches. Measuring point, top of iron pump base, 3.1 feet below land surface.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
July 30, 1935	3 p. m.	−24.50	Sept. 3, 1936	2:20 p. m.	−16.85
Aug. 30, 1935	11:10 a. m.	−23.88	Sept. 5, 1936	2:45 p. m.	−17.53
Sept. 13, 1935	4:15 p. m.	−24.31	Sept. 7, 1936	10 a. m.	−17.41
Oct. 7, 1935	1 p. m.	−22.87	Sept. 10, 1936	9:30 a. m.	−17.28
Oct. 23, 1935	3 p. m.	−22.28	Sept. 12, 1936	8:50 a. m.	−17.16
Nov. 9, 1935		(1)	Sept. 14, 1936	6:40 p. m.	−17.13
Nov. 19, 1935		(1)	Sept. 16, 1936	8:40 p. m.	−17.49
Dec. 3, 1935	6:20 p. m.	[1] −18.15	Sept. 17, 1936	5:15 p. m.	−17.33
Dec. 13, 1935	5:40 p. m.	[1] −16.96	Sept. 19, 1936	10 a. m.	−17.34
Jan. 2, 1936	4:20 p. m.	[1] −16.50	Sept. 21, 1936	10:15 a. m.	−17.05
Jan. 22, 1936	12:30 p. m.	[1] −16.48	Sept. 24, 1936	10:40 a. m.	−16.13
Mar. 2, 1936	11:50 a. m.	[1] −13.85	Sept. 26, 1936	10:30 a. m.	−15.84
May 2, 1936	4 p. m.	[1] −18.29	Sept. 30, 1936	10:40 a. m.	−15.91
June 21, 1936	2 p. m.	−17.88	Oct. 3, 1936	10:45 a. m.	−15.74
July 18, 1936	10:20 a. m.	−17.82	Oct. 19, 1936	1:30 p. m.	−15.12
Aug. 9, 1936	10:10 a. m.	−17.35	Dec. 1, 1936	3:50 p. m.	[1] −8.84
Sept. 2, 1936	10:40 a. m.	−16.53	Dec. 22, 1936	10 a. m.	[1] −11.48

[1] Water from city's surface supply flowing into well.

(D–5–1)9dd. John W. Brown. State claim No. 10921. Depth, 145 feet; diameter, 1½ inches. Measuring point, top of casing, 0.25 foot above land surface. Altitude of surface, 4,569.3 feet. Found flowing prior to measurements of July 18 to September 30, 1936, inclusive.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 18, 1935	10:10 a. m.	−3.63	Sept. 12, 1936	9 a. m.	+5.25
Oct. 23, 1935	9:15 a. m.	−1.40	Sept. 14, 1936	5:30 p. m.	+5.6
Nov. 9, 1935	4:40 p. m.	+.20	Sept. 16, 1936	8:30 p. m.	+5.2
Dec. 10, 1935	2:55 p. m.	+1.49	Sept. 17, 1936	5 p. m.	+5.25
July 18, 1936	10:45 a. m.	+4.9	Sept. 19, 1936	10:30 a. m.	+5.1
Aug. 9, 1936	10:10 a. m.	+5.5	Sept. 21, 1936	do	+5.25
Sept. 2, 1936	11 a. m.	+5.6	Sept. 24, 1936	10:50 a. m.	+6.00
Sept. 3, 1936	2:10 p. m.	+5.6	Sept. 26, 1936	10:40 a. m.	+6.35
Sept. 5, 1936	2:50 p. m.	[1] +5.0	Sept. 30, 1936	10:50 a. m.	+6.15
Sept. 7, 1936	10:10 a. m.	+5.0	Dec. 22, 1936	10:20 a. m.	+8.9
Sept 10, 1936	9:40 a. m.	+5.1			

[1] Flow measured 2 gallons per minute.

(D–5–1)15bb. Charlotte M. Britton. State claim No. 960. Depth, 160 feet; diameter, 2 inches. Measuring point, top of tee, 1.25 feet above land surface. Altitude of surface, 4,553.17 feet. Pressure head: September 20, 1935, 9.1 feet.

(D–5–1)15bd1. Eugene Briggs. State claim No. 5060. Depth, 150 feet; diameter, 2 inches. Measuring point, top of tee, 1.0 foot above land surface. Pressure head: September 20, 1935, 14.85 feet.

(D–5–1)15bd2. Eugene Briggs. State claim No. 5061. Depth, 150 feet; diameter, 2 inches. Measuring point, top of casing, 1.0 foot above land surface.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 20, 1935	1 p. m.	+14.65	Sept. 7, 1936	10:30 a. m.	+24.65
Oct. 23, 1935	9:05 a. m.	+16.75	Sept. 10, 1936	10 a. m.	+24.65
Nov. 19, 1935	12:20 p. m.	+18.05	Sept. 12, 1936	2:20 p. m.	+24.25
Dec. 10, 1935	3:10 p. m.	+18.9	Sept. 14, 1936	5:20 p. m.	+24.8
Jan. 2, 1936	4:10 p. m.	+19.1	Sept. 16, 1936	8:20 p. m.	+24.55
Jan. 22, 1936	2:30 p. m.	+19.25	Sept. 17, 1936	4:40 p. m.	+24.65
Mar. 2, 1936	12 m.	+20.2	Sept. 19, 1936	10:40 a. m.	+24.45
May 2, 1936	3:40 p. m.	+19.7	Sept. 21, 1936	10:45 a. m.	+24.2
June 21, 1936	9:10 a. m.	+23.4	Sept. 24, 1936	11 a. m.	[1] +24.85
July 18, 1936	11:15 a. m.	[2] +24.25	Sept. 26, 1936	10:50 a. m.	+25.45
Aug. 9, 1936	9:50 a. m.	[2] +24.5	Sept. 30, 1936	11 a. m.	+25.2
Sept. 2, 1936	11:15 a. m.	[2] +24.5	Oct. 19, 1936	1:40 p. m.	+25.9
Sept. 3, 1936	1:40 p. m.	+24.65	Dec. 1, 1936	3:40 p. m.	+27.4
Sept. 5, 1936	3:20 p. m.	+23.9	Dec. 22, 1936	do.	+27.2

[1] New well being jetted about 500 feet northwest.
[2] Found flowing.

(D-5-1)15ca. Eugene Briggs. State claim No. 13567. Depth, 150 feet; diameter, 4 inches. Measuring point, top of ell, 1.0 foot above land surface; altitude, 4,535.25 feet. Pressure head: September 20, 1935, 30.8 feet; 1936, gate valve cracked, cannot obtain pressure head.

(D-5-1)15dd1. Heber Barratt. State application No. 11778. Depth, 200 feet; diameter, 4 inches. Measuring point, top of ell, 1.0 foot above land surface. Pressure head: September 11, 1936, 22.9 feet; December 22, 1936, 24.7 feet, small leak during measurement.

(D-5-1)15dd2. Heber Barratt. State claim No. 1151. Depth, 199 feet; diameter, 2 inches. Measuring point, top of tee, 1.0 foot above land surface. Altitude of surface, 4,554.5 feet. Pressure head: September 11, 1936, 22.9 feet.

(D-5-1)16aa. Jacob Hunt. State claim No. 3216. Depth, 140 feet; diameter, 4 inches. Measuring point, top of ell, 1.9 feet above land surface; altitude, 4,545.30 feet. Pressure head: September 18, 1935, 14.8 feet; September 11, 1936, 23.3 feet; December 22, 1936, 29.0 feet.

(D-5-1)16ab1. G. G. Robinson. State claim No. 10937. Depth, 100 feet; diameter, 2 inches. Measuring point, top of casing, 1.25 feet above land surface. Depth to water level: September 18, 1935, 1.46 feet. Pressure head: September 11, 1936, 1.97 feet (found flowing); December 22, 1936, 3.07 feet (found flowing).

(D-5-1)16ab2. G. G. Robinson. State claim No. 4994. Depth, 185 feet; diameter, 2 inches. Measuring point, top of tee, 1.0 foot above land surface. Pressure head: September 18, 1935, 14.45 feet; September 11, 1936, 23.25 feet.

(D-5-1)16ab3. Lehi Roller Mills Co. State claim No. 4995. Depth, 225 feet; diameter, 2 inches. Measuring point, top of 1½-inch outlet, 1.0 foot above land surface. Altitude of surface, 4,543.17 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 18, 1935	11:30 a. m.	+13.15	Sept. 16, 1936	7:45 p. m.	[1] +21.7
Oct. 23, 1935	10 a. m.	+17.10	Sept. 17, 1936	4:30 p. m.	[1] +21.8
July 18, 1936	11:30 a. m.	+21.7	Sept. 19, 1936	10:50 a. m.	[1] +21.55
Aug. 9, 1936	10:45 a. m.	+22.5	Sept. 21, 1936	12:10 p. m.	[1] +21.7
Sept. 2, 1936	11:30 a. m.	+21.8	Sept. 24, 1936	12:50 p. m.	+23.4
Sept. 3, 1936	2 p. m.	+22.1	Sept. 26, 1936	11 a. m.	+23.65
Sept. 5, 1936	3:30 p. m.	+21.0	Sept. 28, 1936	12 m.	+23.75
Sept. 7, 1936	10:45 a. m.	+22.1	Sept. 30, 1936	11:10 a. m.	+23.2
Sept. 10, 1936	10:10 a. m.	+21.8	Oct. 3, 1936	11 a. m.	+23.7
Sept. 12, 1936	1:30 p. m.	+21.35	Dec. 22, 1936	11:10 a. m.	+27.9
Sept. 14, 1936	5:10 p. m.	+22.65			

[1] Well (D-5-1) 16aa flowing.

(D–5–1)16bb. Martha Ball. State claim No. 5069. Depth, 150 feet; diameter, 2 inches. Measuring point, top of tee, 1.2 feet above land surface; altitude of surface, 4,545.80 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 1, 1936	12:30 p. m.	+8.85	Sept. 17, 1936	4:10 p. m.	+9.0
Sept. 3, 1936	12:50 p. m.	+9.25	Sept. 19, 1936	1 p. m.	+9.05
Sept. 5, 1936	2:20 p. m.	+8.45	Sept. 21, 1936	12 m.	+9.25
Sept. 7, 1936	11 a. m.	+8.75	Sept. 24, 1936	12:40 p. m.	+10.15
Sept. 10, 1936	11:30 a. m.	+8.9	Sept. 26, 1936	11:45 a. m.	+10.55
Sept. 12, 1936	9:15 a. m.	+8.95	Sept. 28, 1936	11:50 a. m.	+10.6
Sept. 14, 1936	4:20 p. m.	+9.15	Sept. 30, 1936	12:10 p. m.	+10.55
Sept. 15, 1936	5:50 p. m.	+9.0	Oct. 3, 1936	11:20 a. m.	+10.7
Sept. 16, 1936	5:40 p. m.	+8.85	Dec. 22, 1936	2:30 p. m.	+16.55

(D–5–1)16bc1. Elmer Jackson. State claim No. 11049. Depth, 165 feet; diameter, 2 inches. Measuring point, top of tee, 1.0 foot above land sufrace; altitude of surface, 4,543.37 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
July 25, 1934		[1] +0.67	Sept. 20, 1934		[2] +1.87
July 26, 1934	6 p. m.	[1] +.61	Sept. 25, 1934		[2] +3.00
July 27, 1934	6:30 p. m.	[1] +1.22	Oct. 5, 1934		[2] +3.00
July 28, 1934	6:15 p. m.	[1] +.93	Sept. 14, 1935	2:30 p. m.	+1.86
Sept. 13, 1934		[2] +.33	July 18, 1936	11:50 a. m.	+6.4

[1] Measurements by Roscoe Boden.
[2] Measurements by Kenneth Borg and John M. Neff.

(D–5–1)16bc2. Emma Harper. State claim No. 11164. Depth, 200 feet; diameter, 2 inches. Measuring point, top of ell, 1.2 feet above land surface; altitude of surface, 4,545.77 feet. Pressure head: August 18, 1936, 9.9 feet, found flowing.

(D–5–1)16bd1. Dean D. Van Wagoner. State claim No. 4951. Depth, 200 feet; diameter, 4 inches. Measuring point, top of ell, 0.5 foot above land surface; altitude of surface 4,537.66 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 13, 1935		+13.9	Sept. 5, 1936	3:50 p. m.	+19.1
July 21, 1936	8:45 a. m.	+20.35	Sept. 6, 1936		([1])
Aug. 9, 1936	10:50 a. m.	+20.85	Sept. 7, 1936	12:15 p. m.	+20.5
Sept. 1, 1936	11:40 a. m.	+20.6	Sept. 10, 1936	11:15 a. m.	+20.5
Sept. 2, 1936	12:30 p. m.	+20.8	Sept. 12, 1936	10 a. m.	+20.4
Sept. 5, 1936	3 p. m.	([2])	Dec. 22, 1936	2 p. m.	+27.8

[1] Closed by owner.
[2] Opened by owner (flowing 120 gallons per minute).

(D–5–1)16bd2. Dean D. Van Wagoner. Diameter, 1½ inches. Measuring point, top of casing, 0.2 foot above land surface. Pressure-recording gage maintained on this well from September 1 to October 19, 1936.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 1, 1936	12 m	+20.4	Dec. 12, 1936		+28.6
Oct. 19, 1936	do	+23.95			

(D-5-1)16cd. Henry Lewis. State claim No. 3220. Depth, 165 feet; Diameter, 2 inches. Measuring point, top of ell, 1.1 feet above land surface. Found flowing prior to all measurements except on December 23, 1936.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 18, 1935	12:55 p. m	+28.1	Sept. 14, 1936	4:40 p. m	+35.5
July 21, 1936	3:45 p. m	+34.0	Sept. 16, 1936	8 p. m	+35.5
Aug. 9, 1936	12 m	+35.9	Sept. 19, 1936	12:40 p. m	+35.45
Sept. 2, 1936	12:30 p. m	+34.5	Sept. 21, 1936	11:30 a. m	+35.3
Sept. 3, 1936	2:40 p. m	+34.6	Sept. 24, 1936	12 m	+35.9
Sept. 5, 1936	4:30 p. m	+33.6	Sept. 26, 1936	11:30 a. m	+36.25
Sept. 7, 1936	11:20 a. m	+34.75	Sept. 30, 1936	12 m	+36.4
Sept. 10, 1936	11 a. m	+35.0	Dec. 23, 1936	10:15 a. m	+45.0
Sept. 12, 1936	9:45 a. m	+34.3			

(D-5-1)16dd. J. A. Holdaway. State claim No. 13553. Depth, 158 feet; diameter, 5 inches. Measuring point, top of tee, 1.0 foot above land surface; altitude, 4,528.72 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 18, 1935	12:05 p. m	+27.9	Sept. 12, 1936	2:45 p. m	+34.2
Oct. 23, 1935	9:30 a. m	+31.95	Sept. 12, 1936	10 p. m	(1)
July 21, 1936	9 a. m	+36.5	Sept. 14, 1936	5 p. m	+37.3
Aug. 9, 1936	11 a. m	+37.1	Sept. 16, 1936	7:50 p. m	+37.1
Sept. 3, 1936	4 p. m	(2)	Sept. 19, 1936	11 a. m	+36.9
Sept. 5, 1936	5 p. m	(1)	Sept. 21, 1936	10:50 a. m	+36.65
Do	5:10 p. m	+33.5	Sept. 24, 1936	11:20 a. m	+37.75
Sept. 7, 1936	12 m	+36.4	Sept. 30, 1936	do	+38.1
Sept. 10, 1936	10:20 a. m	+36.25	Dec. 22, 1936	11:30 a. m	+43.2
Sept. 11, 1936	2 p. m	(2)			

[1] Well closed.
[2] Well opened.

(D-5-1)17aa. Reed Wilkins. Depth, 150 feet; diameter, 1½ inches. Measuring point, top of 1½-inch to ½-inch bushing, 0.95 foot above land surface. Altitude of surface, 4,555.85 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 14, 1934		[1] −12.11	Sept. 13, 1936	10:45 a. m	−5.15
Sept. 20, 1934		[1] −9.95	Sept. 14, 1936	11:40 a. m	−4.67
Sept. 25, 1934		[1] −8.28	Sept. 15, 1936	11:10 a. m	−4.68
Oct. 5, 1934		[1] −8.11	Sept. 16, 1936	5:30 p. m	−5.55
Sept. 14, 1935		−9.96	Sept. 17, 1936	12:10 p. m	−4.88
July 21, 1936	3:30 p. m	−5.57	Sept. 19, 1936	5:50 p. m	−4.74
Aug. 9, 1936	5 p. m	−4.43	Sept. 21, 1936	12:20 p. m	−4.45
Sept. 2, 1936	5:40 p. m	−4.25	Sept. 24, 1936	1:40 p. m	−3.56
Sept. 3, 1936	11:30 a. m	−4.41	Sept. 26, 1936	12:40 p. m	−3.22
Sept. 5, 1936	1:30 p. m	−5.17	Sept. 28, 1936	11:40 a. m	−2.99
Sept. 7, 1936	3:30 p. m	−4.89	Sept. 30, 1936	1 p. m	−3.07
Sept. 10, 1936	4:20 p. m	−4.70	Oct. 3, 1936	11:10 a. m	−3.03
Sept. 12, 1936	9:40 a. m	−4.64	Dec. 22, 1936	4 p. m	+2.63
Do	4:20 p. m	−4.74			

[1] Measurement by Kenneth Borg and John M. Neff.

(D–5–1)17ab. Mary Ann Southwick. State claim No. 15984. Depth, 200 feet; diameter, 1½ inches. Measuring point, top of 2½-inch bushing on reducer, 1.0 foot above land surface; altitude of surface, 4,555.43 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 20, 1935	2:20 p. m.	−9.40	Sept. 12, 1936	4:15 p. m.	−4.19
Sept. 27, 1935	4:55 p. m.	−7.98	Sept. 13, 1936	10:45 a. m.	−4.64
Oct. 23, 1935	11 a. m.	−5.86	Sept. 14, 1936	11:40 a. m.	−4.09
Nov. 9, 1935	3:30 p. m.	−3.72	Sept. 15, 1936	11:05 a. m.	−4.08
Dec. 10, 1935	2:10 p. m.	−1.78	Sept. 16, 1936	5:30 p. m.	−5.22
Jan. 2, 1936	5:20 p. m.	−1.37	Sept. 17, 1936	12:10 p. m.	−4.29
Jan. 22, 1936	1 p. m.	−1.11	Sept. 19, 1936	5:50 p. m.	−4.15
Mar. 2, 1936	10 a. m.	−.26	Sept. 21, 1936	12:20 p. m.	−3.85
May 2, 1936	4:20 p. m.	−2.52	Sept. 24, 1936	1:40 p. m.	−3.02
June 22, 1936	10 a. m.	−4.37	Sept. 26, 1936	12:45 p. m.	−2.69
July 18, 1936	do	−4.34	Sept. 28, 1936	11:40 a. m.	−2.46
Aug. 9, 1936	5:20 p. m.	−3.68	Sept. 30, 1936	1:10 p. m.	−2.40
Sept. 2, 1936	5:30 p. m.	−3.57	Oct. 3, 1936	11:15 a. m.	−2.52
Sept. 5, 1936	1:30 p. m.	−4.48	Oct. 19, 1936	1:50 p. m.	−.92
Sept. 7, 1936	3:20 p. m.	−4.22	Dec. 1, 1936	4:30 p. m.	+3.12
Sept. 10, 1936	4:40 p. m.	−4.09	Dec. 22, 1936	4:15 p. m.	+3.33
Sept. 12, 1936	9:30 a. m.	−3.94			

(D–5–1)17ac1. Forrest Fox. Diameter, 1½ inches. Measuring point, top of casing, 1.5 feet above land surface. Depth to water level: September 20, 1935, 3.05 feet.

(D–5–1)17ac2. Alice Holmstead. State claim No. 5082. Depth, 150 feet; diameter, 2 inches. Measuring point, top of casing, 1.2 feet above land surface. Altitude of surface, 4,545.4 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 12, 1935	3:10 p. m.	−1.67	Sept. 12, 1936	4:10 p. m.	+3.17
Sept. 20, 1935	5:45 p. m.	−2.13	Sept. 13, 1936	11:30 a. m.	+2.59
Sept. 25, 1935	5:30 p. m.	−1.41	Sept. 14, 1936	11:50 a. m.	+3.13
Sept. 27, 1935	4:45 p. m.	−.64	Sept. 15, 1936	11 a. m.	+3.11
Oct. 23, 1935	11:10 a. m.	+1.85	Sept. 16, 1936	6 p. m.	+2.13
Nov. 9, 1935	3:25 p. m.	+4.45	Sept. 17, 1936	3:20 p. m.	+2.95
Dec. 10, 1935	2:10 p. m.	+6.90	Sept. 19, 1936	1:30 p. m.	+3.08
July 18, 1936	1 p. m.	+2.17	Sept. 21, 1936	12:30 p. m.	+3.40
Aug. 9, 1936	4:50 p. m.	+3.65	Sept. 24, 1936	2 p. m.	+4.18
Sept. 2, 1936	1:30 p. m.	+3.33	Sept. 26, 1936	1 p. m.	+4.54
Sept. 3, 1936	11:20 a. m.	+3.37	Sept. 28, 1936	do	+4.89
Sept. 5, 1936	1:20 p. m.	+2.66	Sept. 30, 1936	1:20 p. m.	+5.02
Sept. 7, 1936	1:30 p. m.	+3.05	Oct. 3, 1936	11:50 a. m.	+5.0
Sept. 10, 1936	12:15 p. m.	+3.18	Oct. 19, 1936	1:55 p. m.	+6.65
Sept. 12, 1936	10:45 a. m.	+3.32	Dec. 22, 1936	4:30 p. m.	+11.0

(D–5–1)17ac3. Lulu B. Baker. State claim No. 5008. Depth, 145 feet; diameter, 1½ inches. Measuring point, top of casing, at land surface. Altitude of surface, 4,546.50 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 13, 1934		[1] −2.46	Oct. 5, 1934		[1] +2.25
Sept. 20, 1934		[1] −.27	Sept. 12, 1935	12:50 p. m.	−.01
Sept. 25, 1934		[1] +1.58			

[1] Measurement by Kenneth Borg and John M. Neff.

(D-5-1)17ac4. Nola Beverly. State claim No. 11048. Depth, 160 feet; diameter, 2 inches. Measuring point, top of casing, 1.2 feet above land surface. Altitude of surface, 4,544.4 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
July 25, 1934		[1] −3.92	Sept. 20, 1934		[2] −1.64
July 26, 1934	7:15 p. m.	[1] −4.10	Sept. 25, 1934		[2] −.24
July 27, 1934		[1] −2.41	Oct. 5, 1934		[2] +1.21
July 28, 1934		[1] −2.50	Sept. 12, 1935	1:15 p. m.	−1.63
Sept. 14, 1934		[2] −4.00			

[1] Measurement by Roscoe Boden.
[2] Measurement by Kenneth Borg and John M. Neff.

(D-5-1)17ac5. S. F. Littleford. State claim No. 11092. Depth, 160 feet; diameter, 3 inches. Measuring point, top of rim on horizontal outlet from bottom tee, 0.5 foot above land surface. Altitude of surface, 4,541.7 feet. Water-stage recorder maintained on this well from August 27 to October 10, 1936.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
July 25, 1934		[1] −0.77	July 21, 1936	10:50 a. m.	+5.2
July 26, 1934		[1] −.87	Aug. 9, 1936	1:10 p. m.	+7.0
July 28, 1934		[1] +.52	Aug. 18, 1936	2:10 p. m.	+8.7
Sept. 13, 1934		[2] −.6	Aug. 27, 1936	10:30 a. m.	+6.3
Sept. 20, 1934		[2] +1.75	Aug. 28, 1936	12 m.	+5.98
Sept. 25, 1934		[2] +3.0	Oct. 10, 1936	do	+8.19
Oct. 5, 1934		[2] +3.75	Oct. 19, 1936	2 p. m.	+9.84
Sept. 12, 1935	10:45 a. m.	+1.40	Dec. 22, 1936	4:20 p. m.	+14.95

[1] Measurement by Roscoe Boden.
[2] Measurement by Kenneth Borg and John M. Neff.

(D-5-1)17ac6. S. E. Littleford. State claim No. 11157. Depth, 160 feet; diameter, 2 inches. Measuring point, top of tee, 0.4 foot above land surface. Altitude of surface, 4,540.7 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
July 25, 1934		[1] −0.24	Sept. 25, 1934		[2] +4.01
July 26, 1934	6 p. m.	[1] −.37	Oct. 5, 1934		[2] +4.18
July 27, 1934	6:15 p. m.	[1] +1.14	Sept. 12, 1935	10:10 a. m.	+2.09
July 28, 1934	5 p. m.	[1] +.93	July 21, 1936	10:30 a. m.	+6.1
Sept. 13, 1934		[2] −.31	Aug. 18, 1936	1:50 p. m.	+9.35
Sept. 20, 1934		[2] +2.13			

[1] Measurement by Roscoe Boden.
[2] Measurement by Kenneth Borg and John M. Neff.

(D-5-1)17ac7. T. J. Jackson. State claim No. 10901. Depth, 148 feet; diameter, 2 inches. Measuring point, top of tee, 0.25 foot above land surface. Altitude of surface, 4,540.4 feet. Pressure head: September 13, 1934, 0.4 foot, found flowing (by Kenneth Borg and John M. Neff); September 12, 1935, 2.35 feet, found flowing.

(D-5-1)17ac8. John Leland Stewart. State claim No. 11106. Depth, 200 feet; diameter, 2 inches. Measuring point, top of tee, 2.5 feet above land surface. Altitude of surface, 4,540.60 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			Feet
Sept. 13, 1934		[1] +0.25	Oct. 5, 1934		[1] +4.50
Sept. 20, 1934		[1] +1.5	Sept. 12, 1935	11:40 a. m.	[2] +2.80
Sept. 25, 1934		[1] +4.34			

[1] Measurement by Kenneth Borg and John M. Neff.
[2] Inaccurate; leaks in pipe.

(D-5-1)17ad1. A. E. Adams. State claim No. 1836. Depth, 150 feet; diameter, 1¼ inches. Measuring point, top of pitcher pump base, 3.2 feet above land surface. Altitude of surface, 4,543.5 feet. Depth to water level: July 30, 1935, 4.10 feet.

(D-5-1)17ad2. M. S. Lott. State claim No. 3628. Depth, 196 feet; diameter, 2 inches. Measuring point, top of tee, 1.3 feet above land surface. Altitude of surface, 4,542.27 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			Feet
July 30, 1935	1 p. m.	[1] +2.25	Sept. 7, 1936	1:15 p. m.	[1] +8.15
Aug. 30, 1935	11:40 a. m.	[1] +3.50	Sept. 10, 1936	11:45 a. m.	[1] +8.35
Sept. 13, 1935	5:40 p. m.	[1] +2.89	Sept. 12, 1936	10:20 a. m.	[1] +8.5
Oct. 7, 1935	1:40 p. m.	[1] +4.7	Sept. 13, 1936	11:15 a. m.	[1] +8.45
Oct. 23, 1935	10:35 a. m.	+6.85	Sept. 14, 1936	12:50 a. m.	[1] +8.8
Nov. 9, 1935	4 p. m.	+9.7	Sept. 15, 1936	5:40 p. m.	[1] +8.6
Nov. 19, 1935	12 m.	+11.0	Sept. 16, 1936	5:50 p. m.	[1] +8.3
Dec. 10, 1935	2:40 p. m.	+12.2	Sept. 17, 1936	3:50 p. m.	+8.7
Jan. 2, 1936	4:55 p. m.	+12.8	Sept. 19, 1936	1:10 p. m.	[1] +8.75
Jan. 22, 1936	2 p. m.	+12.7	Sept. 21, 1936	11:50 a. m.	[1] +8.9
Mar. 2, 1936	10:25 a. m.	+13.75	Sept. 24, 1936	12:30 p. m.	[1] +9.7
May 2, 1936	5 p. m.	[1] +10.75	Sept. 26, 1936	12 m.	[1] +10.1
June 20, 1936	9:30 a. m.	[1] +7.75	Sept. 28, 1936	12:45 p. m.	[1] +10.35
July 18, 1936	12 m.	[1] +8.3	Sept. 30, 1936	12:20 p. m.	[1] +10.25
Aug. 9, 1936	12:15 p. m.	[1] +9.2	Oct. 3, 1936	11:30 a. m.	[1] +10.25
Sept. 2, 1936	1 p. m.	[1] +8.65	Oct. 19, 1936	1:20 p. m.	+12.15
Sept. 3, 1936	11:40 a. m.	[1] +8.8	Dec. 1, 1936	4:10 p. m.	+17.2
Sept. 5, 1936	2 p. m.	+8.5	Dec. 22, 1936	3:40 p. m.	+17.35

[1] Found flowing.

(D-5-1)17ad3. Heber C. Comer. State claim No. 11174. Depth, 303 feet; diameter, 4 inches. Measuring point, top of tee, 1.2 feet above land surface. Altitude of surface, 4,544.41 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			Feet
Sept. 14, 1935	12:15 p. m.	+14.05	Sept. 13, 1936	11:25 a. m.	+22.4
Oct. 23, 1935	10:45 a. m.	+16.1	Sept. 14, 1936	1 p. m.	+22.4
Nov. 9, 1935	3:45 p. m.	+17.5	Sept. 15, 1936	2:30 p. m.	+21.95
Dec. 10, 1935	2:30 p. m.	+18.75	Sept. 16, 1936	5:50 p. m.	+22.1
Jan. 2, 1936	4:40 p. m.	+19.75	Sept. 17, 1936	4 p. m.	+22.2
Mar. 2, 1936	10:15 a. m.	+21.0	Sept. 19, 1936	1:20 p. m.	+23.35
May 2, 1936	5:20 p. m.	+20.2	Sept. 21, 1936	11:45 a. m.	+23.55
June 21, 1936	9:50 a. m.	+19.0	Sept. 24, 1936	12:20 p. m.	+23.2
July 21, 1936	10:20 a. m.	+18.1	Sept. 26, 1936	12 m.	+23.0
Aug. 9, 1936	12:30 p. m.	+21.55	Sept. 28, 1936	12:40 p. m.	+23.35
Sept. 2, 1936	1 p. m.	+22.0	Sept. 30, 1936	12:15 p. m.	+22.15
Sept. 3, 1936	12:10 p. m.	+20.9	Oct. 3, 1936	11:40 a. m.	+23.55
Sept. 5, 1936	2:10 p. m.	+20.8	Oct. 19, 1936	1:15 p. m.	+22.35
Sept. 7, 1936	1:30 p. m.	+20.95	Dec. 1, 1936	4:20 p. m.	+27.25
Sept. 10, 1936	11:50 a. m.	+21.55	Dec. 22, 1936	3:45 p. m.	+27.4
Sept. 12, 1936	10:40 a. m.	+22.25			

(D-5-1)17ca. Ralph Smith. State claim No. 10918. Depth, 350 feet; diameter, 4 inches. Measuring point, top of cap on casing, 0.65 foot above land surface. Pressure recorder operated on this well from July 25 to October 3, 1936.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 17, 1935	10:45 a. m.	+3.79	July 26, 1936	12 m.	+9.25
July 21, 1936	4:40 p. m.	[1]+7.25	Oct. 3, 1936	do	+11.8
July 25, 1936	4:20 p. m.	+7.6	Do	1:45 p. m.	+11.9

[1] Found flowing.

(D-5-1)17cd1. Odell Peterson. Depth, 150 feet; diameter, 2 inches. Measuring point, top of casing, 0.25 foot above land surface. Altitude of surface, 4,525.60 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 13, 1934		[1]−3.91	Sept. 10, 1936	2:20 p. m.	[2]+1.88
Sept. 20, 1934		[1]−1.33	Sept. 12, 1936	1:50 p. m.	[2]+1.93
Sept. 25, 1934		[1]−.67	Sept. 14, 1936	2:15 p. m.	[2]+1.72
Oct. 5, 1934		[1]+.21	Sept. 15, 1936	3:40 p. m.	[2]+1.65
Sept. 13, 1935	9:55 a. m.	−1.58	Sept. 16, 1936	6 p. m.	[2]+.85
Sept. 17, 1935	11:15 a. m.	−1.59	Sept. 17, 1936	2:30 p. m.	[2]+1.40
Oct. 23, 1935	11:30 a. m.	+2.08	Sept. 19, 1936	3:40 p. m.	[2]+1.78
Nov. 9, 1935	3:10 p. m.	+5.80	Sept. 21, 1936	1:50 p. m.	[2]+1.87
Dec. 10, 1935	2 p. m.	+9.40	Sept. 24, 1936	4:30 p. m.	[2]+2.23
Jan. 2, 1936	5:10 p. m.	+11.35	Sept. 26, 1936	2:40 p. m.	[2]+2.43
Mar. 2, 1936	11:05 a. m.	+11.85	Sept. 28, 1936	3:10 p. m.	[2]+2.58
July 18, 1936	3:30 p. m.	[2]+1.25	Sept. 30, 1936	3:30 p. m.	[2]+2.48
Aug. 9, 1936	1:30 p. m.	[2]+2.77	Oct. 3, 1936	1 p. m.	[2]+3.27
Sept. 2, 1936	3:40 p. m.	[2]+1.57	Oct. 19, 1936	2 p. m.	[2]+6.05
Sept. 5, 1936	11:20 a. m.	[2]+1.70	Dec. 1, 1936	5:15 p. m.	+11.0
Sept. 7, 1936	3 p. m.	[2]+1.71	Dec. 23, 1936	4:40 p. m.	[2]+11.85

[1] Measurement by Kenneth Borg and John M. Neff.
[2] Found flowing.

(D-5-1)17cd2. F. P. Martens. State claim No. 11142. Depth, 200 feet; diameter, 2 inches. Measuring point, top of casing, 2.0 feet above land surface. Altitude of surface, 4,524.30 feet. Pressure head: September 14, 1935, 2.99 feet.

(D-5-1)17cd3. F. P. Martens. State claim No. 11141. Depth, 200 feet; diameter, 2 inches. Measuring point, top of casing, 0.5 foot above land surface. Altitude of surface, 4,523.20 feet. Pressure head: September 14, 1935, 6.15 feet.

(D-5-1)17cd4. F. P. Martens. State claim No. 11143. Depth, 200 feet; diameter, 2 inches. Measuring point, top of coupling, 0.5 foot above land surface. Altitude of surface, 4,523.20 feet. Pressure head: September 14, 1935, 5.4 feet.

(D-5-1)17cd5. F. P. Martens. State claim No. 11113. Depth, 200 feet; diameter, 2 inches. Measuring point, top of casing, 0.5 foot above land surface. Altitude of surface, 4,523.30 feet. Pressure head: September 14, 1935, 5.45 feet.

(D-5-1)17da1. James B. Gray. State claim No. 11042. Depth, 150 feet; diameter, 2 inches. Measuring point, top of upper tee, 1.8 feet above land surface.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 13, 1934		[1]−1.26	Oct. 5, 1934		[1]+2.11
Sept. 20, 1934		[1]+.16	Sept. 14, 1935		−.89
Sept. 25, 1934		[1]+1.07			

[1] Measurement by Kenneth Borg and John M. Neff.

(D–5–1)17da2. Azer Wanless. State claim No. 10872. Depth, 147 feet; diameter, 2 inches. Measuring point, top of lower tee, 0.25 foot above land surface. Altitude of surface, 4,540.67 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
July 25, 1934		[1]+1.14	Sept. 25, 1934		[2]+3.50
July 26, 1934		[1]+.85	Oct. 5, 1934		[2]+4.50
July 27, 1934		[1]+1.54	Sept. 14, 1935		+2.58
July 28, 1934		[1]+1.50	Sept. 11, 1936	2 p. m.	+7.35
Sept. 13, 1934		[2]+.29	Dec. 24, 1936	3:20 p. m.	+17.6
Sept. 20, 1934		[2]+2.31			

[1] Measurement by Roscoe Boden.
[2] Measurement by Kenneth Borg and John M. Neff.

(D–5–1)17db1. Julia T. Gurney. Depth, 167 feet; diameter, 2 inches. Measuring point, top of tee, 0.9 foot above land surface. Altitude of surface, 4,537.90 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
July 25, 1934		[1]+1.93	Sept. 25, 1934		[2]+5.6
July 26, 1934	7:15 p. m.	[1]+1.49	Oct. 5, 1934		[2]+5.93
July 27, 1934		[1]+2.93	Sept. 12, 1935	3:45 p. m.	+4.05
July 28, 1934		[1]+2.85	Sept. 11, 1936	1:50 p. m.	[3]+8.9
Sept. 13, 1934		[2]+3.22	Dec. 23, 1936	5 p. m.	+18.4
Sept. 20, 1934		[2]+4.41			

[1] Measurement by Roscoe Boden.
[2] Measurement by Kenneth Borg and John M. Neff.
[3] Found flowing.

(D–5–1)17db2. Mary E. Jacobs. State claim No. 10928. Depth, 150 feet; diameter, 2 inches. Measuring point, top of horizontal outlet on cross over well, 0.5 foot above land surface. Altitude of surface, 4,535.16 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
July 25, 1934		[1]+1.58	Sept. 20, 1934		[2]+5.16
July 26, 1934		[1]+1.4	Sept. 25, 1934		[2]+6.33
July 27, 1934		[1]+1.29	Oct. 5, 1934		[2]+7.0
July 28, 1934		[1]+2.56	Sept. 12, 1935		+6.15
Sept. 13, 1934		[2]+3.16			

[1] Measurement by Roscoe Boden. He gives pressure head above valve with no altitude or tie to land surface.
[2] Measurement by Kenneth Borg and John M. Neff. Pressure head tied to reference point by using land surface as datum.

(D–5–1)17dc2. George Cox. State claim No. 13546. Depth, 334 feet; diameter, 3 inches. Measuring point, top of outlet pipe, 2.0 feet above land surface. Altitude of surface, 4,528.37 feet. Pressure head: November 9, 1935, 34.25 feet.

(D–5–1)17dc3. George Cox. State claim No. 13547. Depth, 210 feet; diameter, 2 inches. Measuring point, top of ell, 1.0 foot above land surface. Altitude of surface, 4,528.07 feet. Pressure head: November 9, 1935, 15.15 feet.

(D–5–1)17dc4. George Cox. State claim No. 13545. Depth, 328 feet; diameter, 3 inches. Measuring point, top of ell, 2.0 feet above land surface. Altitude of surface, 4,527.77 feet. Pressure head: November 9, 1935, 34.80 feet.

(D-5-1-)**17dc5.** F. P. Martens. State claim No. 11144. Depth, 200 feet; diameter, 2 inches. Measuring point, top of tee, 1.0 foot below land surface. Altitude of surface, 4,520.50 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
July 25, 1934	6:30 p. m.	[1]+2.42	Sept. 20, 1934		[2]+2.25
July 26, 1934	do	[1]+2.37	Sept. 25, 1934		[2]+2.63
July 27, 1934		[1]+2.56	Oct. 5, 1934		[2]+5.0
July 28, 1934		[1]+2.67	Sept. 14, 1935		+3.55
Sept. 13, 1934		[2]+1.5			

[1] Measurement by Roscoe Boden.
[2] Measurement by Kenneth Borg and John M. Neff.

(D-5-1)**18aa.** Eugene Webb. Depth, 285 feet; diameter, 2 inches. Measuring point, top of casing, 0.75 foot above land surface.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 17, 1935	4 p. m.	−3.35	Sept. 16, 1936	6:45 p. m.	[1]−0.42
Oct. 23, 1935	2 p. m.	−.25	Sept. 17, 1936	12:15 p. m.	[1]−.49
Sept. 1, 1936	1:45 p. m.	[1].00	Sept. 19, 1936	5:20 p. m.	[1]−.07
Sept. 5, 1936	9:30 a. m.	[1]+.15	Sept. 21, 1936	2 p. m.	[1]+.19
Sept. 7, 1936	3:10 p. m.	[1]−.01	Sept. 24, 1936	6 p. m.	[1]+.60
Sept. 10, 1936	4:15 p. m.	[1]+.03	Sept. 26, 1936	5 p. m.	[1]+.72
Sept. 12, 1936	12:10 p. m.	[1]+.15	Sept. 28, 1936	do	[1]+.60
Sept. 13, 1936	12:20 p. m.	[1].00	Sept. 30, 1936	4 p. m.	[1]+.95
Sept. 14, 1936	4:10 p. m.	[1]−.10	Dec. 24, 1936	1 p. m.	[1]+5.0
Sept. 15, 1936	1:45 p. m.	[1]−.15			

[1] Found flowing.

(D-5-1)**18ab1.** Wayne Carson. State claim No. 5020. Depth, 150 feet; diameter, 2 inches. Measuring point, top of casing, 2.0 feet above land surface. Altitude of surface, 4,516.8 feet. Water-stage recorder maintained on this well from August 28 to October 3, 1936.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Aug. 18, 1936	12:25 p. m.	[1]+3.37	Oct. 3, 1936	12 m.	+4.41
Aug. 27, 1936	3:40 p. m.	[1]+3.10	Dec. 23, 1936	3:45 p. m.	+11.3
Aug. 28, 1936	12 m.	+3.18			

[1] Found flowing.

(D-5-1)**18ab2.** Moroni Sabey. State claim No. 4909. Diameter, 1½ inches. Measuring point, top of casing, 1.25 feet above land surface. Altitude of surface, 4,517.5 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
July 25, 1934		[1] −3.04	Sept. 11, 1935	4:15 p. m.	−0.67
July 26, 1934		[1] −3.12	July 21, 1936	3 p. m.	+2.2
July 27, 1934		[1] −.90	Sept. 1, 1936	2:20 p. m.	+2.68
July 28, 1934		[1] −.38	Sept. 11, 1936	11:30 a. m.	+3.10
Sept. 13, 1934		[2] +.42	Sept. 13, 1936	12:10 p. m.	+2.40
Sept. 20, 1934		[2] +.25	Sept. 16, 1936	3:50 p. m.	+1.40
Sept. 25, 1934		[2] +.42	Sept. 19, 1936	5:10 p. m.	+2.47
Oct. 5, 1934		[2] +1.66			

[1] Measurement by Roscoe Boden.
[2] Measurement by Kenneth Borg and John M. Neff.

(D–5–1)18ab3. Eli Fox. State claim No. 11078. Depth, 250 feet; diameter, 2 inches. Measuring point, top of casing, at land surface. Altitude of surface, 4,524.00 feet. Pressure head: September 20, 1935, 3.65 feet, found flowing; September 11, 1936, 6.8 feet, found flowing; December 24, 1936, 14.7 feet.

(D–5–1)18ac. R. Ward Webb. State claim No. 4931. Depth, 190 feet; diameter, 2 inches. Measuring point, top of ell on lead pipe, 1 foot south of well, 1.5 feet above land surface. Altitude of surface, 4,519.8 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 13, 1934		[1] −0.3	Oct. 5, 1934		[1] +3.5
Sept. 20, 1934		[1] +2.71	Sept. 11, 1935		+1.97
Sept. 25, 1934		[1] +2.71	Sept. 11, 1936	11:50 a. m.	+5.75

[1] Measurement by Kenneth Borg and John M. Neff.

(D–5–1)18bc1. Aaron Evans. State claim No. 3637. Depth, 175 feet; diameter, 2 inches. Measuring point, top of tee, 2.0 feet above land surface. Altitude of surface, 4,505.70 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 11, 1935	2:30 p. m.	+8.75	Sept. 15, 1936	1:30 p. m.	+12.1
Oct. 23, 1935	12:55 p. m.	+11.6	Sept. 16, 1936	7:20 p. m.	+12.05
Nov. 9, 1935	4:20 p. m.	+13.7	Sept. 17, 1936	1:10 p. m.	+11.75
Mar. 2, 1936	11:30 a. m.	+17.4	Sept. 19, 1936	4:20 p. m.	+11.75
July 21, 1936	2:00 p. m.	+12.1	Sept. 21, 1936	3:10 p. m.	+11.65
Aug. 9, 1936	4:30 p. m.	+12.35	Sept. 24, 1936	5:10 p. m.	+12.5±
Sept. 2, 1936	5:10 p. m.	+12.4	Sept. 26, 1936	3:40 p. m.	+12.65±
Sept. 5, 1936	10:15 a. m.	+12.25	Sept. 28, 1936	4:20 p. m.	+13.1
Sept. 10, 1936	3:20 p. m.	+12.6	Sept. 30, 1936	5 p. m.	+13.25
Sept. 12, 1936	12:30 p. m.	+12.75	Dec. 23, 1936	3:10 p. m.	+17.9
Sept. 14, 1936	2:50 p. m.	+12.25			

(D–5–1)18bc2. Aaron Evans. State claim No. 11166. Depth, 150 feet; diameter, 2 inches. Measuring point, top of casing, at land surface. Altitude of surface, 4,505.20 feet. Pressure head: September 11, 1935, 8.95 feet, found flowing; July 18, 1936, 12.2 feet, found flowing.

(D–5–1)18db. George Goats. Depth, 150 feet; diameter, 2 inches. Measuring point, top of casing, 0.5 foot above land surface. Altitude of surface, 4,515.80 feet. Found flowing prior to all measurements except on December 24, 1936.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 17, 1935	4:15 p. m	+0.25	Sept. 16, 1936	6:50 p. m	+1.90
July 21, 1936	1:45 p. m	+1.98	Sept. 17, 1936	1:30 p. m	+2.05
Aug. 9, 1936	4:10 p.m	+2.70	Sept. 19, 1936	4:10 p. m	+2.27
Aug. 18, 1936	11:55 a. m	+2.81	Sept. 21, 1936	2:30 p. m	+2.30
Sept. 2, 1936	4:40 p. m	+2.46	Sept. 24, 1936	4:40 p. m	+2.80
Sept. 5, 1936	11 a. m	+2.60	Sept. 26, 1936	3 p. m	+3.00
Sept. 10, 1936	3 p. m	+2.95	Sept. 28, 1936	3:40 p. m	+3.22
Sept. 12, 1936	1 p. m	+3.00	Sept. 30, 1936	5:10 p. m	+3.62
Sept. 14, 1936	3:40 p. m	+2.57	Dec. 24, 1936	3 p. m	+10.65
Sept. 15, 1936	2 p. m	+2.34			

(D-5-1)19ac. Stanley Clark. State claim No. 5019. Depth, 150 feet; diameter, 2 inches. Measuring point, top of casing, 0.75 foot above land surface. Altitude of surface, 4,509.20 feet. Found flowing prior to all measurements except on December 24, 1936.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 17, 1935	4:45 p. m	+1.85	Sept. 16, 1936	7:10 p. m	+3.67
Oct. 23, 1935	12:30 p. m	+3.32	Sept. 17, 1936	1:40 p. m	+3.61
July 21, 1936	1:30 p. m	+3.70	Sept. 19, 1936	4 p. m	+3.62
Aug. 9, 1936	3:50 p. m	+3.98	Sept. 21, 1936	2:40 p. m	+3.21
Sept. 2, 1936	4:20 p. m	+3.50	Sept. 24, 1936	4:50 p. m	+3.38
Sept. 5, 1936	10:50 a. m	+3.84	Sept. 26, 1936	2:50 p. m	+3.44
Sept. 10, 1936	3:40 p. m	+4.08	Sept. 28, 1936	3:30 p. m	+3.61
Sept. 12, 1936	1 p. m	+4.00	Sept. 30, 1936	5:30 p. m	+3.78
Sept. 14, 1936	3:50 p. m	+3.85	Oct. 3, 1936	1:30 p. m	+3.90
Sept. 15, 1936	2:15 p. m	+3.75	Dec. 24, 1936	2:50 p. m	+10.5

(D-5-1)19bb. John Smith. Depth, 100 feet; diameter, 2 inches. Measuring point, top of 3-inch tee, 1.5 feet above land surface. Found flowing prior to all measurements.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 10, 1935	2 p. m	+2.03	Dec. 23, 1936	3 p. m	+14.5
Sept. 11, 1936	12:15 p. m	+8.4			

(D-5-1)19db3. J. Freeman Royle. Depth, 90 feet; diameter, 2 inches. Measuring point, top of casing, at land surface. Altitude of surface, 4,497.90 feet. Pressure head: September 13, 1935, 0.52 foot, found flowing.

(D-5-1)19db4. J. Freeman Royle. State claim No. 11087. Depth, 90 feet; diameter, 2 inches. Measuring point, top of casing, 0.25 foot above land surface. Altitude of surface, 4,498.70 feet. Found flowing prior to all measurements.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 13, 1935	1:15 p. m	+6.95	Sept. 19, 1936	3 p. m	+8.15
Sept. 1, 1936	3:10 p. m	+7.7	Sept. 21, 1936	2 p. m	+8.0
Sept. 5, 1936	12 m	+8.4	Sept. 24, 1936	3:45 p. m	+8.15
Sept. 10, 1936	1:50 p. m	+8.8	Sept. 26, 1936	2:10 p. m	+8.15
Sept. 12, 1936	12 m	+8.35	Sept. 28, 1936	2:30 p. m	+8.25
Sept. 14, 1936	2:30 p. m	+8.25	Sept. 30, 1936	2:45 p. m	+8.05
Sept. 15, 1936	4:40 p. m	+8.3	Dec. 23, 1936		(1)
Sept. 17, 1936	1:50 p. m	+8.2			

[1] Well plugged; leak outside casing has developed, and water (about 5 gallons per minute) comes to surface about 1 foot east of well.

(D–5–1)20ab1. Jacob G. Cox. State claim No. 6861. Depth, 152 feet; diameter, 2½ inches. Measuring point, nail in top of stake reference benchmark, 1.5 feet above land surface. Altitude of surface, 4,523.54 feet. Recording gage maintained on this well since September 25, 1935. Pressure head: September 25, 1935, 8.05 feet.

(D–5–1)20ab2. Jacob G. Cox. State claim No. 6865. Depth, 154 feet; diameter, 2 inches. Measuring point, top of casing, at land surface. Altitude of surface, 4,522.04 feet. Pressure head: September 25, 1935, 8.35 feet, found flowing.

(D–5–1)20ab3. Jacob G. Cox. State claim No. 6864. Depth, 158 feet; diameter, 2 inches. Measuring point, top of casing at land surface. Altitude of surface, 4,521.94 feet. Pressure head: September 25, 1935, 10.6 feet, found flowing.

(D–5–1)20ab4. Jacob G. Cox. State claim No. 6860. Depth, 292 feet; diameter, 3 inches. Measuring point, top of flange at end of outlet pipe. Altitude of land surface, 4,523.14 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 25, 1935	2:10 p. m.	+34.4	Sept. 10, 1936	1 p. m.	+42.2
Oct. 7, 1935	2 p. m.	+35.4	Sept. 12, 1936	10 a. m.	+42.7
Oct. 22, 1935	1 p. m.	+35.9	Sept. 14, 1936	12:10 p. m.	+42.85
Nov. 9, 1935	1:10 p. m.	+38.1	Sept. 15, 1936	5:20 p. m.	+42.6
Nov. 19, 1935	11:45 a. m.	+38.8	Sept. 16, 1936	6:10 p. m.	+42.8
Dec. 10, 1935	1:40 p. m.	+39.8	Sept. 19, 1936	1:50 p. m.	+43.9
Mar. 2, 1936	10:40 a. m.	+41.4	Sept. 21, 1936	12:50 p. m.	+44.2
May 2, 1936	4:50 p. m.	+41.3	Sept. 24, 1936	2:30 p. m.	+43.35
June 21, 1936	1:15 p. m.	[1] +38.25	Sept. 26, 1936	1:10 p. m.	+43.15
July 18, 1936	1:10 p. m.	+42.2	Sept. 28, 1936	1:20 p. m.	[2] +43.35
Aug. 9, 1936	2:20 p. m.	+42.75	Sept. 30, 1936	2 p. m.	[3] +39.2
Sept. 2, 1936	2 p. m.	+42.75	Oct. 3, 1936	12:40 p. m.	+43.3
Sept. 3, 1936	11:10 a. m.	+42.5	Oct. 19, 1936	12:10 p. m.	[1] +39.1
Sept. 5, 1936	1 p. m.	+41.9	Dec. 23, 1936	1:50 p. m.	+47.5
Sept. 7, 1936	2:15 p. m.	+42.05			

[1] Found flowing.
[2] Well opened at 1:20 p. m.
[3] Well closed at 1:50 p. m.

(D–5–1)20ab5. Jacob G. Cox. State claim No. 6862. Depth, 200 feet; diameter, 2 inches. Measuring point, top of tee, 0.5 foot above land surface. Altitude of surface, 4,520.90 feet. Pressure head: September 25, 1935, 10.05 feet.

(D–5–1)20ab6. Jacob G. Cox. State claim No. 6863. Depth, 200 feet; diameter, 1¼ inches. Measuring point, top of ell, 1.3 feet above land surface. Altitude of surface, 4,520.35 feet. Pressure head: September 25, 1935, 8.6 feet.

(D–5–1)20bb1. J. Freeman Royle. State claim No. 11089. Depth, 150 feet; diameter, 2 inches. Measuring point, top of casing, 0.25 foot above land surface. Altitude of surface, 4,514.00 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 13, 1934		[1] +0.9	Sept. 16, 1936	6:40 p. m.	+6.9
Sept. 20, 1934		[1] +2.0	Sept. 17, 1936	2:30 p. m.	+6.95
Sept. 13, 1935	11:30 a. m.	+2.93	Sept. 19, 1936	3:30 p. m.	+6.95
July 21, 1936	1:10 p. m.	[2] +6.1	Sept. 21, 1936	1:40 p. m.	+7.0
Aug. 9, 1936	3:30 p. m.	[2] +6.8	Sept. 24, 1936	4:20 p. m.	+7.2
Sept. 2, 1936	3:50 p. m.	[2] +5.75	Sept. 26, 1936	2:30 p. m.	+7.35
Sept. 5, 1936	11:30 a. m.	[2] +6.5	Sept. 28, 1936	3 p. m.	+7.25
Sept. 10, 1936	2:15 p. m.	[2] +6.6	Sept. 30, 1936	3:20 p. m.	+7.4
Sept. 12, 1936	12:40 p. m.	[2] +6.35	Oct. 3, 1936	1:10 p. m.	+8.15
Sept. 15, 1936	4 p. m.	+7.15	Dec. 24, 1936	1:40 p. m.	[2] +16.9

[1] Measurement by Kenneth Borg and John M. Neff.
[2] Found flowing.

(D-5-1)20bb2. J. Freeman Royle. State claim No. 11086. Depth, 150 feet; diameter, 2 inches. Measuring point, top of casing, at land surface. Altitude of surface, 4,513.00 feet. Pressure head: September 13, 1935, 3.22 feet, found flowing.

(D-5-1)20bc. A. B. Anderson. State claim No. 6883. Depth, 151 feet; diameter, 4 inches. Measuring point, top of ell, 1.5 feet above land surface. Altitude of surface, 4,507.60 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 13, 1935	10:40 a. m.	+7.75	Sept. 17, 1936	2:10 p. m.	[1] +10.6
July 21, 1936	12:45 p. m.	[1] +10.9	Sept. 19, 1936	3:20 p. m.	[1] +10.5
Aug. 9, 1936	3:10 p. m.	[1] +11.05	Sept. 21, 1936	1:30 p. m.	[1] +10.45
Sept. 2, 1936	4:10 p. m.	[1] +10.0	Sept. 24, 1936	4 p. m.	[1] +10.8
Sept. 5, 1936	11:40 a. m.	+11.6	Sept. 26, 1936	2:20 p. m.	[1] +10.8
Sept. 10, 1936	2 p. m.	+11.95	Sept. 28, 1936	2:50 p. m.	[1] +10.9
Sept. 12, 1936	12:30 p. m.	[1] +10.8	Sept. 30, 1936	3:10 p. m.	[1] +10.8
Sept. 14, 1936	2 p. m.	[1] +10.45	Dec. 24, 1936	1:50 p. m.	+17.9
Sept. 15, 1936	4:10 p. m.	[1] +10.7			

[1] Found flowing.

(D-5-1)20cb. Mrs. Ellis Davis. State claim No. 13560. Depth, 180 feet; diameter, 2 inches. Measuring point, top of casing, 0.2 foot above land surface. Altitude of surface, 4,501.45 feet. Found flowing prior to all measurements. Pressure head, in feet: September 14, 1936, 21.75; September 15, 1936, 22.05; December 24, 1936, 34.0.

(D-5-1)20db. C. O. Holmstead. State claim No. 3646. Depth, 165 feet; diameter, 2 inches. Measuring point, top of tee, 2.3 feet above land surface. Altitude of surface, 4,503.5 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 17, 1935	5:30 p. m.	+23.2	Sept. 16, 1936	6:20 p. m.	+27.8
Oct. 23, 1935	12:05 p. m.	+28.8	Sept. 17, 1936	3 p. m.	+28.35
July 21, 1936	12:30 p. m.	+28.1	Sept. 19, 1936	5:30 p. m.	+28.4
Aug. 9, 1936	2:45 p. m.	+30.5	Sept. 21, 1936	1 p. m.	+28.4
Sept. 2, 1936	3:30 p. m.	+28.0	Sept. 24, 1936	6:30 p. m.	+28.75
Sept. 5, 1936	12:40 p. m.	+28.2	Sept. 26, 1936	5:20 p. m.	+29.0
Sept. 10, 1936	1:15 p. m.	+28.4	Sept. 28, 1936	1:40 p. m.	+29.15
Sept. 12, 1936	11:20 a. m.	+27.6	Sept. 30, 1936	5:40 p. m.	+28.65
Sept. 14, 1936	1:10 p. m.	+28.3	Oct. 3, 1936	12:50 p. m.	+28.6
Sept. 15, 1936	5:10 p. m.	+27.7	Dec. 23, 1936	2 p. m.	+40.9

(D-5-1)20dc1. F. D. Worlton estate. State claim No. 10905. Depth, 180 feet; diameter, 2 inches. Measuring point, top of ell, 1.4 feet above land surface. Found flowing prior to all measurements.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 2, 1936	2:50 p. m.	+27.1	Sept. 19, 1936	2:45 p. m.	+27.85
Sept. 5, 1936	12:30 p. m.	+27.5	Sept. 21, 1936	1:20 p. m.	+27.2
Sept. 10, 1936	1:30 p. m.	+28.4	Sept. 24, 1936	3:30 p. m.	+28.3
Sept. 12, 1936	11:30 a. m.	+27.65	Sept. 26, 1936	1:40 p. m.	+28.3
Sept. 14, 1936	1:30 p. m.	+26.85	Sept. 28, 1936	1:50 p. m.	+27.95
Sept. 15, 1936	5 p. m.	+27.3	Sept. 30, 1936	2:20 p. m.	+29.5
Sept. 16, 1936	6:30 p. m.	+27.7	Dec. 23, 1936	2:15 p. m.	+40.0

(D-5-1)20dc2. F. D. Worlton estate. State claim No. 10906. Depth, less than 100 feet(?); diameter, 1¼ inches. Measuring point, top of coupling on casing, 0.3 foot above land surface. Pressure head: September 2, 1936, 8.8 feet.

(D-5-1)21ca. Isaac Bone. Diameter, 2 inches. Measuring point, top of tee, 1.0 foot above land surface. Pressure head: September 12, 1936, 47.8 feet; December 23, 1936, 57.5 feet.

(D-5-1)21db. Arthur L. Crawford. State claim No. 3624. Depth, 144 feet; diameter, 2 inches. Measuring point, top of tee, 2.0 feet above land surface. Altitude of surface, 4,599.72 feet

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 20, 1935	3:35 p. m.	+17.15	Sept. 14, 1936	4:50 p. m.	+19.55
Sept. 2, 1936	12:10 p. m.	+18.5	Sept. 19, 1936	11:15 a. m.	+18.95
Sept. 3, 1936	3:30 p. m.	+18.2	Sept. 21, 1936	11:10 a. m.	+18.1
Sept. 5, 1936	4:30 p. m.	+18.25	Sept. 24, 1936	11:40 a. m.	+19.0
Sept. 7, 1936	11:40 a. m.	+18.5	Sept. 26, 1936	11:10 a. m.	+19.5
Sept. 10, 1936	10:30 a. m.	+19.25	Sept. 30, 1936	11:40 a. m.	+19.75
Sept. 12, 1936	3 p. m.	+19.45	Dec. 22, 1936	1:20 p. m.	+20.75

(D-5-1)22bc1. Leon Wagstaff. Depth, 55 feet; diameter, 2 inches. Measuring point, top of ell, 1.0 foot above land surface. Pressure head, in feet: September 20, 1935, 15.05, found flowing; July 18, 1936, 18.1, found flowing; August 9, 1936, 13.5, found flowing; December 22, 1936, 19.5.

(D-5-1)22bc2. Leon Wagstaff. State claim No. 2739. Depth, 55 feet; diameter, 3 inches. Measuring point, top of ell, 2.0 feet above land surface. Pressure head, in feet: July 18, 1936, 18.2; September 11, 1936, 18.2, found flowing; December 22, 1936, 18.8.

(D-5-1)22bc3. Leon Wagstaff. State claim No. 2738. Depth, 187 feet; diameter, 4 inches. Measuring point, top of ell, 2.0 feet above land surface. Altitude of surface, 4,515.87 feet.

Date	Hour	Water level	Date	Hour	Water level
		Feet			*Feet*
Sept. 20, 1935	5:10 p. m.	+43.6	Sept. 11, 1936	4:30 p. m.	+53.75
July 18, 1936	2:40 p. m.	+50.9	Dec. 22, 1936	11:50 a. m.	+59.0
Aug. 9, 1936	11:30 a. m.	[1] +52.1			

[1] Found flowing.

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