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# Ground-Water Resources of Beaver County, Oklahoma

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The University of Oklahoma

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# GROUND-WATER RESOURCES OF BEAVER COUNTY, OKLAHOMA

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## ABSTRACT

Beaver County, the easternmost county in the Oklahoma Panhandle, has an area of 1,793 square miles. The western part of the county consists of flat, high plains, but the central and eastern parts are dissected by tributaries of the North Canadian and Cimarron Rivers, which are the master streams of the area. The climate is semiarid, and the average annual precipitation is 18.6 inches. The county has a population of about 7,000, most of which is rural. Livestock grazing and wheat farming are the predominant types of agriculture, and oil and gas production are the major industries.

The oldest rocks exposed in the county are red sandstone, siltstone, and shale of Permian age. These rocks also contain beds of limestone, dolomite, gypsum, and—in the subsurface—salt. Stock wells in these rocks yield small quantities of water of poor quality. Rocks of Triassic age that occur locally in the western part of the county are similar lithologically and hydrologically to those of Permian age.

The principal aquifer is formed by semiconsolidated deposits of gravel, sand, silt, clay, and caliche, which are Pliocene and Pleistocene in age. These deposits yield an average of about 700 gpm (gallons per minute) to large-diameter gravel-packed wells, and yields range from 200 to about 1,760 gpm. The deposits also supply water to most domestic and stock wells in the county. The water, although moderately hard, is suitable for most uses.

Alluvium, consisting of lenses of sand, gravel, and clay, occurs along most major streams in the county. These deposits yield large quantities of water to a few wells.

Dune sand is present along the north side of the North Canadian River valley and on the High Plains. Because this unit is generally above the water table, it does not yield water to many wells; but it facilitates recharge to the underlying hydrologic units.

Most ground water in Beaver County originates as precipitation within the county, although some enters as underflow from the northwest. The ground water moves generally eastward, but it is diverted toward major streams where it discharges into the alluvium or emerges as springs at the base of the Pliocene and Pleistocene deposits.

The largest use of ground water is for irrigation, but water also is pumped for public-supply, industrial, and domestic and stock use. For 1959 the total pumpage of ground water in Beaver County is estimated to have been 18,000 acre-feet.

*U. S. Geological Survey, Ground Water Branch.

In 1941 the 5-year moving average of precipitation rose abruptly from an average of 15 inches for 1937-40 to an average of 21.5 inches for 1941-51. Water levels rose in response to the added recharge. In some wells the rise was immediate, and annual fluctuations in precipitation correlate with similar fluctuations in water level. In other wells the rise in water level lagged behind the rise in precipitation by about 7 years, and annual fluctuations of precipitation are not shown by fluctuations of water levels. The time lag and smoothing out of the variations in precipitation shown by the water level is a function of the depth to the water table, the permeability of the rocks above the water table, and the topography in the vicinity of the well.

Recharge to ground-water bodies is estimated to be about 18 percent of precipitation during wetter periods, or about 3.9 inches per year. In wet years recharge may be about 350,000 acre-feet of water. The excess of recharge over discharge goes into increased storage, which in the period 1941-51 was 100,000 acre-feet per year. Inflow in the northwestern part of the county is about 7,000 acre-feet per year. In dry periods the total amount of ground water in storage in the Pliocene and Pleistocene deposits is about 20 million acre-feet.

Water obtained from the redbeds of Permian and Triassic age is generally high in sulfate and at some places is high in chloride. It is generally not suitable for many uses. Water from the Pliocene and Pleistocene deposits is of good quality and is used for public supply and irrigation and by industry throughout the county.

# INTRODUCTION

## Purpose, Scope, and History of the Investigation

An investigation of the ground-water resources of Beaver County, Oklahoma, was begun in 1938, near the end of a drought that gripped the region in the 1930's. Successive crop failures caused by this drought led to speculation that irrigation from wells might be possible and would make farming less dependent upon precipitation. Determination of availability of ground water for irrigation and a description of the occurrence of ground water in the county were the original purposes of this investigation. Water-well data were obtained, and water levels were measured in the summers of 1938 and 1939; altitudes of wells were determined by alidade and plane table in the summers of 1940, 1941, and 1942. Geologic mapping was started in 1940. With the advent of World War II and the entry of the project chief, Stuart L. Schoff, into the armed service, the project was suspended.

With the return of the project chief after the war, intermittent geologic mapping was done from 1948 to 1954, but other work prevented an evaluation of the basic data on the geology or hydrology of the county. In 1955 the project chief was assigned to Peru and was unable to complete work on the project.

In July 1960 the present project chief, I. Wendell Marine, was assigned to synthesize the previously collected data, to collect such additional data as were necessary to evaluate current development, and to prepare a report. The purpose of this investigation was to evaluate the occurrence of ground water and its present status of development and to determine as nearly as possible the potential for additional ground-water development.

From its beginning in 1938 to its culmination in 1961, this project has been financed by cooperative agreement between the U. S. Geological Survey and the Oklahoma Geological Survey. In its beginning, the project was under the general supervision of O. E. Meinzer, formerly chief of the Ground Water Branch, U. S. Geological Survey, and R. H. Dott, formerly director of the Oklahoma Geological Survey. It was continued under A. N. Sayre, former chief of the Ground Water Branch, and W. E. Ham, former acting director of the Oklahoma Geological Survey, and was completed under P. E. LaMoreaux, former chief of the Ground Water Branch, and C. C. Branson, director of the Oklahoma Geological Survey. The report was prepared under the immediate supervision of A. R. Leonard, district geologist for the Ground Water Branch in Oklahoma.

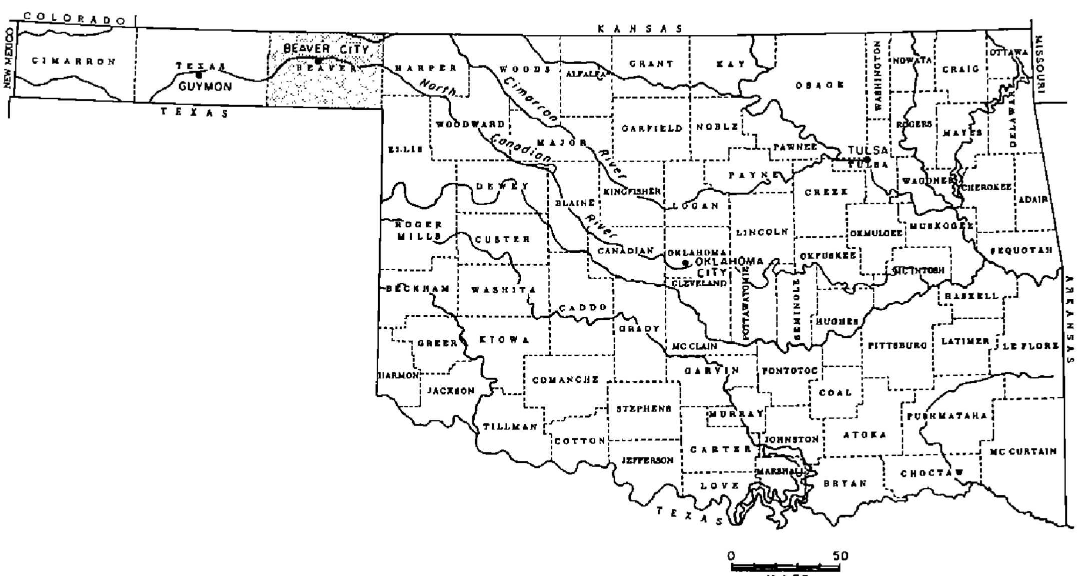


**Figure 1. Index map of Oklahoma showing the location of Beaver County.**

## Location and Extent of the Area

Beaver County is the easternmost of the three counties in the Oklahoma Panhandle (fig. 1). Unlike the rest of Oklahoma in which the land grid originates at the Indian Base and Meridian, the townships and ranges in the three panhandle counties begin at the Cimarron Base and Meridian, which form the western and southern borders of the Panhandle. Beaver County lies in Tps. 1 to 6 N. and Rs. 20 to 28 E., Cimarron Base and Meridian. Its area is 1,793 square miles (U. S. Census Bureau).

## Previous Investigations

The geology of Beaver County was the subject of a report published in 1926 by the Oklahoma Geological Survey (Gould and Lonsdale, 1926). This report has sections on the physiography, geology, economic resources, agriculture, and history of Beaver County. Later reports described the geology of the adjacent counties—Texas (Schoff, 1939) and Harper (Myers, 1959) Counties in Oklahoma, and Meade (Frye, 1942) and Seward (Byrne and McLaughlin, 1948) Counties in Kansas. Ground water in counties in Texas that are adjacent to Beaver County (Lipscomb and Ochiltree) is discussed in a report of a reconnaissance of the northern High Plains of Texas (Alexander, 1961).

## Well-Numbering System

The well-numbering system used in this report is based on the standard township, range, and section land-grid system that is used generally throughout the western United States. The first number is the township; the second, the range; and the third, the section. The first lower-case letter is the quarter section: a—northeast quarter, b—northwest quarter, c—southwest quarter, d—southeast quarter, as illustrated on figure 2. The second lower-case letter is the quarter-quarter section and the third the quarter-quarter-quarter section, with the letters indicating the same arrangement of quarters as the ones listed above. Thus the letters are reversed from the usual subdivisions giving section subdivisions, the larger subdivision being given first instead of last. The final number indicates a specific well within the 10-acre subdivision but gives no clue to the location of the well within the subdivision. Wells are numbered serially within the 10-acre subdivision. For example, well (3N-22E-1adb1) is the first well scheduled in the NW¼ SE¼ NE¼ sec. 1, T. 3 N., R. 22 E. (fig. 2).

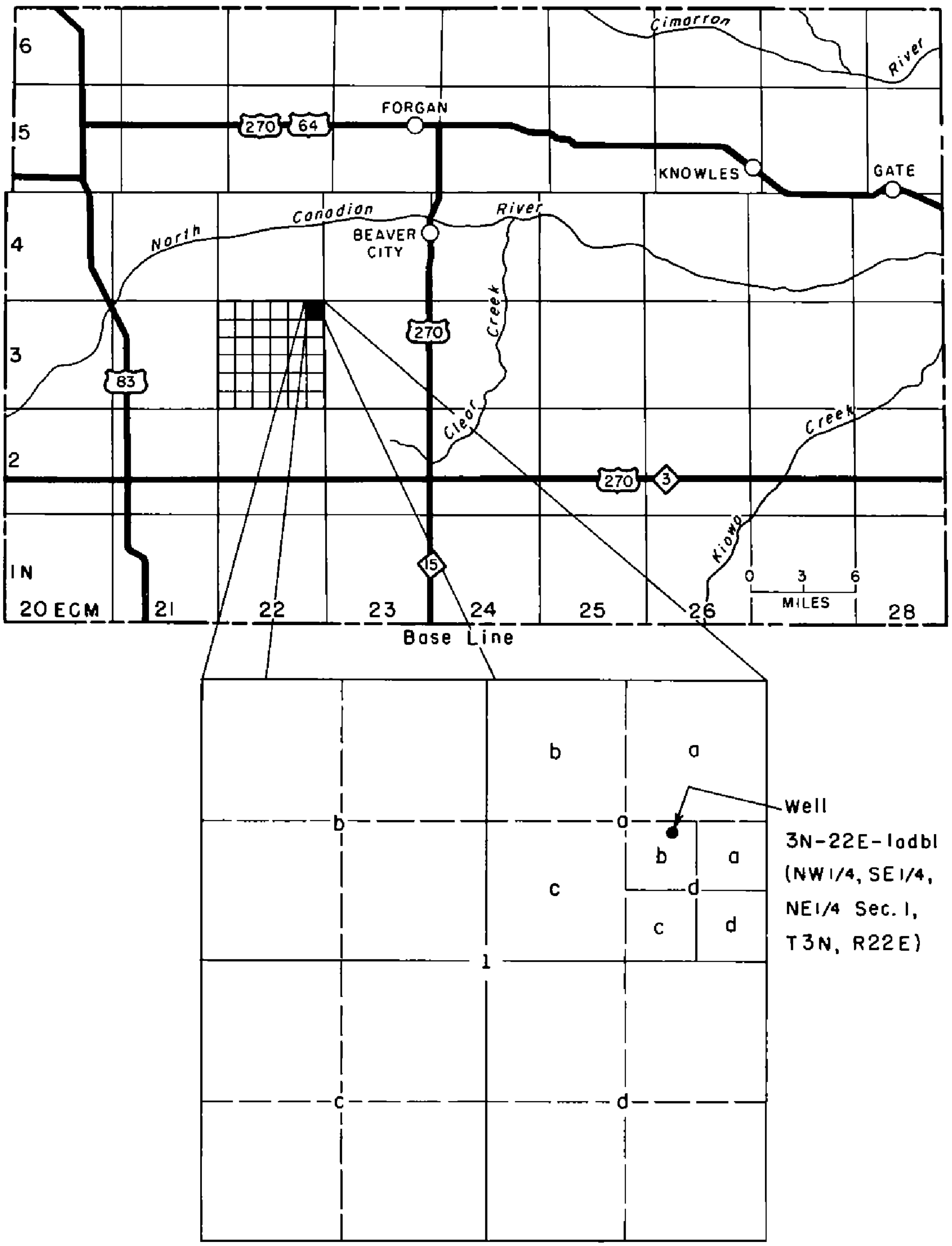


**Figure 2. Map of Beaver County and illustration of the well-numbering system.**

### Acknowledgments

Appreciation is expressed to the many residents, well drillers, and officials who supplied information on which this report is based. Information on many irrigation wells in the county was furnished by the Oklahoma Water Resources Board. Delbert Schwab, county agent at large in Guymon, Oklahoma, also furnished information on irrigation wells. Logs of water wells were furnished by the drillers who operate in Beaver County. Western Gas Service Co. and Southwestern Public Service Co. supplied pumpage data for the municipal systems of Beaver City and Forgan. Carl Kerr of Western Gas Service Co. furnished weekly water-level measurements of a well near the North Canadian River.

## GEOGRAPHY

### Topography and Drainage

Most of Beaver County is dissected by streams tributary to the North Canadian River, locally called the Beaver River, and to the Cimarron River. The North Canadian River flows generally eastward across the middle of the county (fig. 2). Its larger tributaries enter from the south, and these have eroded most of the southern part of the county into a gently undulating surface of low relief. The Cimarron River flows eastward across the northeast corner of the county. On the divide between these two streams are remnants of the undissected High Plains, a flat surface that slopes gently to the east without perceptible relief. In the eastern part of the county, the undissected area of this divide is small; but in the western part, the area includes about five townships. Remnants of the High Plains surface also occur in the southwest corner of the county. Because the eastern two-thirds of the county is dissected, it is included in the Plains Border section of Fenneman (1930), whereas the western third is in the High Plains. The maximum altitude, in the southwest corner of the county, is about 2,960 feet above sea level. The lowest altitude, in the northeast corner, is about 2,000 feet.

The surface of the High Plains is monotonously flat (fig. 3) with only minor features of relief. Small subcircular undrained depressions of various sizes occur on this upland plain. In Beaver County these depressions are neither so numerous nor so well developed as in other parts of the High Plains. The

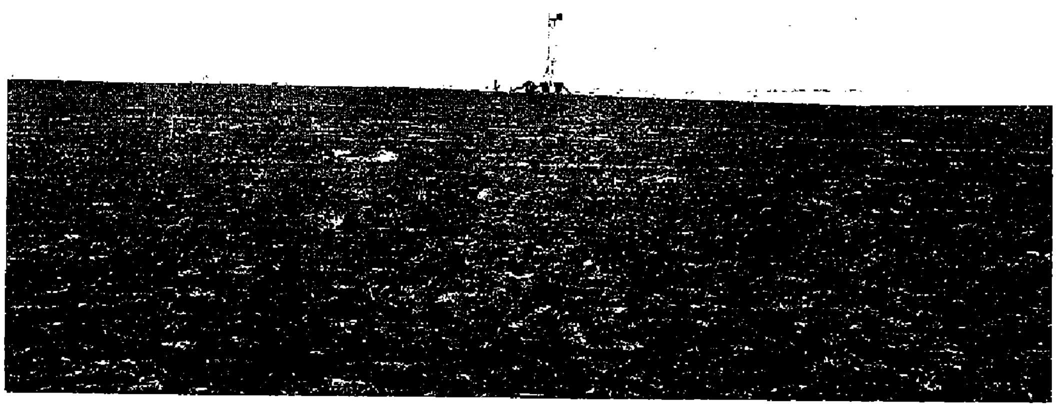

**Figure 3. The flat surface of the High Plains in Beaver County (sec. 10, T. 5 N., R. 23 E.).**

largest are several hundred feet across and are 10 to 20 feet deep. Some of these depressions retain water for a period after a rain and then are most conspicuous. The origin of these depressions has been the subject of much speculation, and there is no agreement on the subject. The High Plains north of the North Canadian River are about 200 feet lower than the equivalent surface south of that river. The surface of the High Plains slopes generally to the east at about 10 feet per mile.

Between the High Plains surface and the river bottoms is an area varying in width where the land is intricately dissected by small tributaries of the master streams. This dissected area is called the "breaks" because it is a break in the flat surface of the plains. Owing to the topography, pasture is more common than are cultivated fields in the breaks. Relief in the breaks from the High Plains to the river bottoms is as great as 400 feet in the eastern part of the county but is only about 200 feet in the west.

Sand dunes contribute relief to part of the High Plains as well as to the breaks and valley bottoms. They are most common on the north slope of the North Canadian River valley, where the source of the sand probably was the flood plain of the river. The prevailing southerly winds blow the sand out of the flood plain onto the north slope of the valley. Many of these dunes are now more or less stabilized by vegetation, but close to the river some are actively shifting and are barren of vegetation. Dunes that cover the upland are more subdued and better stabilized and therefore are probably older than the dunes closer to the river, but an age cannot be given to any except the youngest. In some places local relief on the dunes is as much as 50 feet.

In the eastern half of the county are several sinklike depressions that may or may not have external drainage. Their diameters range from a few hundred yards to about 3 miles. The largest basin is between Gate and the Harper County line. Drainage of these basins, where it exists, probably has developed subsequent to the formation of the basins. The larger of these basins have a complex geomorphic history probably similar to that of the basin in Harper County that was studied by Stephens (1960). However, the closed depression itself probably was caused by collapse of the overlying rock into a solution cavity in the redbeds. These cavities are caused by the removal of gypsum or salt, which are common constituents of the Permian rocks underlying this area. Many of the depressions contain a small ephemeral lake at their lowest point.

The North Canadian River is the principal drainageway for the county even though the stream bed is dry for part of the year. Tributaries from the north are short and mostly intermittent, whereas some of those from the south are 20 to 30 miles in length and are commonly perennial in their lower reaches. The sand-filled channel of the river averages about 200 feet in width, and its banks are low bluffs, 1 to 10 feet high. In the sand-filled part of the channel, the braided water courses shift frequently. A low flood plain borders the channel in some places, and it is covered by bushes or has a few small trees. Phreatophytes (plants that use large quantities of water from the saturated zone) grow in the flood plain at some places but are not so common as they are along the Cimarron River.

The average annual rate of flow of the North Canadian River at the gaging station at Beaver City during the period 1939-58 ranged from a low of 12 cfs (cubic feet per second) in 1943 to a high of 357 cfs in 1950. Mean monthly discharge during the same period ranged from 0 to nearly 3,000 cfs. The river gradient is about 5½ feet per mile eastward, and the altitude drops from about 2,600 feet to about 2,200 feet within the county.

Within the county are several large creeks that are tributary to the North Canadian from the south, and the largest of these are Clear and Kiowa Creeks. Most of these creeks are perennial and generally begin to have water in their channels where they cross the contact between the Pliocene and Pleistocene deposits and the redbeds. The water is discharged from the Pliocene and Pleistocene ground-water reservoir. Where this water emerges at the surface, the creek channels are generally lined with large cottonwood and willow trees.

The Cimarron River is perennial throughout its length in Beaver County. Tributaries that originate in Oklahoma are small, but a large one, Crooked Creek, which joins the Cimarron on the north, originates in Kansas. The sandy channel of the river is commonly wider than that of the North Canadian River, being more than a quarter of a mile wide in some places. Within the sandy channel the water course is braided and shifts frequently. Bordering the channel are low flood plains that contain large areas of phreatophytes. Along the river most vegetation is small, and trees are few.

The flow of the Cimarron River does not vary as greatly as that of the North Canadian. The mean annual discharge ranged from about 44 to about 200 cfs in the period 1943-58. The gradient of the river in Beaver County is about 10½ feet per mile eastward, and its altitude drops from about 2,270 to about 2,000 feet.

## Climate

Beaver County is semiarid and has cool winters and warm summers. The average annual temperature is about 57°F, but the seasonal range is great (fig. 4A). The annual precipitation averages 18.56 inches. Since 1909, records of the U. S. Weather Bureau show that precipitation at Beaver City has ranged from 8.40 inches in 1956 to 35.33 inches in 1941 (fig. 4B). Figure 4A shows that the amount of precipitation in any given month can be variable, but that precipitation in the summer normally is greater than in the winter. Most of the precipitation is in the form of torrential rains from thunderstorms.

## Population

The population of Beaver County has been declining since about 1920 (table 1). In 1960 the county had only about half

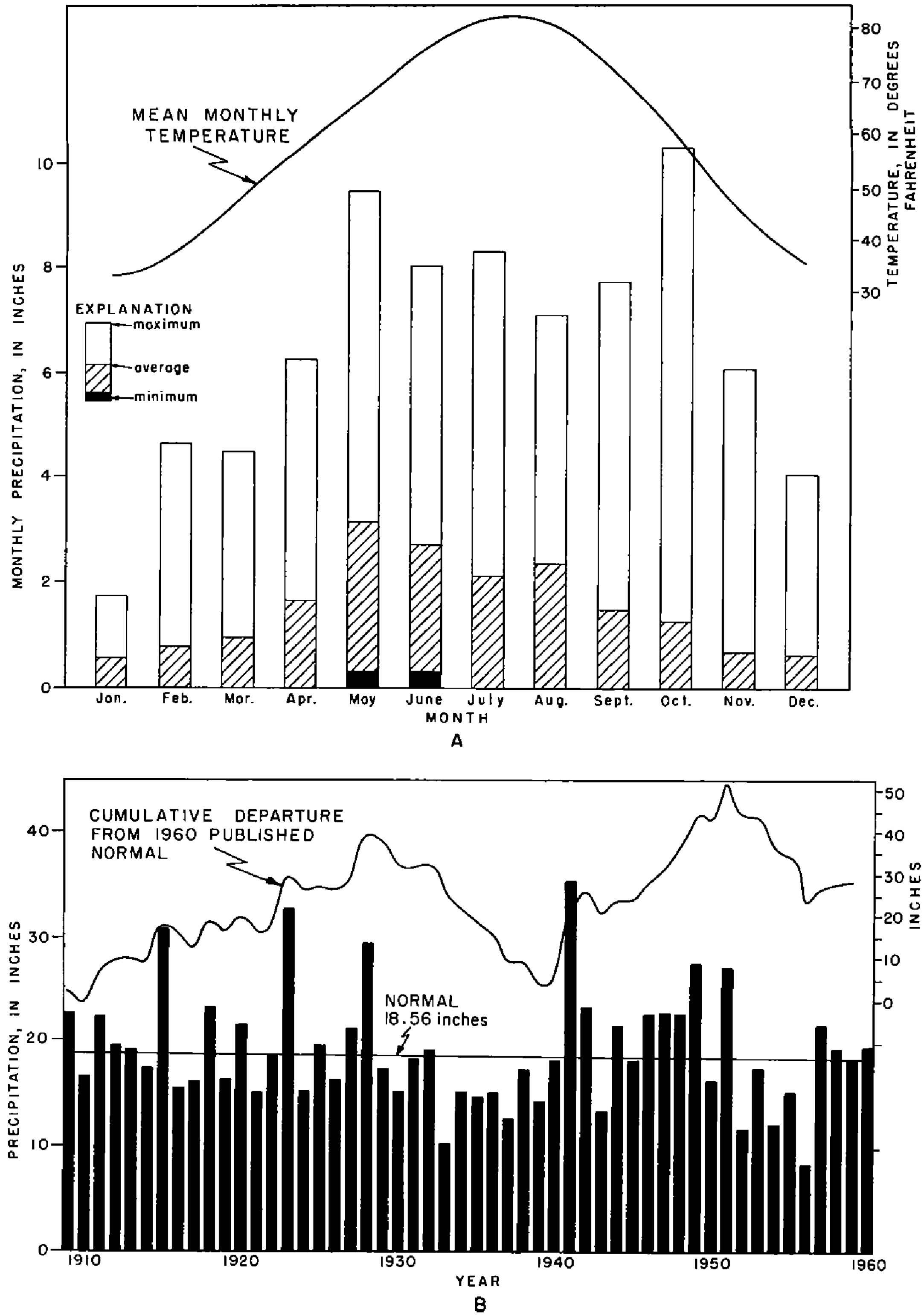


**Figure 4. A, Maximum, average, and minimum monthly precipitation and mean monthly temperature at Beaver City.**
**B, Annual precipitation and cumulative departure from normal at Beaver City, 1909-60.**
**(Data from U. S. Weather Bureau)**

TABLE 1.—POPULATION OF BEAVER COUNTY, OKLAHOMA, FROM 1907 TO 1960, AND THE POPULATION OF TOWNS WITHIN THE COUNTY

(Data from U. S. Census Bureau)

| YEAR | BEAVER COUNTY | BEAVER CITY | FORGAN | GATE | KNOWLES | TURPIN | BALKO |
|---|---|---|---|---|---|---|---|
| 1907 | 13,364 | 271 | | | | | |
| 1910 | 13,631 | 326 | | | | | |
| 1920 | 14,048 | 920 | 582 | 309 | | | |
| 1930 | 11,452 | 1,028 | 605 | 307 | 219 | | |
| 1940 | 8,648 | 1,166 | 428 | 243 | 105 | | |
| 1950 | 7,411 | 1,495 | 410 | 197 | 91 | | |
| 1960 | 6,965 | 2,087 | 532 | 130 | 62 | 200 | 100 |

as many people as it did in 1920. The population is, and has always been, predominantly rural. About 2,000 people live in Beaver City, the largest town.

## AGRICULTURE AND INDUSTRY

Agriculture and the oil and gas industry account for most of the income in Beaver County. In 1958 about 243,000 acres were cultivated in Beaver County. Winter wheat is the major crop and, in 1958, 5 million bushels of wheat were harvested from 225,000 acres. Most of the wheat was produced on dry-farm land with only about 1,500 acres being irrigated. Other crops grown are hay, oats, sorghum, corn, and cotton. In 1959, about 11,000 acres were under irrigation in the county. Livestock is a major product, and beef cattle is the principal stock. In 1958 there were about 60,000 head of beef cattle in Beaver County. Other livestock included about 4,500 dairy cows, 1,500 sheep, 4,500 hogs and pigs, and 7,500 chickens (Data from U. S. Dept. Agriculture).

Oil and gas production is the major industry in Beaver County. In 1959 there were about 25 gas fields and about 30 oil fields within the county. Several gas transmission lines cross the county, and there are two compressor stations and two plants manufacturing liquefied petroleum gases in the county.

Business other than petroleum and agriculture is small. In a small pit near Gate, volcanic ash is mined intermittently for silica powder, and some sand and gravel are mined for local use. About 80 retail-trade establishments provide services and merchandise in support of agriculture and the petroleum industry.

# GEOLOGY AND WATER-BEARING CHARACTERISTICS OF THE ROCKS

The oldest rocks exposed in Beaver County are redbeds consisting of red shale and sandstone of Permian age (table 2). In most places these are overlain by semiconsolidated sand, gravel, and clay of Pliocene and Pleistocene age. Dune sand and alluvium may lie directly upon the redbeds or overlie the Pliocene and Pleistocene deposits. In the subsurface Pennsylvanian and older rocks occur, but they are at depths too great to be tapped by water wells. Triassic rocks overlie the redbeds of Permian age in the subsurface of the western third of the county and may crop out locally in that area.

The regional structure of the county is simple, and most beds have a slight easterly or southeasterly dip (Greene, 1926). Owing to collapse structures, however, beds that dip steeply in any direction occur locally.

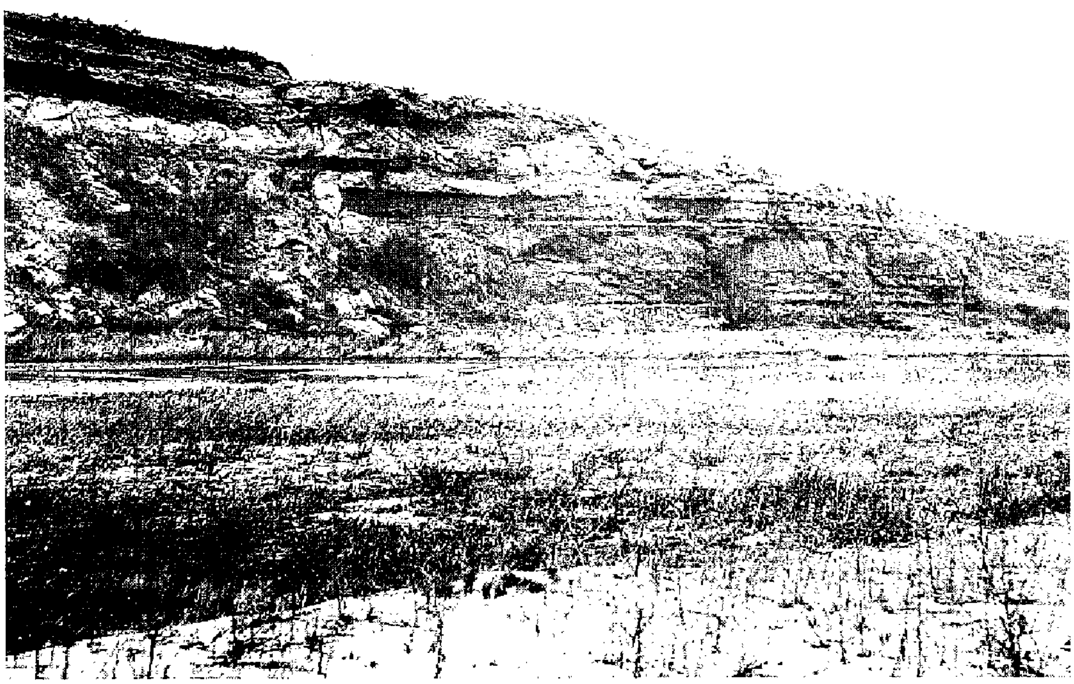

**Figure 5. Red shale and thin sandy zones overlain by white gypsum beds alternating with red shale in the redbeds of Permian age (sec. 11, T. 3 N., R. 24 E.).**

Some domestic wells obtain water from the red shale and sandstone of Permian and perhaps Triassic age, which are generally termed bedrock in this part of Oklahoma. The Pliocene and Pleistocene deposits form the principal aquifer in Beaver County and supply most of the water for domestic, stock, irrigation, industrial, and public-supply purposes. Alluvium along the rivers and major tributaries supplies water to domestic and stock wells and to several irrigation wells. Dune sand forms a veneer which may overlie the redbeds, the Pliocene and Pleistocene deposits, or the alluvium. The dune sand is not an extensive aquifer in Beaver County but may be important in increasing the amount of recharge to the underlying rocks.

## Permian Rocks

In Beaver County, as in most of western Oklahoma, the Permian rocks are generally called redbeds. They consist primarily of dark reddish-brown sandstone, siltstone, shale, and sandy shale. Most of the sandstone is fine- to very fine-grained, and silt is a common constituent in both the shale and sandstone. Gypsum, common in the redbeds in many areas, occurs in the shale and sandstone as a cementing agent, as thin flakes, as thin veins that may intersect the beds at any angle, and as beds. Figure 5 shows a sequence of shale and thin sandy zones overlain by gypsum beds alternating with shale. Thin, discontinuous zones of white or gray sandstone occur within the redbeds throughout the county. Gray limestone and dolomite crop out in thin beds at several localities, most of which are in the northeastern part of the county.

Bedded salt also is a constituent of the redbeds of Permian age in the subsurface of Beaver County. The depth to the uppermost salt deposits is shown on figure 6A, and the configuration of this salt deposit is shown on figure 6B.

The redbeds of Permian age exposed in Beaver County undoubtedly belong to the upper part of the Permian section of Oklahoma; however, there is disagreement on what formations are represented and the extent of their exposure. Gould and Lonsdale (1926) mapped all the redbed and thin gypsum exposures in the county as the Cloud Chief Formation. In modifying their map, Six (1930) showed many exposures of the Whitehorse Group throughout eastern Beaver County. The presence of the Quartermaster Formation in the western part of the county was indicated by Bloesch and Schoff (*in* Stovall,

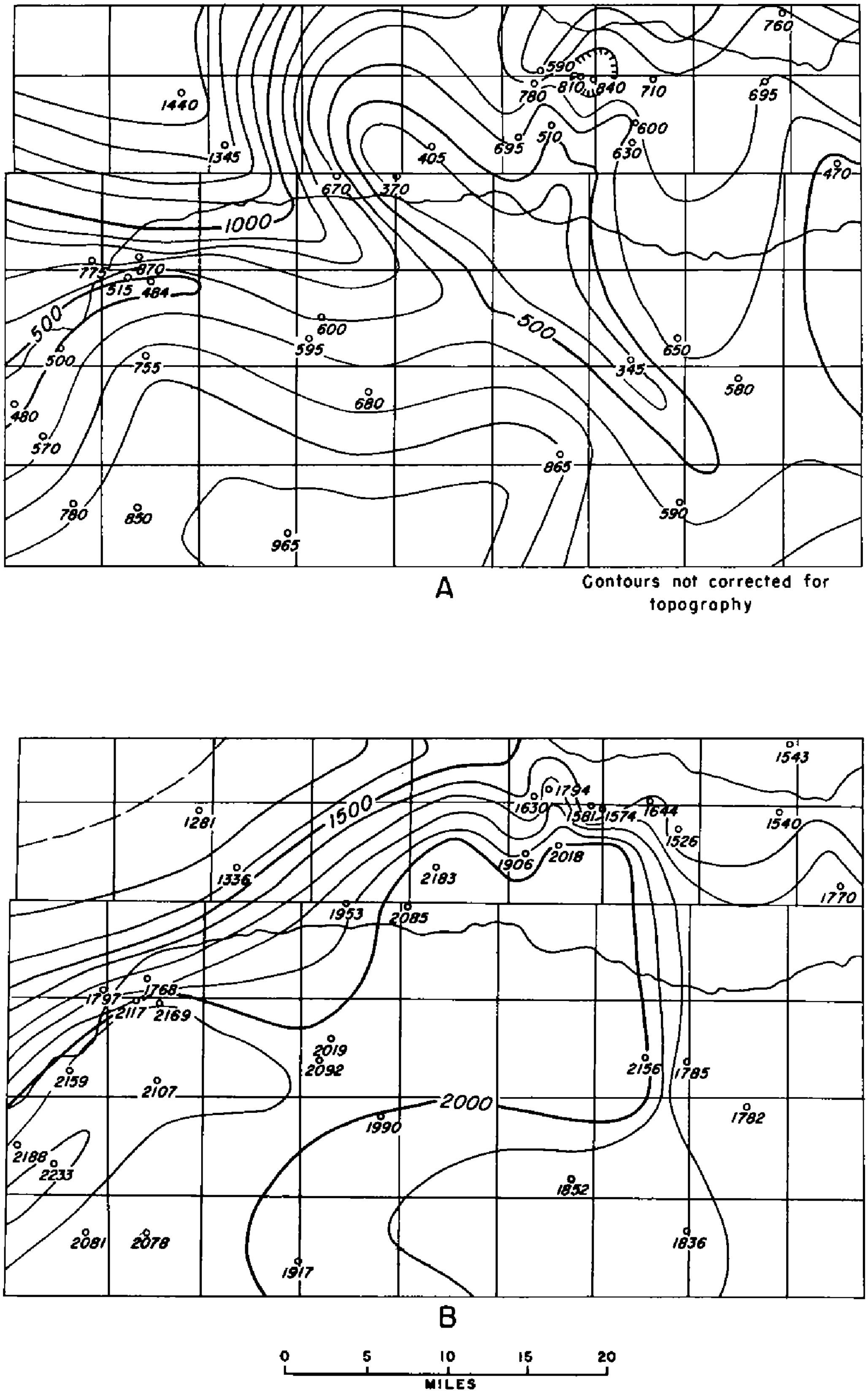


**Figure 6. A, Depth to uppermost salt deposits in the redbeds of Permian age of Beaver County.**
**B, Altitude of the top of the uppermost salt deposits.**
(Written communication from P. E. Ward, U. S. Geological Survey)

1941, p. 18). The *Geologic map of Oklahoma* (Miser, 1954) shows the Whitehorse Group only in the northeastern part of the county and shows the rest of the Permian rocks as the Cloud Chief Formation. The *Paleotectonic maps of the Triassic System* (McKee, and others, 1959, pl. 2) show that Triassic rocks in the extreme western part of Beaver County are underlain by the Whitehorse Group. All these units have similar water-bearing characteristics; therefore, the redbeds have not been differentiated into formations in this report. The distribution of these rocks at the surface is shown on plate I.

The thickness of the redbeds in Beaver County is reported by Gould and Lonsdale (1926, p. 17) to be about 1,500 feet, and inspection of modern drilling logs indicates that this figure is substantially accurate. As redbeds do not constitute the lower part of the Permian sequence in this county, this figure does not represent the total thickness of Permian rocks. The maximum thickness of exposed redbeds that has been measured is 145 feet (sec. 33, T. 6 N., R. 28 E.).

The upper surface of the redbeds of Permian age is an erosional unconformity having a relief of several hundred feet (pl. I). Some of the relief also is due to collapse structures resulting from solution of gypsum and salt from deeper Permian rocks. Throughout most of the county, the redbeds of Permian age are overlain by Pliocene and Pleistocene deposits; however, they are overlain by redbeds of Triassic age (Dockum Group) in the extreme western part (McKee and others, 1959). The distinction between the two sequences of redbeds is not made easily. Where the Permian rocks are not overlain by Triassic rocks or by Pliocene and Pleistocene deposits, they either crop out or are overlain by a veneer of dune sand or alluvium, principally along the two major rivers or along the lower reaches of their tributaries (pl. I). In these localities the overlying blanket of Pliocene and Pleistocene rocks, which at one time covered the entire area, has been eroded away. The relief on the upper surface of the Permian, therefore, has been caused by Pleistocene and Recent cycles of erosion, pre-Pliocene and post-Triassic cycles of erosion, perhaps by a pre-Late Triassic period of erosion, and by collapse caused by solution.

Most wells that obtain water from the redbeds in Beaver County yield only small amounts. The shale and cemented sandstone beds are relatively impermeable except where the rocks are fractured or jointed. Open fractures that have not been filled in or recemented are uncommon in most areas. Some wells, however, penetrate a sufficient number of openings to yield enough water for domestic use. The redbeds are poor aquifers that are used only where no other is available. In some areas the permeability of the redbeds may have been increased by solution of gypsum or salt, but the quality of the water is likely to be poor. Any well drilled into the salt deposit, the top of which is shown on figure 6, should penetrate beds containing salt water just above the deposit.

Most of the water in the redbeds has percolated downward through the overlying Pliocene and Pleistocene deposits. Some recharge may occur locally in the area of outcrop or where the redbeds are overlain by dunes or alluvium, but the amount is probably small. Besides some natural discharge in the form of seeps, a small amount of water is pumped from the redbeds for domestic use.

The principal hydrologic function of the redbeds is to impede the downward movement of water from the Pliocene and Pleistocene deposits. This causes a saturated zone of varying thickness in the lower part of these deposits. Water, being unable to move downward, moves laterally toward points of discharge where the contact of the redbeds and the overlying deposit is exposed. The contact, especially in creeks, is marked by numerous springs (pl. I) and by willow trees, cottonwood trees, and other water-loving vegetation.

Most of the water from these beds is highly mineralized and is unfit for human consumption, and some is unfit for stock. The quality of this water is discussed in more detail in the section on the chemical quality of ground water.

## Triassic Rocks

In most early reports, all the redbeds in Beaver County were mapped as Permian; however, the *Paleotectonic maps of the Triassic System* (McKee and others, 1959) show Triassic rocks in the western part of the county. This interpretation was based on subsurface data from one well in the county and a few exposures just west of the county line which were assigned to the Triassic System by Bloesch and Schoff (*in* Stovall, 1941, p. 19). Mudge (*in* McKee and others, 1959, pl. 4) mapped these Triassic rocks as equivalent to the Dockum Group of Cimarron County, Oklahoma, the Texas Panhandle, and northeastern New Mexico.

TABLE 2.--GENERALIZED SECTION OF THE HYDROLOGIC UNITS IN BEAVER COUNTY, OKLAHOMA

| System | Series | Hydrologic unit | Thickness (feet) | Physical character | Water supply |
|---|---|---|---|---|---|
| Quaternary | Pleistocene and Recent | Dune sand | 0 - 50± | Fine to coarse, round to subround, wind-blown sand consisting mostly of quartz grains. | Mostly above water table and not saturated. Where saturated yields water readily to domestic or stock wells but supply may not be permanent. Water most likely to occur in this unit where underlain by relatively impermeable redbeds. |
| | | Alluvium | 0 - 55 Average 30 | Light-brown or gray sand, silt, and gravel in discontinuous lenses along the courses of the major streams. | Yields about 400 to 2,000 gpm to wells or pits. Water level commonly within 20 feet of the surface. Water quality satisfactory for most purposes except where redbeds are nearby. |
| Tertiary and Quaternary | Pliocene and Pleistocene | Pliocene and Pleistocene deposits | 0 - 570 | Interfingering lenses of gravel, sand, silt, clay, limestone, and mixtures of these. In many places consolidated by lime cement, but in other places loose and free. Color generally brown or light gray but may include red, pink, yellow, white, and black beds. The more common rock types are clay, silt, sand, gravel, sandstone, conglomerate, and caliche. Less common are limestone, volcanic ash, and blackish-green shale. | Principal aquifer in the county. Irrigation wells yield 200 to 1,760 gpm and average 700 gpm. Specific capacities range from 2.4 to 100 gpm per ft. of drawdown and average about 15 gpm per ft. Water quality suitable for most uses. Dissolved solids average about 440 ppm and calcium, magnesium, hardness about 230 ppm. |
| Triassic | | Redbeds | 0 - 160 | Red shale, sandstone, and siltstone are predominant rocks, but light-gray and gray-black clay also present. | May supply small quantities to some stock and industrial wells, but yield is insufficient for irrigation wells. |
| Permian | | Redbeds | 1,500 | Red shale, sandstone, and siltstone predominate. Limestone, dolomite, gypsum, and salt are common. | Supplies small quantities to stock wells, but does not transmit water at a rate sufficient to supply an irrigation well. Water normally high in dissolved solids, particularly in sulfate and in some places in chloride. Generally unsuitable for drinking. |

Sandstone of Mesozoic age crops out in two small patches in western Beaver County, according to Bloesch and Schoff (*in* Stovall, 1941, p. 18). The *Geologic map of Oklahoma* (Miser, 1954) shows these patches by a symbol that includes Triassic and Jurassic, but the map explanation includes a note that Jurassic rocks are restricted to Cimarron County. By elimination then, the two small outcrops were mapped as Triassic. The rocks of the two outcrops consist of boulders of pink and white sandstone, which probably rest in place on redbeds. The nature and small size of the outcrops make an age determination difficult and unreliable.

In adjacent Texas County, Oklahoma, Triassic(?) rocks were described by Schoff (1939, p. 39; 1955, p. 149-152) as consisting chiefly of red shale and fine-grained buff, pink, red, and white sandstone, and minor beds of fine-grained conglomerate in which most of the pebbles are gray or white clay. The Triassic rocks in Beaver County probably are similar to those in Texas County.

The Triassic rocks in Beaver County are as thick as 160 feet, according to Mudge (*in* McKee and others, 1959, pl. 4). An unconformity on the top of the Triassic rocks suggests that their original thickness has been reduced by erosion. Triassic rocks are restricted to the extreme western part of Beaver County.

Where penetrated by water wells, Triassic rocks are usually called redbeds by drillers and are not differentiated from the redbeds of Permian age unless the color is significantly different. Hydraulically, these rocks are similar to the redbeds of Permian age, and generalizations made about the water-bearing properties of redbeds apply equally to rocks of both systems. Triassic rocks are included with the redbeds of Permian age as a hydrologic unit on pl. I.

## Pliocene and Pleistocene Deposits

In Beaver County the redbeds are overlain unconformably by fluvial deposits of gravel, sand, silt, clay, and limestone of Pliocene and Pleistocene age. The deposits have become partly consolidated by later deposition of calcium carbonate from circulating ground water. A consolidated cross-bedded sandstone, which commonly occurs near the base of these deposits, is shown in figure 7. None of the beds is traceable over large areas. Individual lithologic types interfinger and grade into one an-

Figure 7. Cross-bedded sandstone near the base of the Pliocene and Pleistocene deposits (sec. 2, T. 4 N., R. 27 E.).

Figure 8. "Flattop," a small mesa capped by algal limestone in the Pliocene and Pleistocene deposits (sec. 3, T. 1 N., R. 28 E.).

other in short distances. Many of the beds are calcareous and, depending on grain size, may become cemented into sandstone, siltstone, or conglomerate. Most of the indurated beds are friable and may be broken easily with a hammer. Caliche occurs in the form of nodules, veins, irregular masses, and layers.

The clastic parts of the deposits range in size from clay through silt and all sand sizes to gravel with cobbles as much as about 4 inches in diameter. Most deposits consist of varied proportions of these sizes and sorting ranges from good to poor. Common descriptive terms are clay, clayey sand, sandy clay, sandstone, sandy gravel, and conglomerate. The particles are derived principally from pre-existing sandstones, such as the Dakota sandstones and the Cheyenne Sandstone of the Purgatoire Formation of Cretaceous age, which crop out to the west. Fragments of dark igneous rock derived from basalt mesas in northwestern Oklahoma, northeastern New Mexico, and southeastern Colorado also occur. Clastic particles derived from the redbeds of Permian and Triassic age are common and in some beds are so concentrated that they impart an overall red color to the deposit. The red color may be so intense that it is difficult to distinguish the Pliocene and Pleistocene deposits from the older redbeds. Generally, however, these deposits are light gray, tan, brown, white, or pink.

Limestone is common in these deposits. Near their base locally is a soft chalky grayish-white limestone. It is commonly called "saw rock" because during the early settlement of the region it was sawed into blocks and used for building stone. This limestone locally weathers into spherical boulders that resemble large cannon balls. Higher in these deposits, thin-bedded sandy limestones that grade into calcareous sandstones occur. Much of the calcareous material is caliche, which was probably deposited by soil-forming processes after the deposition of the clastic particles. However, some of the more persistent limestone layers were probably deposited in lakes at the same time that clastic rocks were being deposited nearby. Many writers (Elias, 1931, p. 136; Smith, 1940, p. 41) have reported a persistent layer of limestone at the top of the Ogallala Formation. In many areas this limestone forms the high plains surface and is called algal limestone because it consists of fine, wavy laminations and small seedlike "inclusions" similar to those formed by lime-secreting algae. Elias (1931, p. 138) attributed the formation of the limestone to the alga *Chlorel-*

*lopsis bradleyi*, which he named and described from this unit in Kansas. In Beaver County this unit is restricted to several small, low flat-topped mesas (fig. 8).

Volcanic-ash falls were common in Pliocene and Pleistocene time, and thin horizontal beds of ash occur at several horizons in these deposits. The ash is light-gray or white, very fine-grained pumice. Locally thicker accumulations of ash are present, and in sec. 8, T. 5 N., R. 28 E., the ash is of sufficient thickness to be of intermittent economic value.

Black shale, although not common in Beaver County, occurs in the basal deposits of the Pliocene and Pleistocene in sec. 5, T. 3 N., R. 28 E. The fact that the shale contains much carbonaceous matter prompted local residents to dig an exploratory coal mine about 1900. The venture was apparently without economic success.

In this report the Pliocene and Pleistocene deposits are treated as a unit because hydrologically and, with certain generalizations, lithologically they are one unit. However, within these deposits there are beds of many ages, and in areas where it has been the practice to differentiate formations on the basis of age, a great many formational names have resulted. Different workers in the same area and workers in other areas have produced entire suites of new names that differ from those of previous workers or from the names used in adjacent areas. Fossil assemblages commonly are local in extent and cannot be used readily for correlation over large areas. Part of the stratigraphic difficulties results from the removal, in the Plains Border section of the Great Plains, of a large part of the Ogallala Formation and its replacement with Pleistocene material deposited in local depressions on an irregularly eroded surface. Some of the depressions were caused by collapse of underlying beds of Permian age. Two nearby collapse depressions may not have formed at the same time and so may contain material and fossils of different stages within the Pleistocene. Modern workers are making progress in deciphering the correct relationships of the material and the fossils within this body of sediments (Taylor, 1960; Stephens, 1960).

As considered in this report, the Pliocene and Pleistocene deposits probably include rocks equivalent to (1) the Late Tertiary rocks as used by Gould and Lonsdale (1926), (2) the Laverne Formation as used by Schoff (1956), (3) the Ogallala Formation as used by Schoff (1939), Frye (1942), Myers

(1959), and Alexander (1961), (4) the Rexroad Formation as used by Byrne and McLaughlin (1948), (5) the Odee Formation as used by Smith (1940), (6) the Meade Formation as used by Frye (1942), (7) the Crooked Creek Formation as used by Hibbard (1949), (8) the Ballard Formation as used by Hibbard (1958), (9) the Sanborn Formation as used by Frye and Leonard (1952), (10) the Kingsdown Silt as used by Frye and Hibbard (1941), and equivalent formations as used by other authors. These deposits also include lake deposits and sink-fill material similar to those described by Stephens (1960), perhaps some high terrace deposits, and some loess.

The thickness of the Pliocene and Pleistocene deposits in Beaver County is irregular (pl. I). These deposits were laid down upon an undulating erosional surface of the redbeds. In addition to the original relief, there are collapse features that developed in the redbeds during the deposition of the Pliocene and Pleistocene sediments. Such features are reflected in the steep dips of the older parts of the Pliocene and Pleistocene deposits and in abrupt differences in thickness (pl. I). Some collapse basins have been filled, but some are only partly filled and are closed surface depressions underlain by a greater thickness of the Pliocene and Pleistocene deposits than is the surrounding area. Relief on the erosion surface of the redbeds beneath younger deposits in Beaver County is several hundred feet (pl. I). Another factor that contributes to the variability in thickness of the Pliocene and Pleistocene deposits is the relief of the modern land surface which generally forms their upper boundary and which also is several hundred feet. The thickest section of Pliocene and Pleistocene deposits measured in Beaver County was 104 feet (sec. 7, 8, 17, 18, T. 2 N., R. 23 E.), but the base was not exposed. The maximum thickness of these deposits penetrated by a well is 570 feet (sec. 29, T. 1 N., R. 23 E).

The approximate thickness of the Pliocene and Pleistocene deposits in the county is shown on plate I. The boundaries of the thickness zones on this map are uncorrected for topography. Thickness data are scant, so caution must be exercised in the use of this map.

The lower boundary of these deposits, the redbed contact, is sharp over most of the county but locally is indistinct. The upper boundary is generally the land surface, but at some places it is formed by the contact with the overlying dune sand or alluvium. At these places the boundary may be difficult to distinguish. The alluvium particularly may be nearly identical lithologically with that of part of the older deposits, and the contact may be gradational. On plate I both the dune sand and the alluvium are mapped primarily on the basis of their geomorphic expression.

Except along the slopes of the major river valleys, where erosion has removed them entirely, the Pliocene and Pleistocene deposits cover the entire county. They are generally thickest where erosion has been least.

*Water-bearing characteristics.*—The Pliocene and Pleistocene deposits form the principal aquifer in Beaver County. Most domestic and stock wells and almost all irrigation, municipal, and industrial wells in the county obtain water from this aquifer. Where these deposits are saturated, domestic wells commonly have adequate yields. Sites for large-capacity wells are generally selected after several test holes have been drilled. Lateral variations in the permeability of the deposits are so great that several test holes may be needed within a quarter section to locate a suitable site for a production well. The success of a well is largely a matter of local permeability, and no large area in the county can be designated as being especially favorable or especially unfavorable for the production of ground water. Of course, for a well to be successful, the saturated thickness must be sufficient irrespective of the permeability of the material penetrated. Areas where the deposits are thin (pl. I) are in general not so favorable for wells as are those where the deposits are thicker.

The depth to water below the land surface in Beaver County is shown on plate II. Use of this map in conjunction with the map showing the approximate thickness of the Pliocene and Pleistocene deposits (pl. I) will indicate areas of greatest saturated thickness.

Yields of 62 irrigation wells that produce water from the Pliocene and Pleistocene deposits range from 200 to 1,760 gpm and average 710 gpm. The yield of a well depends not only on the permeability and thickness of the water-bearing material but also on the pumping equipment and the amount of water desired. To minimize the effect of the latter two factors in comparing the water-producing ability of one well with that of another, a characteristic known as specific capacity is used. When water is pumped from a well, the water level in the well declines. The amount of water-level decline is related to the rate at which the well is pumped as well as other factors. The specific capacity of a well is the pumping rate, in gallons per minute, divided by the amount of water level decline in feet. Specific capacity varies as the permeability and saturated thickness of the sediments penetrated by the well. Specific capacities of 50 irrigation wells in the Pliocene and Pleistocene deposits range from 2.3 to 100 gpm per foot of drawdown and average about 15 gpm per foot of drawdown.

Most of the recharge to these deposits comes from precipitation within the county; however, a small amount of water enters by subsurface flow from the northwest, as indicated on plate II. Ground water moves generally toward the major rivers and discharges onto the surface where the base of the deposits crops out in the tributary drainageways (pl. I). Water also moves out of the county as subsurface outflow into Harper and Ellis Counties, Oklahoma. Probably little water moves from these permeable deposits into the underlying redbeds, which are relatively less permeable. The principal method of discharge from these deposits, other than the springs issuing from their base and subsurface outflow, is by wells.

Most of the water in the Pliocene and Pleistocene deposits is of good chemical quality and may be used for any purpose for which quality specifications are not rigid. It has a moderate hardness and is low in dissolved solids. The chemical quality of this water is discussed in more detail in the section on chemical quality of ground water.

## Alluvium

Alluvium, as considered in this report, consists of deposits that were laid by a stream that had nearly the same course that it has today. It includes the deposits of the channel, flood plain, and the low terraces. These sediments consist of light-brown or gray sand, silt, and gravel in discontinuous lenses and may resemble the Pliocene and Pleistocene deposits. On the surface the alluvium can be distinguished by its topographic form, but in the subsurface it is difficult to separate from the underlying Pliocene and Pleistocene deposits.

The upper and possibly all the deposits of the channel and flood plain are of Recent age. However, the low terrace materials and deeper deposits beneath the channel and flood plain may be of late Pleistocene age. The deposits of these two ages, if there are two, are gradational, and no differentiation was possible.

The principal areas in which alluvium occurs are along the Cimarron River, the North Canadian River, and Kiowa Creek (pl. I). Small deposits occur in the larger tributaries to each of these streams. The maximum thickness of alluvium noted during this investigation was 55 feet in a well in the middle of the flood plain of the North Canadian River (sec. 27, T. 4 N., R. 28 E.). The average thickness of alluvium in the larger stream valleys is about 30 feet.

The coarser parts of the alluvium yield water readily to wells. Several large-capacity irrigation wells are developed in the alluvium. Three such wells had yields of 390, 700, and 2,000 gpm, respectively. The two wells in which the drawdown was known had specific capacities of 20 and 23 gpm per foot of drawdown. Because of the shallow water level in the alluvium, it is commonly possible to penetrate a sufficient saturated thickness with a much shallower well than at many places in the Pliocene and Pleistocene deposits. At some places it is economically feasible to construct shallow wells with a much larger diameter than is common in wells in other areas. The larger diameter wells allow large yields of water to be developed from sediments of low relative permeability. Some large wells in the alluvium are nothing more than pits dug below the water table with a bulldozer.

The alluvium is a conduit which carries the underflow of streams. Water levels in the alluvium are affected by river stage (fig. 12). Any water from the Pliocene and Pleistocene deposits that goes through the ground into the river must pass through the alluvium. The hydraulic connection between the Pliocene and Pleistocene deposits and the alluvium is good, and water passes freely from one to the other where the two are in contact. For long reaches the alluvium of some streams rests upon relatively impermeable redbeds.

The chemical quality of water in the alluvium depends principally on the character of the water in the stream. The quality of surface water normally has a wider range than does the quality of ground water, and generally the quality of water in the alluvium of Beaver County is more varied than water in the Pliocene and Pleistocene deposits but less so than that in the streams. The alluvium acts as a buffer between the two. In general, water in the alluvium is suitable for most uses. However, at some places where redbeds are in contact with the alluvium and discharge water into it, the water may not be usable for domestic purposes.

## Dune Sand

Deposits of dune sand are common in Beaver County but large individual dunes are few. These deposits may be distinguished by their physiographic form, which is especially striking on aerial photographs. The dunes in most areas resemble ripples on a water surface. The dune material is composed of fine to coarse, round to subround grains of sand that probably was blown up from the flood plains or reworked from the Pliocene and Pleistocene deposits. The sand in the dunes is characteristically cross-bedded and is white or reddish brown.

The age of most of the dunes is probably Recent, and many are being formed and shifted today. However, some dunes high on the divides have been more or less stabilized by vegetation and may be Pleistocene in age.

The dune sand overlies the redbeds, the Pliocene and Pleistocene deposits, and locally the alluvium. In most places an unconformity separates the dune sand from the underlying rocks. The unconformable relation of the dune sand and the redbeds is shown on figure 9. The thickness of the dune sand is difficult to determine because its base commonly is not exposed. In some areas, the height of individual dunes is about 50 feet.

The principal area of dune sand is on the north side of the North Canadian River (pl. I). Two large dune areas in the middle of the county extend from near the North Canadian River onto the divide between it and the Cimarron River. Another large area of dunes is on the High Plains in the northwestern part of the county. Most other dune areas are small and are related directly to a sand source along some tributary to the master streams.

The dune sand probably would be a good aquifer if it were saturated with water. Unfortunately the water table is above the base of the dune sand in only a few areas where the dune sand overlies the relatively impermeable redbeds. The redbeds impede the downward movement of water, allowing it to accumulate just above the base of the dune sand.

The principal hydrologic function of the dune sand is to absorb precipitation, which it does readily, and to transmit the

**Figure 9. Redbeds of Permian age cropping out in dune-covered area north of Beaver City (sec. 7, T. 4 N., R. 24 E.).**

water to the underlying units. It therefore acts as a temporary reservoir for recharge water.

If an area were found where the dune sand was saturated, the quality of the water probably would be excellent because most of the sand is relatively insoluble, and water moves through it rapidly with little opportunity for solution of rock material.

# GROUND-WATER RESOURCES

## Occurrence

All ground water in Beaver County within the zone normally reached by water wells comes from precipitation. Water that condenses and falls from the atmosphere may be evaporated where it falls; it may collect in ponds or lakes, such as the high plains depressions; it may flow off into the streams and rivers; or it may be absorbed by the soil. The water that enters the soil is used and transpired by plants or passes through the soil into the underlying rock to become ground water. Ground water may be pumped for use by man, or it may discharge from the ground in the form of springs. The springs contribute to the flow of streams and rivers which may ultimately reach the ocean where the water is evaporated into the atmosphere. This cycle through which water is continually passing is called the hydrologic cycle.

Most rock near the surface of the earth is not solid but includes many pore spaces, cracks, and cavities, which may be filled with air, water, natural gas, or petroleum. The number, size, and shape of the openings depend upon the type of rock and its degree of consolidation. Coarse gravel has a small number of large pores, whereas the same volume of fine sand has a large number of smaller pores. Theoretically, the total amount of open space in both materials is the same. However, if coarse gravel and fine sand are mixed, the volume of pore space will be greatly reduced because the sand will fill the openings between the particles of gravel. The same effect is obtained when gravel or sand is consolidated by a cement that fills the pore spaces. Cracks, crevices, and cavities in rock also constitute open spaces, although they do not occur with the same regularity as pores in sand and gravel. Clay contains a great many microscopic pores, and the total percentage of pore space may exceed that of sand and gravel. Porosity is defined as the percentage of open space in a rock to its total volume. The porosities of several types of rock in Beaver County are shown on table 3.

It is of great practical importance to distinguish water that is contained in the openings of rocks from water that will move through those openings. Rocks with large total pore space do not necessarily transmit water readily. Clay, for example, may contain a large amount of water, but the water is held so tightly

TABLE 3.—GRAIN SIZE, POROSITY, SPECIFIC YIELD, AND COEFFICIENT OF PERMEABILITY OF SEVERAL TYPES OF ROCK IN BEAVER COUNTY, OKLAHOMA

| TYPE OF ROCK | LOCATION OF SAMPLE | MECHANICAL ANALYSIS (PERCENT BY WEIGHT) | | | | | | POROSITY (PERCENT BY VOLUME) | SPECIFIC YIELD (PERCENT BY VOLUME) | COEFFICIENT OF PERMEABILITY (MEINZER UNITS) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | GRAVEL AND VERY COARSE SAND (> 1.0MM) | COARSE SAND (1.0-0.5MM) | MEDIUM SAND (0.50-0.25MM) | FINE SAND (0.25-0.125MM) | VERY FINE SAND (0.125-0.062MM) | SILT AND CLAY (< 0.062 MM) | | | |
| **Pliocene and Pleistocene deposits** | | | | | | | | | | |
| Gravel | NW¼ sec. 2, T. 3 N., R. 21 E. | 56.5 | 22.5 | 7.3 | 5.8 | 2.9 | 4.7 | 24.8 | 16.3 | 850 |
| Medium sand | SW¼ sec. 1, T. 3 N., R. 24 E. | 2.5 | 6.7 | 49.3 | 22.9 | 12.2 | 5.5 | 22.8 | 18.8 | 25 |
| Fine sandstone | NW¼ sec. 2, T. 3 N., R. 21 E. | 0.05 | 0.4 | 9.7 | 46.2 | 17.7 | 25.3 | 11.4 | 5.7 | 5 |
| Fine sandstone | SW¼ sec. 1, T. 3 N., R. 24 E. | --- | --- | 7.3 | 53.7 | 22.2 | 16.2 | 14.2 | 10.5 | 2 |
| **Redbeds** | | | | | | | | | | |
| Medium sandstone | NW¼ sec. 15, T. 1 N., R. 20 E. | 0.1 | 6.7 | 48.7 | 25.7 | 9.2 | 8.9 | 23.2 | 16.2 | 8 |
| Shale | Sec. 35, T. 4 N., R. 21 E. | --- | --- | --- | 2.4 | 12.6 | 85.0 | 31.3 | 15.3 | --- |

by molecular forces that it does not move easily. The size of individual openings and the size of the connecting spaces determine to a large degree how easily water will move through a rock. Although the total volume of pore space in gravel is approximately the same as that in fine sand, water will move much more readily through gravel because the openings are larger. This property of rocks, which determines how easily fluids will pass through them, is known as permeability. The coefficient of permeability is defined as the rate of flow in gallons per day through a cross section 1 square foot under unit hydraulic gradient. The coefficients of permeability of several types of rock in Beaver County are given in table 3.

The most permeable rocks in Beaver County are the gravel lenses in the Pliocene and Pleistocene deposits, which are more or less uniform in grain size. Even where a large amount of coarse sand is mixed with the gravel it still is permeable. If considerable quantities of fine sand, silt, or clay are present, the permeability of the gravel lenses is lessened. Uniform coarse sand in the Pliocene and Pleistocene deposits is the next most permeable rock in the county, but if the sand becomes cemented or contains a large amount of silt and clay the permeability is decreased greatly. Within the Pliocene and Pleistocene deposits and the alluvium, only the gravel and sand beds are sufficiently permeable to allow the development of successful wells.

In consolidated rocks the pore space between the grains is small, and so the permeability is normally much less than that in unconsolidated rocks. However, cracks, crevices, or solution cavities may increase the permeability of these rocks. Redbeds in Beaver County have few fractures because they have not been subjected to severe stresses. However, they probably contain cavities caused by solution and removal of limestone, gypsum, or salt. Where solution features become large, the adjacent sediments commonly collapse near the solution opening. As a result of this collapse and because the cavities are of local extent, they generally are not dependable sources of large supplies of ground water on a county-wide basis. The water in such cavities is likely to be highly mineralized.

Near the surface the pore spaces of rocks commonly are filled with air. Some water also is held in the finest pores by capillary forces. At some depth, which differs from place to place, water will fill both the large and small openings in the rock. The contact between the zone where openings above capillary size are filled with water and the zone where these openings are filled with air is called the water table. The altitude of the water table differs from place to place, depending on the shape and slope of the land surface and on the conditions of recharge, movement, and discharge of ground water. The altitude of the water table in Beaver County is shown on plate II and is discussed later under source, movement, and natural discharge of ground water.

Recharge, movement, and discharge of ground water not only differ from place to place but also vary from time to time, and, as these factors change, the water table responds by rising or declining. This subject is discussed more fully under water-level fluctuations.

If the zone above the water table contains a bed of clay, it may impede the downward movement of water from the surface. Just above this clay bed, water may accumulate to form a water body, perhaps temporarily, above the main zone of saturation. Such a water body is said to be perched, and its upper surface is called a perched water table. In Beaver County perched water bodies are small, and most are temporary. Ordinarily a well developed in a perched water body cannot be depended upon for a permanent water supply.

Water tables exist only in rocks that have openings larger than capillary size. If the depth at which the water table would normally occur is occupied by a rock that has only capillary openings, then no water table exists at that location. Water below the water table that is in hydraulic connection with that surface is called unconfined water. Most of the ground water in Beaver County is unconfined.

Confined water under sufficient hydraulic pressure to rise above the bottom of the confining layer, where tapped by a well, is called artesian. If the pressure is sufficient, the water level in the well will rise above the land surface, and the well will flow. Generally this water has a hydraulic connection with a water table that is some distance away and at a higher altitude than the top of the artesian aquifer. No flowing wells were found in Beaver County during this investigation. Conditions in the county are generally unfavorable for flowing wells because there is no wide-spread system in which water is confined. Within the Pliocene and Pleistocene deposits, water may be confined locally by clay beds, but these confining beds generally are not extensive.

## Source, Movement, and Natural Discharge

Precipitation is the sole source of fresh water in Beaver County. Infiltration of precipitation within the county accounts for most of the ground water, but some enters the county as subsurface inflow into the northwestern part of the county.

The shape of the water table is shown by contours on plate II. The contours are lines of equal altitude of the water table, and ground-water flow is perpendicular to the lines at all points and toward areas of lower water-table altitude. The direction of flow at certain points is shown on plate II by short arrows. The water-table map (pl. II) shows that the general movement of ground water is eastward, but the direction of movement is strongly modified by several of the major streams, which cause depressions in the water table. Ground water flows toward these depressions, where it discharges into the streams or emerges as springs at the base of the Pliocene and Pleistocene deposits and contributes to the flow of the streams.

The direction of ground-water movement at the boundaries of Beaver County, as indicated on plate II, shows that the largest segment through which water enters the county is in the northwest, where it enters from Texas County, Oklahoma, and Seward County, Kansas. In the southwestern corner a small amount of water enters from Texas County, Oklahoma, across a short segment of the county line. The contours on plate II show that most water along the southern county boundary is either flowing eastward along the county line or leaving Beaver County and flowing into Ochiltree or Lipscomb Counties, Texas. Water is generally leaving Beaver County along the eastern boundary and passing into Harper County, Oklahoma. Along the northern boundary, some water enters from Clark and Meade Counties, Kansas, but this water discharges into the nearby Cimarron River and flows out of the county.

Infiltration of rainfall contributes recharge to ground-water reservoirs throughout Beaver County, but the rate varies, depending upon the character of the soil and underlying rock, the slope of the land surface, and the vegetation. Sand dunes generally facilitate recharge, owing to their high permeability. A ground-water mound generally underlies the sand dunes in Beaver County, as shown by a comparison of plate I with plate II. The Pliocene and Pleistocene deposits receive recharge directly from rainfall and from the overlying sand dunes. The redbeds are the least favorable unit for infiltration, owing to their low permeability.

Where the land surface slopes steeply, runoff is facilitated and infiltration is impeded. Much of the land surface in Beaver County has a gentle slope, thus facilitating recharge. Different types of vegetation use different amounts of water and cause a variation in infiltration rates. Most of Beaver County is covered by vegetation that is similar throughout the county, and there are no large areas where recharge rates are vastly different for this reason. Plants that use large amounts of water are common only in the river bottoms where large supplies of water are close to the surface. The area covered by these plants is large in relation to river-bottom area but small in comparison with the total area of the county.

Ground water moves from areas of recharge toward the major streams of the area. These streams are discerned readily on plate II by their influence on the water-table contours. They are the Cimarron and North Canadian Rivers, and Crooked, Clear, and Kiowa Creeks. Water flows in the channels of most of these streams all of the time. However, the North Canadian is dry in some months (fig. 10A) because the underflow through the permeable alluvium can accommodate all the water supplied to it from the Pliocene and Pleistocene deposits and the redbeds. The alluvium of the Cimarron River is probably equally as extensive and permeable as that of the North Canadian, but the recharge to it is greater. There is more water than the underflow through the alluvium can accommodate, and the excess appears at the surface giving the river a perennial flow. The Cimarron River receives more ground water than does the North Canadian because the river bed is lower in altitude, and the ground-water gradient toward it is steeper (pl. II).

Natural discharge from the principal ground-water body in Beaver County is in the form of springs and seeps and of subsurface flow into the alluvium of the larger rivers. Some of the springs in the county are shown on plate I. A few small springs and seeps discharge where perched water bodies intersect the land surface, but most of them discharge at the outcrop of the base of the principal water body; that is, at the contact of the Pliocene and Pleistocene deposits with the underlying redbeds. Seeps also discharge in creek channels where the water table intersects the land surface. Ground water in the alluvium not only may enter the stream but also may be transpired by plants on the flood plain or evaporated directly. In the summer, evapotranspiration from the alluvium probably accounts for a major part of the water discharged by the Pliocene and Pleistocene deposits. The Pliocene and Pleistocene deposits extend across the eastern boundary of Beaver County, and ground water leaves the county by subsurface outflow into Harper and Ellis Counties. The water-table map (pl. II) shows a ground-water gradient to the east across a part of the county line, but the gradient is low. Probably the quantity of ground water leaving the county by subsurface outflow is not large, compared to the amount of ground water leaving by streams.

## Well Construction, Water Use, and Pumpage

Wells have been a primary source of water for domestic and stock use in Beaver County since the first settlement. Windmills have been and still are a major source of power, although many rural homes now use electricity. Most domestic wells are 4 to 6 inches in diameter and have been drilled by either cable tool or hydraulic rotary drilling rigs. The wells generally are drilled and cased several feet below the water table. Ordinarily a yield sufficient for home or stock use is not difficult to obtain if the well is bottomed in the Pliocene and Pleistocene deposits. Where the well is bottomed in the redbeds, it may not have a sufficient yield. Because a domestic and stock well commonly is drilled only a few feet into saturated material, the water level may decline below the bottom of the well during drought. In many areas, however, the water table has been rising during the past 20 years, so little difficulty in this respect has been experienced recently.

Most of the large-capacity wells in Beaver County are used for irrigation, but a few are used for industrial or public-supply purposes. In 1959 there were 78 irrigation wells, 11 industrial wells, and 8 public-supply wells.

*Irrigation use.*—Large-diameter wells from which a large yield is anticipated for irrigation have been drilled mostly since 1952 (table 4). These wells are commonly drilled through the entire thickness of alluvium or Pliocene and Pleistocene deposits and bottom on top of the redbeds. The diameters of the holes range from 20 to 36 inches. Shutter or perforated screens that range in diameter from 10 to 18 inches are installed opposite the saturated section in the well, and blank casing is set opposite the unsaturated part. The annular space between the casing and sides of the hole is then filled with a uniform-sized gravel, and the well is developed and tested. Turbine pumps are installed in most irrigation wells, and most are powered by internal-combustion engines using natural gas or liquefied petroleum gas for fuel although some wells have electric- or diesel-power units. Table 4 shows the increase in the number of irrigation wells from 1952 to 1959. In 1959 there were 78 irrigation wells in the county, but not all of them are used every year. The wells are rather evenly distributed throughout the county, and there is no area of intense irrigation-well development (pl. II). The influence of irrigation on the water table does not extend beyond the immediate vicinity of the individual wells.

The area irrigated from wells and an estimate of the amount of ground water used for irrigation during each year from 1952 to 1959 is shown on table 4. In 1959 irrigated acreage was as follows: sorghum, 6,500; alfalfa, 2,000; small grain, 1,500; corn,

TABLE 4.—PUMPAGE OF GROUND WATER FOR IRRIGATION IN BEAVER COUNTY, OKLAHOMA, 1952-59

| YEAR | NUMBER OF WELLS | AREA IRRIGATED (ACRES) | PUMPAGE (ACRE-FT.) |
|---|---|---|---|
| Prior to 1952 | 18[1] | 613[2] | 1,800[2] |
| 1953 | 27[1] | --- | --- |
| 1954 | 38[1] | 780[3] | 1,600[4] |
| 1955 | 61[1] | 2,597[3] | 3,600[4] |
| 1956 | 66[1] | 10,400[3] | 16,900[4] |
| 1957 | 75[3] | 11,925[3] | 12,500[4] |
| 1958 | 78[3] | 9,575[3] | 8,000[4] |
| 1959 | 78[3] | 11,520[3] | 16,000[4] |

[1]Compiled by U. S. Geological Survey from information on Water Rights applications on file at Oklahoma Water Resources Board.

[2]From field survey by U. S. Geological Survey conducted by interviewing well owners.

[3]From Irrigation Survey Summary compiled by Robert B. Duffin, Extension Irrigation Specialist, Oklahoma State University, Stillwater, Oklahoma.

[4]Computed by U. S. Geological Survey by subtracting precipitation during the growing season of various crops from the consumptive use given for these crops by Garton and Criddle (1955, table II) in Beaver County, Oklahoma, and multiplying the result by the acreage of these crops given by Duffin in the Irrigation Survey Summary referred to in footnote 3. An irrigation efficiency of 70 percent was assumed based on Garton and Criddle (1955, p. 9).

TABLE 5.—DATA ON WELLS THAT SUPPLY WATER FOR BEAVER CITY, OKLAHOMA

| WELL NUMBER | TOWN DESIGNATION | DEPTH (FT.) | DIAMETER (IN.) | DEPTH TO WATER (FT.) | YIELD (GPM) | DRAW-DOWN (FT.) | SPECIFIC CAPACITY (GPM/FT.) |
|---|---|---|---|---|---|---|---|
| 4N-24E 7acb2 | 1 | 65 | 10 | 15 | 600 | 40 | 15 |
| 7bac1 | 2 | 64 | 16 | 12.5 | 400 | 20 | 20 |
| 6dbb1 | 3 | 168 | 16 | 30 | 200 | 108 | 1.8 |
| 5N-24E 30ccc1 | 4 | 100 | 16 | 10 | 750 | --- | --- |

1,025; pasture, 700; and cotton, 275. Surface water was used to irrigate 480 acres out of the total of 12,000 acres irrigated. The number of acres irrigated by surface water varies from year to year, but it has never exceeded 10 percent of the total amount of irrigated land. After a large increase in 1955 of the number of irrigation wells installed and a large increase in 1956 of the area under irrigation both have remained fairly constant.

Although the amount of irrigation water applied varies from year to year, depending on the rainfall during the growing season, it averaged about 1.4 acre-feet per acre from 1955 to 1959. In 1952 the U. S. Geological Survey made a field investigation which showed that 2.9 acre-feet per acre was being applied to irrigated land. This difference may be due to: (1) 1952 being

TABLE 6.—MUNICIPAL PUMPAGE AT BEAVER CITY AND FORGAN, OKLAHOMA, 1941-59

| YEAR | BEAVER CITY (ACRE-FT.) | FORGAN (ACRE-FT.) | YEAR | BEAVER CITY (ACRE-FT.) | FORGAN (ACRE-FT.) |
|---|---|---|---|---|---|
| 1941 | 83 | 25 | 1951 | 206 | 50 |
| 1942 | 89 | 30 | 1952 | 272 | 54 |
| 1943 | 118 | 39 | 1953 | 272 | 51 |
| 1944 | 110 | 40 | 1954 | 286 | 62 |
| 1945 | 128 | 42 | 1955 | 296 | 72 |
| 1946 | 174 | 54 | 1956 | 377 | 71 |
| 1947 | 187 | 64 | 1957 | 335 | 54 |
| 1948 | 192 | 62 | 1958 | 338 | 62 |
| 1949 | 183 | 54 | 1959 | 284 | 75 |
| 1950 | 206 | 57 | | | |

TABLE 7.—DATA ON WELLS THAT SUPPLY WATER FOR FORGAN, OKLAHOMA

| WELL NUMBER | TOWN DESIGNATION | DEPTH (FT.) | DIAMETER (IN.) | DEPTH TO WATER (FT.) | YIELD (GPM) | DRAW-DOWN (FT.) | SPECIFIC CAPACITY (GPM/FT.) |
|---|---|---|---|---|---|---|---|
| 5N-23E | | | | | | | |
| 13baa1 | 1 | 85 | 72-10 | 68 | 40 | --- | --- |
| 13baa2 | 2 | 85 | 10 | 60 | 40 | --- | --- |
| 13baa3 | 3 | 87 | 10 | 57 | 75 | 25 | 3.0 |
| 13baa4 | 4 | 93 | 8 | 55 | 77 | 8 | 9.8 |

drier than the 1955-59 period, (2) the different methods of investigation (see footnotes 2 and 4 on table 4), (3) a difference in the crops irrigated, (4) the irrigation efficiency being less than 70 percent, which was assumed in the computations for 1955-59.

*Public-supply use.*—Only three towns in Beaver County have public water-supply systems, and all are supplied by wells. The systems of two of these towns, Beaver City and Forgan, are owned and operated by Western Gas Service Co., which bought the systems from Southwestern Public Service Co. in 1959. The town of Gate owns its own system.

Until 1961 water for Beaver City was supplied by three wells north of the North Canadian River. An additional well was drilled in 1961 to provide a greater quantity of water of better quality. These wells range in depth from 64 to 168 feet. Redbeds crop out nearby, but it is reported that the wells did not reach them. Apparently the wells are in alluvial or Pliocene and Pleistocene deposits which fill a steep-walled basin in the redbeds. The steep dip of nearby redbed outcrops supports this idea (fig. 9). The yields and specific capacities of these wells are given in table 5. The annual municipal pumpage of Beaver City since 1941 is shown in table 6. Use is greatest during

TABLE 8.—DATA ON WELLS THAT SUPPLY WATER FOR GATE, OKLAHOMA

| WELL NUMBER | TOWN DESIGNATION | DEPTH (FT.) | DIAMETER (IN.) | DEPTH TO WATER (FT.) | YIELD (GPM) |
|---|---|---|---|---|---|
| 5N-28E | | | | | |
| 32ddc3 | Old well | 50 | 18 | 40 | 10 |
| 32ddc4 | do. | 50 | 24 | 40 | 5 |
| 32cdd1 | New well | 70 | 16 | 52 | 135 |

August, when about 15 million gallons is pumped. The minimum use is in December, when about 3 million gallons is pumped.

Forgan is supplied by four wells on the east side of town. The wells range in depth from 85 to 93 feet and obtain water from the Pliocene and Pleistocene deposits. The yields and specific capacities of the wells are given in table 7. Annual pumpage for the Forgan public supply from 1941 to 1959 is given in table 6. Maximum pumpage is in August (about 3.5 million gallons per month), and the minimum pumpage is in the spring and fall (about 1.2 million gallons per month).

Water for Gate was supplied by two dug wells on the south edge of town until 1960, when a new well was drilled half a mile southwest of town. The yields of these wells, all of which tap the Pliocene and Pleistocene deposits, are given in table 8. The water used by Gate is not metered, but a member of the town council estimates that pumpage is about 750,000 gallons per month in the winter and 1.5 million gallons per month in the summer. Pumpage by Gate in 1959 is estimated to be about 40 acre-feet.

*Industrial use.* — The only water pumped for industrial use in Beaver County is for two plants that extract liquefied petroleum gases from natural gas and for two compressor stations. This water also is used for domestic purposes by the people that live in adjacent company-owned houses. The plants are in sec. 15, T. 1 N., R. 20 E.; sec. 31, T. 1 N., R. 20 E.; sec. 24, T. 2 N., R. 24 E.; and sec. 18, T. 5 N., R. 25 E. Most of the water is pumped from the Pliocene and Pleistocene deposits, but some of the water for the plant in sec. 31, T. 1 N., R. 20 E., is probably pumped from Triassic rocks.

The industrial plants have from 2 to 4 wells each. The yields of the wells range from 40 to about 200 gpm, and specific capacities range from 1 to 6 gpm per foot of drawdown. The two gas-products plants each use an average of about 900,000 gallons per month, and the two compressor stations each use an average of about 4 million gallons per month. Pumpage at the compressor stations is about three times greater in the summer than in the winter. The 1959 annual pumpage at the industrial plants was 120 million gallons or 370 acre-feet.

*Commercial use.*—Commercial use of water includes use for motels, gasoline stations, restaurants, and other business establishments. The amount of water used for commercial purposes is small, especially when considered apart from public supplies. Most wells that supply water for this purpose are similar in construction and demand to domestic wells and are, therefore, included in this category.

*Domestic and stock use.*—The greatest number of wells in Beaver County supply water for domestic and stock purposes. Most of the wells are pumped by windmills, although a few are pumped by electricity. The measured yields of 40 wells that were pumped by windmills averaged 2½ gpm and ranged from ½ to 6 gpm. The average of the several that used electricity was 25 gpm. Most domestic and stock wells obtain water from the Pliocene and Pleistocene deposits, although many obtain it from the redbeds or the alluvium. Wells in the redbeds are consistently reported to have inadequate yields.

Total pumpage in the county for domestic and stock purposes is necessarily estimated and may indicate only an order of magnitude. An estimate of the domestic pumpage was made by multiplying the rural population (obtained by subtracting the sum of the population of towns with public supplies from the total population) by 35 gpd (gallons per day) per person (Anderson, 1955, p. 38). By this method, the domestic pumpage in Beaver County is estimated to be about 165 acre-feet per year. By the use of the same method for stock (60,000 head at 12 gpd, 4,500 dairy cows at 30 gpd, considering the amount of water used by other livestock to be negligible), an estimate of 950 acre-feet per year is obtained. The total domestic and stock pumpage is, therefore, about 1,100 acre-feet per year.

From the above estimates, the total ground-water pumpage in Beaver County for 1959 may be computed:

| | ACRE-FEET |
|---|---|
| Irrigation | 16,000 |
| Public supply | 400 |
| Industrial use | 370 |
| Domestic and stock | 1,100 |
| TOTAL (rounded) | 18,000 |

A

B

**Figure 10. A, Bed of the North Canadian River in sec. 20, T. 4 N., R. 26 E., on September 14, 1960.**
**B, The Cimarron River in sec. 28, T. 6 N., R. 28 E., on the same day.**

## WATER-LEVEL FLUCTUATIONS

Water levels in wells in Beaver County may move up or down in response to changes in atmospheric pressure and to changes in the volume of ground water in storage. A decline in atmospheric pressure causes a rise in the water level in a well in response to the decreased load pressing downward on the water surface. A rise in atmospheric pressure causes a decline in water level. The reason for this effect is that pressure differences are communicated to the water level more readily through the well than through the surrounding rock material. If the water table is near the surface and the intervening material is permeable, atmospheric pressure will not affect the water level. The atmosphere presses equally on the water in the well and on the water in the surrounding aquifer. If the water table is deep and many impermeable lenses intervene, changes in atmospheric pressure are not transmitted as readily nor as directly to the water table through the ground as to the water surface in the well. In much of Beaver County the water table is more than 50 feet below the surface (pl. II) and intervening relatively impermeable lenses are common. Therefore the water levels in most wells fluctuate owing to changes in atmospheric pressure.

Water-level changes caused by changes in the amount of water in storage generally are greater and longer lasting than changes caused by atmospheric pressure. Water in storage is not static but is slowly moving from areas of recharge to areas of discharge. Because the bottom of the aquifer is fixed by the relatively impermeable bedrock, changes in storage are reflected chiefly as changes in the altitude of the water table. The ground-water reservoir underlying Beaver County has been divided into four hydrologic units, each of which has distinctive recharge and discharge characteristics that produce characteristic water-level fluctuations.

*Redbeds.*—Natural water levels in the redbeds probably fluctuate only slightly. Although the redbeds receive some recharge water directly from precipitation, probably most of it comes from an overlying unit that absorbs water from precipitation more quickly. The overlying unit in turn provides a relatively constant head of water for recharging the redbeds. The character of water-level fluctuations in the redbeds is similar to that in the overlying deposits; that is, a general rise began in the late 1940's and culminated in the early or middle 1950's. However, the rise in water level is less than that in the Pliocene and Pleistocene deposits, being only about 5 feet.

*Pliocene and Pleistocene deposits.*—Water-level fluctuations in wells tapping the Pliocene and Pleistocene deposits are shown on figure 11. Water levels rose from a low between 1937 and 1940 to a high between 1950 and 1960. Water levels that reached a maximum in 1950 have declined steadily since that time.

As water moves from the surface of the ground downward to the water table, individual pulses of recharge are reduced in amplitude and averaged so that the water level fluctuates smoothly. Factors that determine the extent of smoothing are the depth to the water table, the permeability of the material between the surface and the water table, and the topographic position of the well. Probably none of the water-level fluctuations in wells in the Pliocene and Pleistocene deposits would correlate with recharge from individual storms because the depth to water is too great and the permeability of the material too low. Water-levels might fluctuate seasonally, however, in areas of shallow water table. Annual fluctuations correlate better, but the best method of presenting precipitation data for correlation with water-level fluctuations in these deposits is a graph of the 5-year moving average of precipitation. Each annual point plotted on the graph at the top of figure 11 is the average of the precipitation for the previous 5 years.

The same factors that determine the averaging effect in recharge determine the lag in the correlation of water levels with precipitation. The hydrographs on figure 11 are arranged with the one having the least lag at the top and the one having the greatest lag at the bottom. Between are hydrographs showing intermediate lags. As would be expected, the hydrograph with the least lag (LeCrone well, fig. 11) correlates best with the small fluctuations in the graph of the 5-year moving average of precipitation. The hydrograph with the greatest lag (Peters well, fig. 11), hardly correlates with any of the small fluctuations on the precipitation graph. In the Peters well only a general rise of water level in the latter part of the graph correlates with the general increase in precipitation from 1941 through 1951.

The period 1933-40 was one of drought in Beaver County, as it was in most of the Great Plains. The water table was at a record low near the end of this period. The 5-year moving average of precipitation for the period 1937-40 has a mean of

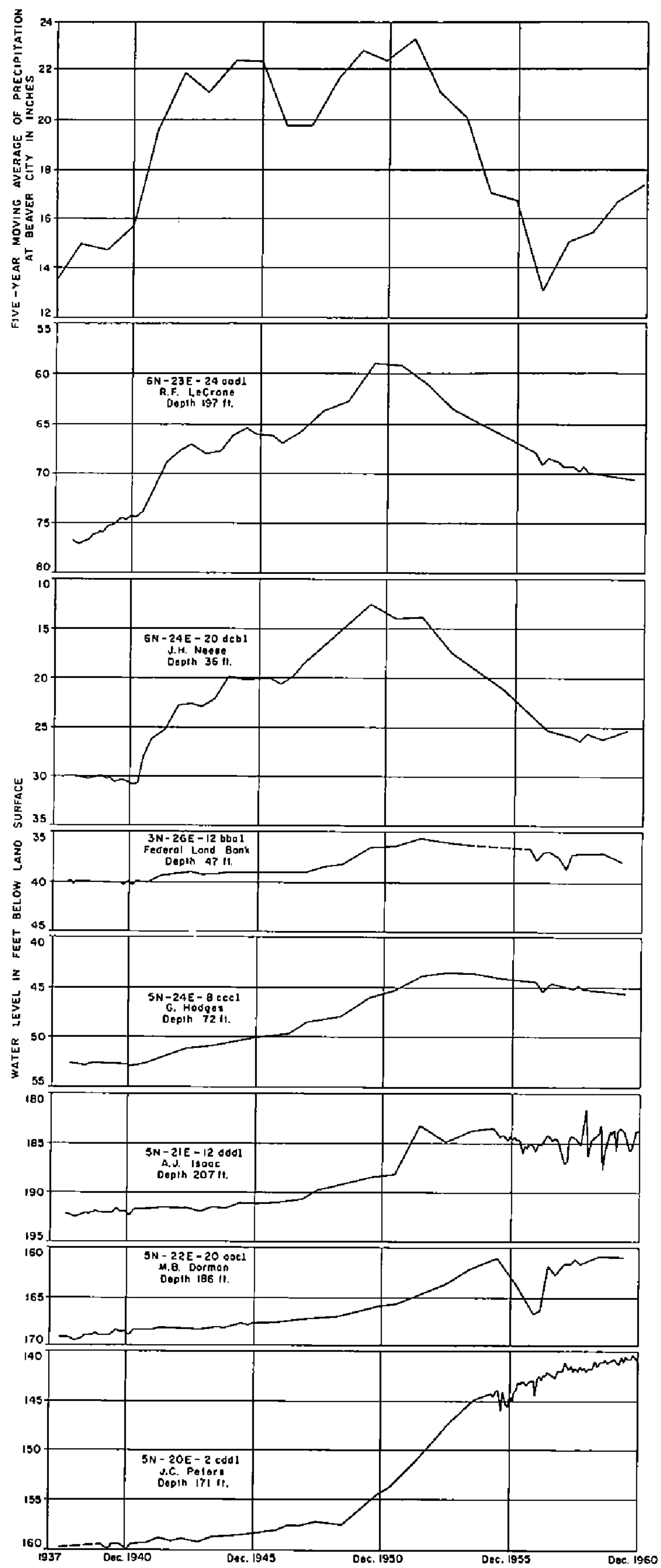


**Figure 11. Fluctuations of water levels in the Pliocene and Pleistocene deposits.**

about 15 inches. Precipitation increased in 1941, and for the next 11 years the 5-year moving average had a mean of 21.5 inches. Water levels did not rise abruptly in response to increased precipitation but rose gradually as increments of recharge in excess of the discharge were added to the ground-water body each year. In some wells the rise in water level began in the same year as the increased precipitation (LeCrone and Neese wells, fig. 11), whereas in others the effect of increased precipitation was not reflected by a sharp rise in the water level until 1948, a lag of 7 years (Peters well, fig. 11).

From 1951 through 1956, the 5-year moving average of precipitation decreased steadily. In hydrographs that show the best correlation, the water levels declined steadily also, indicating an excess of discharge over recharge. During the same period, hydrographs showing a large lag time were still rising slightly, owing to the high precipitation of 1941-51. These water levels probably will start to decline soon. The water levels in wells showing intermediate lag time are declining but probably are not as low as they will go even if precipitation increases in the next several years.

Since 1956 there has been a slight increase in precipitation, but none of the hydrographs shows a corresponding rise. However, the water-level decline in the LeCrone well has halted.

Most of the hydrographs on figure 11 show an increased number and greater magnitude of fluctuations after 1955 than they do before. Part of this is caused by an increase in the number of measurements made in a given year. The hydrograph of the Peters well (fig. 11) is a good example of this effect. In other wells, however, the water-level fluctuates more than it did prior to 1955, owing to the proximity of irrigation wells. As shown in table 4, the number of irrigation wells in Beaver County increased by about 50 percent each year from 1952 to 1955 and by a total of 210 percent for the 3-year period. The range of the fluctuations of the water level in an individual well depends largely on its location with respect to areas of heavy intermittent pumping. The hydrograph of the Dorman well shows the effects of a nearby irrigation well that was drilled during 1955 and probably was pumped for a long period during 1956, a year of minimum precipitation. A third reason for the increased number of fluctuations after 1955 is that at higher stages the adjustment of the water table to small differences in the recharge-discharge balance is more delicate.

*Alluvium.*—The water levels of wells in alluvium fluctuate more than those of wells in the Pliocene and Pleistocene deposits, as may be seen by comparing figure 11 with figure 12. The increased number of fluctuations is caused in part by the fact that the water level is close to the surface and that the surface material is more permeable than the surface of the Pliocene and Pleistocene deposits, thus allowing more rapid infiltration of precipitation. In contrast to the water level in the Pliocene and

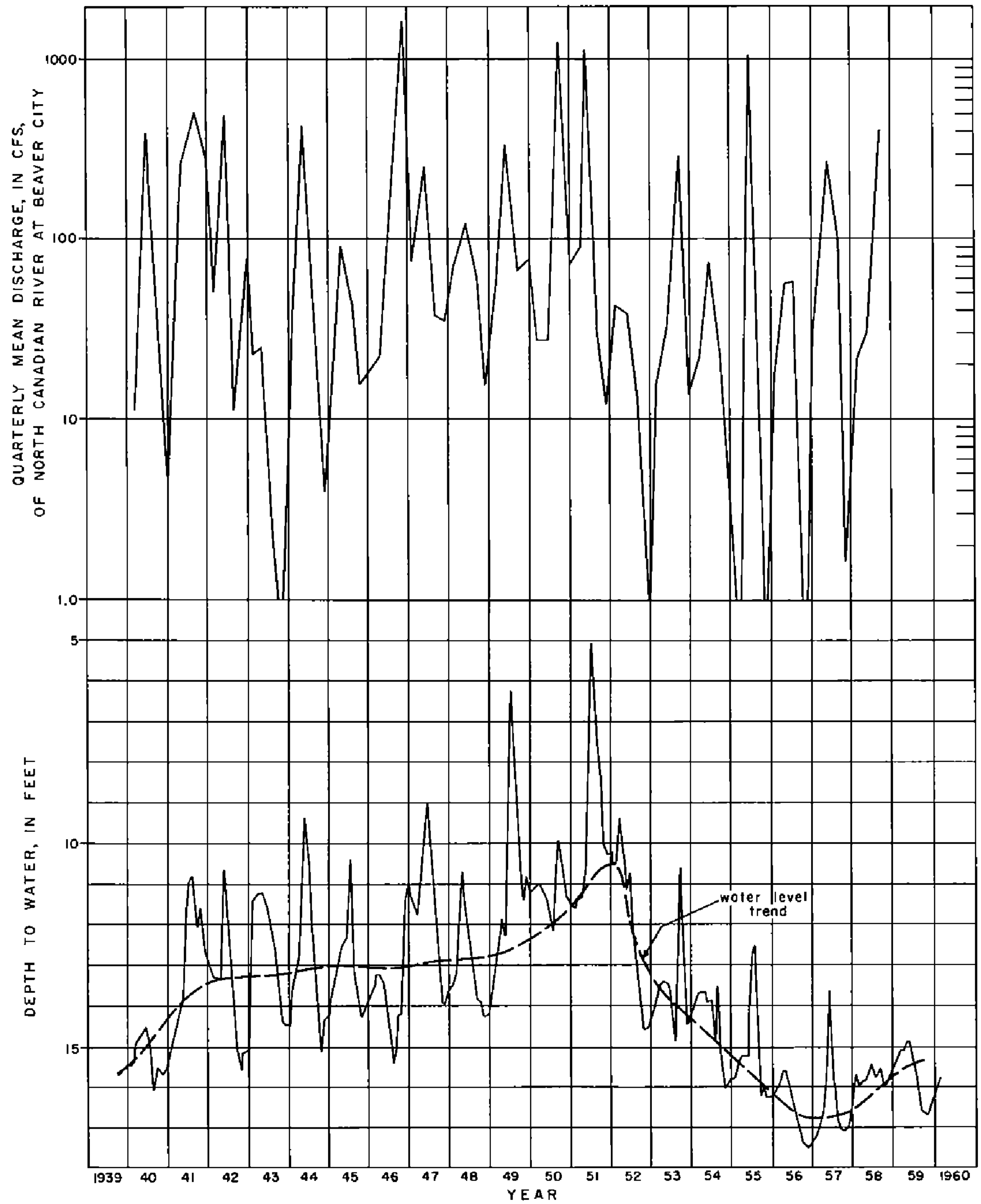


**Figure 12. Fluctuations of the water level in the alluvium of the North Canadian River (well 4N-24E-7dbb1).**

Pleistocene deposits, which lags behind and smooths out the fluctuations in precipitation, the water level in the alluvium may rise during rainy periods. The water level also fluctuates in response to evapotranspiration because the water table is near the land surface. In addition, the flow of streams influences the ground-water level. All of these factors tend to produce a greater number of fluctuations of water levels in wells in alluvium than in those tapping the Pliocene and Pleistocene deposits.

With so many variable controlling factors, the water level in the alluvium does not show a complete and unequivocal correlation with any one of the factors. However, the hydrograph in figure 12 appears to correlate best with the quarterly average of streamflow.

Many peaks in the ground-water level lag behind peaks in the quarterly mean stream discharge by as much as 2 months. The lag time, if any, may depend on the combinations of other factors that tend to dampen or reinforce water-level fluctuations caused by river stage.

That the fluctuations of the water level in the alluvium appear to correlate to some extent with the river flow does not mean that the source of this ground water is wholly the river. The shape of the ground-water surface shown on plate II indicates that water in the alluvium drains from the Pliocene and Pleistocene deposits. However, the discharge from these deposits is relatively constant and does not cause the sharp fluctuations of the water level shown in figure 12. If the sharp peaks in the water level (fig. 12) are disregarded, the water-level trend generally rises from 1940 to 1951 and declines from 1951 to 1956. This trend is caused by contributions of water from the Pliocene and Pleistocene deposits in excess of discharge from the alluvium. Fluctuations of the water level in the alluvium caused by river stage and evapotranspiration are superimposed on those caused by variations in the amount of water contributed by seepage from the Pliocene and Pleistocene deposits.

*Dune sand.*—For the most part the deposits of dune sand in Beaver County are not saturated, and no observation wells are completed in them. The dune sand absorbs rainfall quickly and transmits it to the underlying formations. If a record of water-level fluctuations were available for the dune sand, it would probably correlate closely with the record of precipitation, and the time lag between increased rainfall and a rise in water level would be small.

## Recharge, Transmissibility, Inflow, and Storage

Recharge to the ground-water body from rainfall already has been discussed in general terms under the section entitled source, movement, and natural discharge. The rate of recharge may be estimated on the basis of the fluctuations of the water table in response to precipitation. For the Pliocene and Pleistocene deposits, the only significant sources of recharge are precipitation and underflow from the northwest. The major streams contribute no water to these deposits because the direction of water movement is toward the streams (pl. II).

Water levels in the Pliocene and Pleistocene deposits rose in response to the increased precipitation of the 1940's. Figure 11 shows that in 1941 the 5-year moving average of precipitation increased abruptly from about 15 inches for the period 1937-40 to about 21.5 inches for the period 1941-51.

The water table began to rise in response to the increased precipitation. During the period of rise recharge exceeded discharge, and the quantity of ground water in storage in the county increased. The rise in water level in the wells for which hydrographs are shown on figure 11 ranged from 4.5 feet to 17 feet and averaged 11 feet. The distribution of observation wells over the county (pl. II) is fair, and there is no reason to believe that the water table did not respond to the increased precipitation in a similar way in areas not represented by hydrographs.

Most hydrographs shown on figure 11 are approximately horizontal for the period 1937-40. During this period recharge apparently was equal to discharge. When the 5-year moving average of precipitation increased by 6.5 inches for a period of 11 years, recharge exceeded discharge and storage increased, causing an average rise in the water table of 11 feet. This rise averages 1.0 foot per year for the entire period. The specific yields for the Pliocene and Pleistocene deposits listed in table 3, range from 5.7 to 18.9 percent and average 12.8 percent. The specific yield of a rock is the ratio of the volume of water it will yield by gravity to its own volume, expressed in percent. In the following calculations a specific yield of 10 percent will be used. With a specific yield of 10 percent, the 1-foot rise per year in water level represents an addition to the ground-water body of 0.1 foot of water. This 0.1 foot, or 1.2 inches of water, is not the total recharge but only the amount of recharge in excess of discharge.

To account for the water added to storage, recharge had to be at least 1.2 inches per year, or 18 percent of the increase in precipitation during the wet years, 1941-51. Because ground water is being discharged continually from the ground-water reservoir, the total recharge must have been greater than 1.2 inches. The rate at which ground water would be discharged depends on the altitude of the water table and the hydraulic gradient near the points of discharge. As the water table rose in response to the increased recharge, the rate of discharge would increase. During the wet cycle, recharge had to provide an amount of water equal to that discharging at low ground-water stages, plus an amount equal to the increased discharge caused by the higher water table, plus the 1.2 inches per year that was added to storage. Although 18 percent of the increased precipitation became ground-water storage, the percent of the total precipitation recharging the ground-water body is unknown. If, however, 18 percent of the total precipitation became recharge, then in the wet period the recharge would have been about 3.9 inches per year. Recharge over the part of the county underlain by Pliocene and Pleistocene deposits, dune sand, or alluvium (1,700 square miles) would then be 350,000 acre-feet per year. The increase in ground-water storage alone in this period averaged 100,000 acre-feet per year.

A method of estimating permeability in the vicinity of individual wells is to multiply the yield factor by about 15 or 20. The yield factor is the specific capacity divided by the thickness of water-bearing material penetrated by the well (Back, 1957, p. 5) and multiplied by 100. Yield factors in Beaver County range from about 5 gpm to about 80 gpm per foot.

The permeabilities calculated in this manner range from about 70 to about 1,200. The transmissibility is the permeability multiplied by the thickness of the aquifier. Transmissibilities estimated from the specific capacity of 22 wells distributed throughout the county ranged from about 5,000 to about 35,000 gpd per foot and averaged about 20,000 gpd per foot.

In addition to recharge from precipitation, some recharge reaches the ground-water body in Beaver County by inflow from Texas County, Oklahoma, and Seward County, Kansas. The amount of inflow may be calculated from Darcy's law. The average transmissibility was estimated to be 20,000 gpd per foot, the ground-water gradient in the northwestern part of the county is about 20 feet per mile (pl. II), and the length of the 2,660-foot water-table contour (pl. II) is about 15 miles. Therefore, the ground-water inflow is about 6,000,000 gpd or about 7,000 acre-feet per year—only about 2 percent of the recharge from precipitation.

For future planning it is useful to know the total amount of water available from storage in Beaver County, even though it would not be feasible to pump all the water. The method of calculation is to multiply the volume of saturated Pliocene and Pleistocene deposits by their specific yield. The area underlain by these deposits is about 1,700 square miles, and their thickness averages about 300 feet (pl. I). From plate II, the average depth to water in these deposits is about 100 feet. Hence, the saturated thickness is about 200 feet over an area of 1,700 square miles, and the approximate specific yield is 10 percent. The amount of water in storage is estimated to be about 20 million acre-feet.

In summary, recharge from precipitation in wet periods is estimated to be about 350,000 acre-feet per year. Subsurface inflow is estimated to be 7,000 acre-feet per year. The total ground water available from storage is estimated to be 20 million acre-feet. These magnitudes may be compared to the total pumpage in 1959, which was estimated to be 18,000 acre-feet.

## Chemical Quality of Water

All natural water contains mineral matter dissolved from the rock and soil with which it has come in contact. The quantity of dissolved mineral matter in ground water depends primarily upon the type of rocks or soil through which the water has passed, the time of contact, and the pressure and temperature. In addition to the natural factors there are others connected with human activities such as infiltration from streams and wells used for disposal of sewage, industrial water, or oil-field wastes.

The mineral constituents and physical properties of ground water from selected wells in Beaver County are given in table 9. These analyses fall into two groups: (1) samples collected in 1939-40 that were analyzed for bicarbonate, sulfate, chloride, nitrate, and calcium magnesium hardness and (2) samples collected in 1951-60 that were analyzed for all the constituents and properties shown on the table heading. These samples, generally from irrigation wells, were collected by the U. S. Department of Agriculture. Most of the analyses given on table 9 are

TABLE 9.—CHEMICAL ANALYSES OF WATER FROM WELLS AND SPRINGS IN BEAVER COUNTY, OKLAHOMA
(Constituents in parts per million; analyses by U. S. Geological Survey)

| Well number | Location | Depth (ft.) | Probable aquifer[1] | Date of collection | Calcium (Ca) | Magnesium (Mg) | Sodium and potassium (Na & K) | Bicarbonate ($HCO_3$) | Sulfate ($SO_4$) | Chloride (Cl) | Nitrate ($NO_3$) | Boron (B) | Dissolved solids | Hardness as $CaCO_3$: Calcium, magnesium | Hardness as $CaCO_3$: Non-carbonate | SAR | Specific conductance (micromhos at 25°C) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1-20-15aad1 | SE, NE, NE 15-1-20 | 380 | QT | 11-28-39 | | | | 182 | 28 | 20 | 4.7 | | | 174 | | | |
| 1-21-21ddd1 | SE, SE, SE 21-1-21 | 245 | QT | 11-28-39 | | | | 232 | 200 | 88 | 6.2 | | | 204 | | | |
| 1-22-21aaa1 | NE, NE, NE 21-1-22 | 180 | QT | 11-28-39 | | | | 300 | 7 | 2.0 | 19 | | | 318 | | | |
| 1-23-12cdc1 | SW, SE, SW 12-1-23 | 146 | QT | 11-29-39 | | | | 213 | 3 | 3.0 | 8.9 | | | 165 | | | |
| 1-23-19ddd1 | SE, SE, SE 19-1-23 | 326 | QT | 9-18-59 | 54 | 31 | 45 | 228 | 53 | 80 | 3.1 | 0.18 | 437 | 260 | 73 | 1.2 | 706 |
| 1-23-26b | NW 26-1-23 | 37 | QT | 8- 4-59 | 31 | 19 | 48 | 236 | 19 | 30 | 3.2 | 0.23 | 349 | 155 | 0 | 1.7 | 530 |
| 1-23-26ddd1 | SE, SE, SE 26-1-23 | 409 | QT | 8- 4-59 | 46 | 32 | 91 | 226 | 67 | 130 | 5.4 | 0.25 | 585 | 245 | 60 | 2.5 | 909 |
| 1-23-29cbb1 | NW, NW, SW 29-1-23 | 585 | QT | 9-15-59 | 56 | 37 | 116 | 232 | 124 | 155 | 6.3 | 0.26 | 672 | 290 | 100 | 3.0 | 1,100 |
| 1-23-33abb1 | NW, NW, NE 33-1-23 | 290 | QT | 6-19-59 | 48 | 41 | 62 | 220 | 78 | 112 | 6.2 | 0.00 | 519 | 290 | 100 | 0.6 | |
| 1-24-15bcc1 | SW, SW, NW 15-1-24 | 197 | QT | 11-29-39 | | | | 253 | 70 | 50 | 3.6 | | | 228 | | | |
| 1-25-2dcc1 | SW, SW, SE 2-1-25 | 100 | QT | 11-29-39 | | | | 264 | 8 | 10 | 24 | | | 288 | | | |
| 1-26-22ccb1 | NW, SW, SW 22-1-26 | 44 | QT | 11-29-39 | | | | 297 | 72 | 48 | 0.2 | | | 288 | | | |
| 1-27-9ccc1 | SW, SW, SW 9-1-27 | 122 | QT | 4- 5-40 | | | | 244 | 12 | 15 | 5.4 | | | 198 | | | |
| 1-28-22bcc1 | SW, SW, NW 22-1-28 | 97 | QT | 4- 5-40 | | | | 217 | 32 | 18 | 1.9 | | | 207 | | | |
| 2-20-24 | | Spring | | 11-28-39 | | | | 152 | 10 | 6.0 | 1.2 | | | 144 | | | |
| 2-21-21aaa1 | NE, NE, NE 21-2-21 | 164 | QT | 11-28-39 | | | | 232 | 7 | 6.0 | 2.4 | | | 158 | | | |
| 2-22-16ddd1 | SE, SE, SE 16-2-22 | 175 | QT | 11-28-39 | | | | 206 | 30 | 28 | 4.2 | | | 194 | | | |
| 2-23-14baa1 | NE, NE, NW 14-2-23 | 23 | QT | 11-29-39 | | | | 228 | 7 | 6.0 | 2.2 | | | 136 | | | |
| 2-24-9cdc1 | SW, SE, SW 9-2-24 | 88 | QT | 11-29-39 | | | | 238 | 23 | 19 | 1.9 | | | 219 | | | |
| 2-25-9bbc1 | SW, NW, NW 9-2-25 | 135 | QT | 11-29-39 | | | | 225 | 38 | 105 | 3.7 | | | 159 | | | |
| 2-26-21ddd1 | SE, SE, SE 21-2-26 | 150 | QT | 5- 5-40 | | | | 214 | 22 | 10 | 5.2 | | | 183 | | | |
| 2-27-27aab1 | NW, NE, NE 27-2-27 | 68 | QT | 4- 5-40 | | | | 337 | 12 | 22 | 33 | | | 279 | | | |
| 2-28-10bbb1 | NW, NW, NW 10-2-28 | 10 | A | 4- 5-40 | | | | 240 | 26 | 22 | 147 | | | 228 | | | |
| 3-20-23ccb1 | NW, SW, SW 23-3-20 | 20 | A | 11-28-39 | | | | 296 | 1,000 | 248 | 83 | | | 1,680 | | | |
| 3-21-15adb | NW, SE, NE 15-3-21 | Spring | QT | 11-28-39 | | | | 192 | 20 | 8.0 | 0.7 | | | 174 | | | |
| 3-22-5a | NE 5-3-22 | | | 11-21-58 | 42 | 19 | 9.7 | 187 | 24 | 15 | 5.1 | .77 | 239 | 182 | 29 | 0.3 | 394 |
| 3-22-14daa1 | NE, NE, SE 14-3-22 | 50 | QT | 11-28-39 | | | | 206 | 12 | 14 | 3.1 | | | 174 | | | |
| 3-23-3bcc1 | SW, SW, NW 3-3-23 | 138 | R | 11-28-39 | | | | 87 | 1,800 | 52 | 1.2 | | | 1,290 | | | |
| 3-24-16aab1 | NW, NE, NE 16-3-24 | 83 | R | 11-29-39 | | | | 100 | 1,700 | 23 | 1.2 | | | 1,440 | | | |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3-25-9aad1 | SE, NE, NE 9-3-25 | 123 | R | 11-29-39 | | | | 142 | 1,400 | 18 | 1.2 | | | 1,245 | | | |
| 3-26-29ddd1 | SE, SE, SE 29-3-26 | 109 | QT | 4- 5-40 | | | | 222 | 48 | 53 | 12 | | | 261 | | | |
| 3-27-25dbb1 | NW, NW, SE 25-3-27 | 23 | QT | 4- 5-40 | | | | 229 | 8 | 6 | 28 | | | 186 | | | |
| 4-20-22cdd1 | SE, SE, SW 22-4-20 | 131 | QT | 4- 8-40 | | | | 250 | 40 | 37 | 12 | | | 273 | | | |
| 4-22-21ddd1 | SE, SE, SE 21-4-22 | 97 | R | 11-28-39 | | | | 216 | 750 | 28 | 7.3 | | | 645 | | | |
| 4-23-20cdd1 | SE, SE, SW 20-4-23 | 78 | R | 11-28-39 | | | | 32 | 2,000 | 1,355 | 1.7 | | | 2,040 | | | |
| 4-24-7acb2 | NW, SW, NE 7-4-24 | 54 | A | 11-29-39 | | | | 243 | 38 | 49 | 4.5 | | | 174 | | | |
| 4-25-29bbb1 | NW, NW, NW 29-4-25 | 40 | QT | 11-29-39 | | | | 301 | 66 | 32 | 2.1 | | | 288 | | | |
| 4-27-2bdc1 | SW, SE, NW 2-4-27 | 230 | QT | 8-12-59 | 88 | 9.8 | 11 | 252 | 23 | 25 | 22 | 0.18 | 323 | 260 | 54 | 0.3 | 323 |
| 4-27-10baa1 | NE, NE, NW 10-4-27 | 120 | QT | 4- 4-40 | | | | 198 | 14 | 63 | 15 | | | 219 | | | |
| 5-20-22d | SE 22-5-20 | 256 | QT | 10-21-59 | 46 | 29 | 77 | 252 | 105 | 60 | 2.6 | .30 | 476 | 236 | 30 | 2.2 | 759 |
| 5-20-27dac1 | SE, NE, SW 27-5-20 | 150 | QT | 4- 8-40 | | | | 258 | 52 | 14 | 9.8 | | | 267 | | | |
| 5-20-34bbb1 | NW, NW, NW 34-5-20 | 452 | QT | 4-15-60 | 68 | 46 | 417 | 260 | 207 | 595 | 0.1 | | 1,500 | 360 | 147 | 9.6 | 2,570 |
| 5-21-28bbc1 | SW, NW, NW 28-5-21 | 180 | QT | 4- 8-40 | | | | 248 | 54 | 21 | 9.8 | | | 228 | | | |
| 5-22-14ddc1 | SW, SE, SE 14-5-22 | 103 | QT | 4- 8-40 | | | | 255 | 10 | 6 | 7.5 | | | 201 | | | |
| 5-23-13bba 1, 2, 3 | NE, NW, NW 13-5-23 3 Wells | 85 | QT | 11-29-39 | | | | 308 | 36 | 22 | 17 | | | 258 | | | |
| 5-23-13baa1 | NE, NE, NW 13-5-23 | 85 | QT | 11-19-51 | 68 | 13 | 63 | 278 | 42 | 42 | 19 | | 405 | 223 | 0 | 1.8 | 666 |
| 5-23-13baa2 | NE, NE, NW 13-5-23 | 85 | QT | 11-19-51 | 82 | 14 | 35 | 314 | 27 | 18 | 20 | | 359 | 262 | 4 | 0.9 | 602 |
| 5-23-13baa3 | NE, NE, NW 13-5-23 | 87 | QT | 11-19-51 | 77 | 14 | 30 | 302 | 27 | 15 | 11 | | 347 | 250 | 2 | 0.8 | 562 |
| 5-24-10cdc1 | SW, SE, SW 10-5-24 | 215 | QT | 4- 3-40 | | | | 229 | 13 | 4 | 9.2 | | | 216 | | | |
| 5-24-30ccc1 | SW, SW, SW 30-5-24 | 100 | QT | -61 | 54 | 12 | 41 | 254 | 13 | 34 | 3.5 | | 326 | 184 | | 1.0 | 547 |
| 5-25-17dad1 | SE, NE, SE 17-5-25 | 179 | QT | 4- 3-40 | | | | 247 | 38 | 35 | 10 | | | 243 | | | |
| 5-26-25adb1 | NW, SE, NE 25-5-26 | 215 | QT | 4- 4-40 | | | | 220 | 13 | 18 | 1.4 | | | 189 | | | |
| 5-27-9add1 | SE, SE, NE 9-5-27 | 100 | QT | 4- 4-40 | | | | 237 | 17 | 24 | 75 | | | 237 | | | |
| 5-28-15dca1 | NE, SW, SE 15-5-28 | 36 | QT | 4- 4-40 | | | | 229 | 15 | 42 | 67 | | | 243 | | | |
| 5-28-27a | NE 27-5-28 | 137 | | 7-27-59 | 54 | 34 | 164 | 326 | 106 | 180 | 0 | .28 | 750 | 275 | 8 | 4.3 | 1,260 |
| 5-28-32ddc1 | SW, SE, SE 32-5-28 | 50 | QT | 11-19-51 | 91 | 11 | 10 | 291 | 15 | 8.0 | 32 | | 342 | 272 | 34 | 0.2 | 539 |
| 5-28-35c | SW 35-5-28 | 147 | | 7-27-59 | 117 | 75 | 268 | 180 | 528 | 345 | 0.1 | .32 | 1,540 | 600 | 452 | 4.8 | 2,250 |
| 6-20-20daa1 | NE, NE, SE 20-6-20 | 159 | QT | 4- 8-40 | | | | 235 | 46 | 13 | 27 | | | 264 | | | |
| 6-21-29ddc1 | SW, SE, SE 29-6-21 | 189 | QT | 4- 8-40 | | | | 238 | 42 | 16 | 15 | | | 240 | | | |
| 6-22-29cdc1 | SW, SE, SW 29-6-22 | 220 | QT | 4- 9-40 | | | | 233 | 60 | 99 | 8.7 | | | 276 | | | |
| 6-23-34bba1 | NE, NW, NW 34-6-23 | 114 | QT | 4- 9-40 | | | | 313 | 230 | 80 | 4.1 | | | 348 | | | |
| 6-24-20dcc1 | SW, SW, SE 20-6-24 | 258 | QT | 4- 9-40 | | | | 259 | 26 | 11 | 3.6 | | | 234 | | | |
| 6-25-33bab1 | NW, NE, NW 33-6-25 | 40 | QT | 4- 3-40 | | | | 244 | 10 | 12 | 4.4 | | | 198 | | | |
| 6-27-30dab1 | NW, NE, SE 30-6-27 | 65 | QT | 4- 4-40 | | | | 282 | 15 | 26 | 0.3 | | | 231 | | | |

[1] A=alluvium, R=redbeds, QT=Pliocene and Pleistocene deposits.

of water from the Pliocene and Pleistocene deposits; however, several are from the redbeds and the alluvium.

*Constituents.*—The chemical quality of water affects its use for certain purposes. Calcium and magnesium make water hard and are largely responsible for the formation of boiler scale. Sodium and potassium in concentrations of 50 to 100 ppm (parts per million), which is the range for much of the ground water in Beaver County, make careful operation of steam boilers necessary to prevent foaming. Sodium also affects the usability of the water for irrigation. Bicarbonate in the concentrations found in the ground water of Beaver County has little effect on the usefulness of the water.

The recommended upper limit of sulfate concentration in water used for drinking on interstate carriers by the U. S. Public Health Service is 250 ppm (U. S. Public Health Service, 1946). This limit was not exceeded in any of the water samples from the Pliocene and Pleistocene deposits but was exceeded in all samples from the redbeds. The high concentration of sulfate in the water from the redbeds is caused by the large quantity of gypsum (calcium sulfate) in that unit.

The upper limit of chloride concentration in water used for drinking on interstate carriers recommended by the U. S. Public Health Service is 250 ppm. This limit was exceeded in only two of the samples collected, one in the redbeds and one in the Pliocene and Pleistocene deposits. High concentrations of chloride should be anticipated from wells in the redbeds, owing to the presence of salt (sodium chloride) layers. The depth to the top of the salt beds ranges from 345 to 1,440 feet below the surface. The depth to the first salt bed and the configuration of its upper surface are shown on figure 6. Large quantities of chloride make water corrosive and affect its use by industry. The use of water for irrigation also may be limited by its chloride content.

High concentrations of nitrate may indicate organic pollution. Nitrate contents of greater than 44 ppm may contribute to methemoglobinemia in infants (blue babies). The upper limit of dissolved solids in water used for drinking on interstate carriers recommended by the U. S. Public Health Service is 500 ppm unless no other water is available, in which case water of 1,000 ppm is acceptable.

The general classification of hardness of water is as follows: less than 50 ppm, soft; 50 to 150 ppm, usable for most purposes without treatment except for industries where soap consumption is a major economic factor; 150 to 300 ppm, commonly softened for municipal or industrial use; more than 300 ppm, generally treated for most uses. The hardness of most water from the Pliocene and Pleistocene deposits ranges from 150 to 300 ppm, whereas that of most waters from the redbeds is greater than 600 ppm and may be more than 1,000 ppm.

The sodium adsorption ratio (SAR) is useful in determining whether the water can be used successfully for irrigation over long periods of time. This property is defined and discussed later in this section under the usefulness of water for irrigation.

Specific conductance of a water is a measure of its ability to conduct electricity. The specific conductance varies with the concentration and degree of ionization of different minerals in solution. It is commonly used as a rough indication of total dissolved solids.

*Source.*—Water obtained from the redbeds generally is very hard; it is also too high in sulfate and in some places is too high in chloride to be used for drinking. It is used, however, for stock watering where other water is not available.

Water from the Pliocene and Pleistocene deposits is generally suitable for most purposes although it is moderately hard. It is satisfactory for general household use, but it may have to be treated for some industrial uses. Water from the Pliocene and Pleistocene deposits is satisfactory for irrigation, although salinity control may be needed for growing certain plants.

The quality of water in the alluvium depends on its source. At some places it is similar to water from the redbeds, at other places to water from the Pliocene and Pleistocene deposits, and at still other places to water from an adjacent stream. Water from both the North Canadian River and the Cimarron River is generally higher in most constituents than water from the Pliocene and Pleistocene deposits, as shown by comparing the analyses in table 10 with analyses in table 9.

*Use.*—Water suitable for domestic use can be obtained at most places from the Pliocene and Pleistocene deposits. Water suitable for domestic use cannot be expected from the redbeds at most places; however, water of quality suitable for stock use can be obtained at many places from the redbeds. For most industrial and municipal uses, water of suitable quality may be obtained from the Pliocene and Pleistocene deposits but generally not from the redbeds.

TABLE 10.—QUALITY OF SURFACE WATER IN BEAVER COUNTY, OKLAHOMA

(constituents in ppm)

| CONSTITUENT | NORTH CANADIAN RIVER AT BEAVER CITY | CIMARRON RIVER NEAR MOCANE WEIGHTED AVERAGES SOURCE: U. S. GEOL. SURVEY, 1952 A AND B | |
|---|---|---|---|
| | OCT. 8, 1951 DISCHARGE 1.05 CFS | 1947 DISCHARGE 113 CFS | 1948 DISCHARGE 94.4 CFS |
| Calcium | 144 | 77 | 74 |
| Magnesium | 63 | 33 | 33 |
| Sodium and potassium | 417 | 266 | 286 |
| Bicarbonate | 176 | 226 | 219 |
| Sulfate | --- | 143 | 164 |
| Chloride | 570 | 387 | 422 |
| Nitrate | --- | 3.0 | 3.8 |
| Hardness | | | |
| Calcium, magnesium | 620 | 328 | 324 |
| Noncarbonate | 471 | 142 | 145 |
| Specific conductance (micromhos at 25°C) | 2,820 | 1,760 | 1,900 |

The suitability of water for irrigation depends upon several factors in addition to the mineral content of the water. Among these are the type and drainage characteristics of the soil, the amount of water applied, and the amount and distribution of rainfall. The following paragraphs on this subject have been adapted from Handbook 60 of the U. S. Department of Agriculture (1954).

All water used for irrigation carries varying quantities of chemical constituents. If their concentration is not too great, some of these constituents favor the growth of plants; others are harmful to plant growth and to soils. The total concentration of dissolved solids in water used for irrigation may range from a few parts to many thousand parts per million, but most irrigation waters range from 100 to 1,500 ppm. Principal constituents of these waters are calcium, magnesium, sodium, bicarbonate, sulfate, and chloride. Other constituents, such as potassium, nitrate, and boron are normally present but only in a low concentration.

The characteristics of an irrigation water that appear to be most important in determining its usefulness are: (1) total concentration of soluble salts (salinity hazard); (2) relative proportion of sodium to other cations (sodium or alkali hazard); (3) concentration of boron or other elements that may be toxic; and (4), under some conditions, the bicarbonate concentration as related to the concentration of calcium and magnesium.

The total concentration of soluble salts in irrigation water (salinity hazard) is most easily expressed in terms of electrical conductivity. This property varies with the amount and kinds of dissolved salts and the temperature. Specific conductance is usually expressed in terms of micromhos per centimeter at 25°C. Nearly all irrigation waters that have been used successfully over extended periods of time have specific conductances less than 2,250 micromhos. Most waters from the Pliocene and Pleistocene deposits have a medium to high salinity hazard, and, for those waters in the high range, special management and drainage practices may have to be exercised.

The sodium (alkali) hazard is determined by computing the sodium adsorption ratio (SAR) by dividing the sodium concentration by the square root of half the sum of the calcium and magnesium concentrations, in equivalents per million. The SAR is reported on table 9 for 12 samples from the Pliocene and Pleistocene deposits and for four samples of undetermined source. The sodium hazard is low in all these samples.

Boron in small quantities is essential for the normal growth of practically all plants, but in excessive amounts it can be toxic. The amount of boron in water from the Pliocene and Pleistocene deposits as reported on table 9 is below the dangerous level for the types of crops generally grown in Beaver County.

## FUTURE OF GROUND-WATER DEVELOPMENT

In Beaver County the principal aquifer is the deposits of Pliocene and Pleistocene age, which consist chiefly of sand, gravel, silt, clay, conglomerate, and caliche. These deposits are underlain by relatively impermeable redbeds, which yield small quantities of water of poor quality to wells. Alluvium is a major aquifer locally, but most of the water in this unit comes from lateral seepage from the Pliocene and Pleistocene deposits. Dune sand absorbs precipitation readily and facilitates recharge to the Pliocene and Pleistocene deposits but does not store much ground water. Ground-water occurrence and movement in the Pliocene and Pleistocene deposits govern the water economy of the county.

When the 5-year average of precipitation is about 21.5 inches, as during the 1940's, recharge may be about 350,000 acre-feet per year. As a result of the wet period, 1941-51, 1.2 million acre-feet of water was added to storage in the 11-year period, an average of 100,000 acre-feet per year. If future dry and wet cycles follow the same pattern as they have in the past and are of the same intensity, then 50,000 acre-feet of water per year could be developed without progressively lowering water levels or disturbing natural discharge on a long-term basis. In 1959 about 18,000 acre-feet of water was pumped.

Although perennial yield is an elusive factor, it is estimated to exceed 50,000 acre-feet per year in Beaver County. However, when the pumpage reaches about 50,000 acre-feet per year, the ground-water situation should be re-evaluated to ascertain whether or not the perennial yield is being exceeded. When the annual pumpage becomes 50,000 acre-feet depends mainly upon the development of irrigation. If the present crops and agricultural methods are continued and precipitation is adequate, it will be a long time; however, table 4 shows that in 1956, when precipitation was 8.40 inches or 55 percent below normal, irrigated acreage increased by almost 400 percent. Although irrigation decreased in wetter years, many farmers continued to irrigate. It is anticipated, therefore, that irrigation will not increase constantly, but that it may increase suddenly during the next drought or remain the same for a long period.

TABLE 11.—RECORDS OF WELLS IN BEAVER COUNTY, OKLAHOMA

| Well number[1] | Location | Owner or name | Depth (ft.) | Diameter (in.) | Use of water[2] | Probable aquifer[3] | Water level: Depth below land surface (ft.) | Water level: Date of measurement | Altitude of land surface (ft.) |
|---|---|---|---|---|---|---|---|---|---|
| **T1N-R20E** | | | | | | | | | |
| 1ada1 | NE SE NE 1 | W. S. Mills | 199 | | N | QT | 152.0 | 7- 8-39 | 2913 |
| 2ddb1 | NW SE SE 2 | State of Oklahoma | 158 | | N | QT | 142.0 | 7- 8-39 | 2902 |
| 7ccc1 | SW SW SW 7 | State of Oklahoma | 86 | 5 | N | R | 27.9 | 7- 7-39 | 2858 |
| 9bcc1 | SW SW NW 9 | M. R. Todd | 120 | 5 | N | QT | 102.7 | 7- 7-39 | 2862 |
| 11ddd1 | SE SE SE 11 | D. C. Roberson | 172 | 6 | D, S | QT | 156.2 | 7- 8-39 | 2913 |
| 14bab1 | NW NE NW 14 | C. B. Leatherman | 114 | | D, S | QT | 113.3 | 7- 7-39 | 2870 |
| 15aad1 | SE NE NE 15 | Natural Gas Pipe Line Co. of America No. 6 | 380 | 8 | In | QT | 113 | - -39 | |
| 15aad2 | SE NE NE 15 | do. No. 5 | 380 | 8 | In | QT | 108 | - -39 | |
| 15aa— | — NE NE 15 | do. No. 2 | 363 | | N | | | | |
| 15aa— | — NE NE 15 | do. No. 4 | 362 | | N | QT | | | |
| 15aa— | — NE NE 15 | do. No. 3 | 350 | | N | QT | 100 | - -39 | |
| 16cdd1 | SE SE SW 16 | ——— | | | S | QT | 103.2 | 8-10-56 | |
| 17bab1 | NW NE NW 17 | O. W. Springmeyer | 76 | 5 | D | R | 35.3 | 7- 7-39 | 2812 |
| 19aad1 | SE NE NE 19 | C. C. Ragsdale | 96 | | D, S | QT | 87.3 | 7- 7-39 | 2882 |
| 21cdc1 | SW SE SW 21 | J. O. Smart | 130 | 5 | N | QT | 129.1 | 7- 6-39 | 2910 |
| 24aaa1 | NE NE NE 24 | Ensmenger | 203 | 4 | N | QT | 194.9 | 7- 6-39 | 2938 |
| 25bbc1 | SW NW NW 25 | Lola Gray | 190 | | N | QT | 181.0 | 7- 6-39 | 2923 |
| 26dcc1 | SW SW SE 26 | Hannah Litke | 235 | | N | QT | 196.2 | 7- 7-39 | 2938 |
| 27aba1 | NE NW NE 27 | Dallas Land Bank | 164 | | N | QT | 158.9 | 7- 6-39 | 2921 |
| 28aaa1 | NE NE NE 28 | Fair View School | 142 | | Ps | QT | 131.1 | 7- 6-39 | 2905 |
| 29dda1 | NE SE SE 29 | Central Life Assurance Co. | 160 | | D, S | QT | 145.6 | 7- 7-39 | 2927 |
| 30aba1 | NE NW NE 30 | J. R. Anderson | 142 | 5 | D, S | QT | 136.3 | 7- 6-39 | 2932 |
| 31aba1 | NE NW NE 31 | T. J. Crunk | 182 | | N | QT | 168.7 | 7- 6-39 | 2961 |
| 31cba1 | NE NW SW 31 | The Texas Co. No. 1 | 195 | 8 | In | | 140 | - -57 | |
| 31cba2 | NE NW SW 31 | The Texas Co. No. 3 | 200 | 8 | In | | | | |
| 31cbb1 | NW NW SW 31 | John Lehman | 117 | | S | QT | 109.6 | 7- 6-39 | 2905 |
| 31cbb2 | NW NW SW 31 | The Texas Co. No. 4 | 205 | 8 | In | | 126 | - -58 | |
| 31cca1 | NE SW SW 31 | The Texas Co. No. 2 | 192 | 8 | In | | 132 | - -57 | |
| 35cdc1 | SW SE SW 35 | J. E. Anderson | 233 | | N | QT | 224.3 | 7- 6-39 | 2956 |
| **T1N-R21E** | | | | | | | | | |
| 1baa1 | NW NE NE 1 | W. M. Ollenbarger | 204 | 4¾ | N | QT | 192.2 | 8-10-39 | 2885 |
| 8bbb1 | NW NW NW 8 | Gray Estate | 186 | 3½ | D, S | QT | 172.9 | 8- 8-39 | 2913 |
| 12bbb1 | NW NW NW 12 | H. Miller | 216 | 6 | D, S | QT | 201.7 | 8- 9-39 | 2896 |
| 13cbc1 | SW NW SW 13 | H. K. Skeen | 225 | 5 | D, S | QT | 217.9 | 8- 9-39 | 2914 |
| 16aaa1 | NE NE NE 16 | R. C. Johnson | 224 | 5 | N | QT | 214.4 | 8- 8-39 | 2928 |
| 19daa1 | NE NE SE 19 | J. N. Harris | 215 | 4½ | D, S | R | 200.5 | 8- 8-39 | 2936 |
| 21ddd1 | SE SE SE 21 | J. W. Mounts | 245 | 5 | D, S | QT | 239.3 | 8- 8-39 | 2934 |
| 31bad1 | SE NE NW 31 | John Tyree | 240 | | D, S | QT | 231.4 | 7- 7-39 | 2952 |
| 34cdd1 | SE SE SW 34 | Carl Jamison | 265 | 6 | S | QT | 239.4 | 8- 8-39 | 2937 |
| 35aab1 | NW NE NE 35 | A. J. Kelly | 232 | 4 | D, S | QT | 226.6 | 8- 8-39 | 2913 |
| 36dcc1 | SW SW SE 36 | Joe Juliason | 230 | | D, S | QT | 225.3 | 8- 8-39 | 2910 |
| **T1N-R22E** | | | | | | | | | |
| 1aaa1 | NE NE NE 1 | J. J. York | 178 | 5 | D, S | QT | 154.5 | 8-10-39 | 2824 |
| 3aaa1 | NE NE NE 3 | Emma Laughton | 201 | 6 | D, S | QT | 175.8 | 8-10-39 | 2848 |
| 4daa1 | NE NE SE 4 | C. F. Saunders | 214 | 4 | D | QT | 199 | - -53 | |
| 4daa2 | NE NE SE 4 | do. | 248 | 11 | Ir | QT | 199 | - -49 | |
| 5baa1 | NE NE NW 5 | C. F. Huguley | 210 | | N | QT | 202.6 | 8-10-39 | 2885 |
| 8cdc1 | SW SE SW 8 | Mr. Buzzard | 218 | | D, S | QT | 213.7 | 8- 9-39 | 2896 |
| 9aba1 | NE NW NE 9 | Mrs. Munger | 198 | | D, S | QT | 190.3 | 8-10-39 | 2869 |
| 12dcc1 | SW SW SE 12 | S. B. Gregory | 200 | 4½ | D, S | QT | 175.1 | 8-10-39 | 2852 |
| 17dac1 | SW NE SE 17 | C. E. Presnall | 230 | 5 | S | QT | 194.5 | 8-10-39 | 2887 |
| 21aaa1 | NE NE NE 21 | Blue Mound School | 180 | | Ps | QT | 163.7 | 8-10-39 | 2859 |
| 24ddd1 | SE SE SE 24 | State of Oklahoma | 236 | 6 | D, S | QT | 206.7 | 8- 9-39 | 2868 |
| 27ddd1 | SE SE SE 27 | Mrs. Sebastian | 242 | | D, S | | 220.0 | 8- 9-39 | 2892 |
| 29aad1 | SE NE NE 29 | H. E. Pattison | 226 | 4½ | D | QT | 202.5 | 8-10-39 | 2891 |
| 30daa1 | NE NE SE 30 | Helena Meyer | 230 | | N | QT | 217.9 | 8- 9-39 | 2905 |
| 31dca1 | NE SW SE 31 | W. M. Clark | 235 | | D, S | QT | 223.7 | 8- 9-39 | 2905 |
| 34bdd1 | SE SE NW 34 | Dick Naylor | 375 | | Ir | QT | 220 | - -55 | |
| 34cdc1 | SW SE SW 34 | A. W. Caldwell | | 16 | Ir | QT | 225 | - -54 | |
| 34dbc1 | SW NW SE 34 | A. P. Sager | 318 | 16 | Ir | QT | 228 | - -59 | |
| **T1N-R23E** | | | | | | | | | |
| 1add1 | SE SE NE 1 | J. R. Woodson | 63 | 5 | N | QT | 60.0 | 8- 3-38 | 2679 |
| 4ccd1 | SE SW SW 4 | Julia Martz | 210 | 6 | D | QT | 198.0 | 8-28-39 | 2850 |
| 8dab1 | NW NE SE 8 | J. O. Cates | 302 | 16 | Ir | QT | 195 | - -54 | |
| 10cdc1 | SW SE SW 10 | L. R. Cates | 209 | 4 | D, S | QT | 196.3 | 8-28-39 | 2838 |
| 12cdc1 | SW SE SW 12 | L. T. Adelman | 146 | 4 | D, S | QT | 135.3 | 8-28-39 | 2790 |
| 14dad1 | SE NE SE 14 | R. D. Hall | 169 | 5 | D, S | QT | 161.4 | 8- 3-38 | 2797 |
| 17bab1 | NW NE NW 17 | J. O. Cates | 207 | 4½ | N | QT | 194.5 | 8-28-39 | 2856 |
| 19ddd1 | SE SE SE 19 | Eugene Mahoney | 326 | 16 | Ir | QT | 216 | - -55 | |
| 20db1 | NW SE 20 | Leo Kerns | 330 | 16 | Ir | QT | 210 | - -55 | |
| 22daa1 | NE NE SE 22 | T. J. Ogilvie | 195 | 5 | D, S | QT | 187.9 | 8-29-39 | 2824 |
| 22dd1 | SE SE 22 | do. | 343 | 16 | Ir | QT | 194 | - -55 | |
| 26dad1 | SE NE SE 26 | C. R. Key | 409 | 16 | Ir | QT | 202 | - -54 | |
| 28cbc1 | SW NW SW 28 | W. Rutledge | 218 | | S | QT | 204.3 | 8-28-39 | 2852 |
| 28ddd1 | SE SE SE 28 | J. A. Ryan | 240 | 5 | D | QT | 208 | - -41 | 2847 |
| 29cbb1 | NW NW SW 29 | Paul Caldwell | 585 | 16 | Ir | QT | 214 | - -60 | |
| 31cdb1 | NW SE SW 31 | Dave Hummer | 256 | 4 | N | QT | 211.4 | 8- 9-39 | 2864 |
| 33abb1 | NW NW NE 33 | Leroy Hughes | 290 | 16 | Ir | QT | 200 | - -59 | |
| 33caa1 | NE NE SW 33 | D. A. Rutledge | 420 | 12 | Ir | QT | 200 | - -55 | |
| 34abd1 | SE NW NE 34 | Beulah Hall | 264 | 4½ | D, S | QT | 205.4 | 8-28-39 | 2841 |
| 36bca1 | NE SW NW 36 | G. W. Ottinger | 232 | 5 | D, S | QT | 189.3 | 8-29-39 | 2816 |

[1]See figure 2, page 9.

[2]D—domestic, In—industrial, Ir—irrigation, N—none (includes abandoned wells), Ps—public supply, S— stock, T—test hole.

[3]A—alluvium, R—redbeds, QT—Pliocene and Pleistocene deposits.

| WELL NUMBER[1] | LOCATION | OWNER OR NAME | DEPTH (FT.) | DIAMETER (IN.) | USE OF WATER[2] | PROBABLE AQUIFER[3] | WATER LEVEL | | ALTITUDE OF LAND SURFACE (FT.) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | DEPTH BELOW LAND SURFACE (FT.) | DATE OF MEASUREMENT | |
| **T1N-R24E** | | | | | | | | | |
| 1bba1 | NE NW NW 1 | M. E. Thomas | 173 | | D, S | QT | 161.8 | 8-30-39 | 2770 |
| 1abb1 | NW NW NE 1 | C. S. Cook | 330 | 16 | Ir | QT | 200 | - -55 | |
| 7cdc1 | SW SE SW 7 | L. T. Adelman | 190 | | N | QT | 163.9 | 8- 3-38 | 2785 |
| 10dda1 | NE SE SE 10 | Hannah Danner | 141 | | S | QT | 136.0 | 8-30-39 | 2735 |
| 12cbb1 | NW NW SW 12 | Wesley Stevens | 69 | 5 | S | QT | 57.0 | 8-29-39 | 2675 |
| 13bbb1 | NW NW NW 13 | Wesley Jenkins | 185 | 4 | D, S | QT | 158.1 | 8-29-39 | 2751 |
| 15bcc1 | SW SW NW 15 | W. A. Getz | 197 | 4½ | D, S | QT | 172.5 | 8-30-39 | 2775 |
| 18bbb1 | NW NW NW 18 | L. T. Adelman | 185 | 4 | S | QT | 163.4 | 7- 1-41 | 2788 |
| 19abb1 | NW NW NE 19 | W. J. Lehman | 199 | 4½ | N | QT | 177.9 | 8- 3-38 | 2800 |
| 20ccc1 | SW SW SW 20 | Joe Kupka | 212 | 5 | D, S | QT | 200.6 | 8-30-39 | 2816 |
| 23ccc1 | SW SW SW 23 | State of Oklahoma | 154 | | N | QT | 137.3 | 8-30-39 | 2738 |
| 24dda1 | NE SE SE 24 | B. J. Frass | 250 | 4½ | D, S | QT | 190.1 | 8-29-39 | 2780 |
| 26aba1 | NE NW NE 26 | C. Nelson | 218 | 4½ | D, S | QT | 195.4 | 8-30-39 | 2792 |
| 28cdc1 | SW SE SW 28 | N. C. Morris | 170 | 3½ | D, S | QT | 155.2 | 8-30-39 | 2769 |
| 32cbc1 | SW NW SW 32 | J. F. Ondracek | 228 | 4 | D, S | QT | 205.3 | 8-29-39 | 2821 |
| 35aab1 | NW NE NE 35 | D. E. Lawson | 153 | 4½ | D, S | QT | 140.2 | 8-29-39 | 2737 |
| 35dba1 | NE NW SE 35 | Caleb Harper | 95 | | S | QT | 81.1 | 8-29-39 | 2679 |
| **T1N-R25E** | | | | | | | | | |
| 1cbb1 | NW NW SW 1 | Chris Winfrow | 185 | | D, S | QT | 176.3 | 9-11-39 | 2668 |
| 2dcc1 | SW SW SE 2 | E. S. Altmiller | 100 | 6 | D, S | QT | 60 | - -39 | |
| 4aaa1 | NE NE NE 4 | W. S. Miller | 368 | 16 | Ir | QT | 193 | - -55 | |
| 4ddd1 | SE SE SE 4 | C. E. Still | 69 | 5½ | N | QT | 52.2 | 9-11-39 | 2640 |
| 12aad1 | SE NE NE 12 | George Beck | 152 | | S | QT | 142.7 | 10-11-39 | 2622 |
| 12cbb1 | NW NW SW 12 | Dexter Gilger | 75 | | D, S | QT | 69.2 | 10-11-39 | 2568 |
| 15ada1 | NE SE NE 15 | I. E. Flock | 41 | 6 | D, S | QT | 35.5 | 10-11-39 | 2567 |
| 15bbc1 | SW NW NW 15 | J. T. Ray | 27 | 5 | D | A | 21.3 | 10-11-39 | 2570 |
| 18aab1 | NW NE NE 18 | Mrs. Taylor | 170 | | D, S | QT | 135.9 | 9-11-39 | 2720 |
| 20bcc1 | SW SW NW 20 | F. E. Knowles | 160 | 4 | D, S | QT | 139.5 | 9-11-39 | 2723 |
| 22abc1 | SW NW NE 22 | F. M. Deming | 189 | 4½ | D, S | QT | 119.7 | 10-11-39 | 2667 |
| 25cba1 | NE NW SW 25 | J. L. Mercer | 123 | 5 | S | QT | 91.3 | 10- 3-39 | 2610 |
| 26aab1 | NW NE NE 26 | Federal Land Bank | 52 | | S | QT | 40.5 | 10-11-39 | 2562 |
| 28aab1 | NW NE NE 28 | Arthur Williams | 223 | 6 | D, S | QT | 172.7 | 10- 3-39 | 2737 |
| 32adc1 | SW SE NE 32 | B. J. Messner | 37 | 48 | D, S | A | 35.5 | 10- 3-39 | 2613 |
| **T1N-R26E** | | | | | | | | | |
| 1cbb1 | NW NW SW 1 | A. W. McClurg | 38 | 8 | S, Ir | A | 22.0 | 10-16-39 | 2382 |
| 1ccc1 | SW SW SW 1 | M. M. Mansfield | 30 | 4 | | A | 16.3 | 10-16-39 | 2381 |
| 2dac1 | SW NE SE 2 | Winton Jett | 60 | 16 | Ir | QT | 17 | - -55 | |
| 4dda1 | NE SE SE 4 | J. W. Lindsay | 51 | 5 | S | QT | 47.4 | 10-13-39 | 2465 |
| 5ddc1 | SW SE SE 5 | R. A. Phillips | 102 | 5½ | D, S | QT | 95.6 | 10-13-39 | 2539 |
| 14dbd1 | SE NW SE 14 | Cornelia Dance | 24 | 5 | N | A | 14.9 | 10-13-39 | 2399 |
| 15cda1 | NE SE SW 15 | Emma Thompson | 47 | 7 | | QT | 23.6 | 10-13-39 | 2422 |
| 17ddc1 | SW SE SE 17 | L. M. Kerns | 111 | 6 | N | QT | 89.7 | 10-13-39 | 2521 |
| 18ada1 | NE SE NE 18 | Ernest Kerns | 133 | 3 | D, S | QT | 111.5 | 10-12-39 | 2560 |
| 18ccc1 | SW SW SW 18 | L. M. Kerns | 34 | 5 | D | QT | 21.9 | 10-11-39 | 2510 |
| 19cac1 | SW NE SW 19 | W. E. Huddleston | 39 | 6 | D | QT | 26.0 | 10-12-39 | 2499 |
| 20cbb1 | NW NW SW 20 | R. M. Ford | 46 | 5 | N | QT | 34.9 | 10-12-39 | 2497 |
| 22bb | NW NW 22 | Harold Luck | 148 | 16 | Ir | QT | 21 | - -54 | |
| 22bcb1 | NW SW NW 22 | H. L. Smith | 195 | | Ir | QT | 30 | - -54 | |
| 22ccb1 | NW SW SW 22 | C. H. Baldwin | 44 | 5 | D | QT | 29.2 | 9- 5-39 | 2435 |
| 24cdc1 | SW SE SW 24 | C. C. Griswold | 86 | 5 | D | QT | 60.3 | 10-13-39 | 2600 |
| 27bab1 | NW NE NW 27 | A. M. Daily | 145 | 16 | Ir | QT | 39.0 | - -55 | |
| 27dcd1 | SE SW SE 27 | A. M. Gehring | | 5 | D, S | A | 30.2 | 10-13-39 | 2439 |
| 28bbb1 | NW NW NW 28 | J. C. Woods | 60 | 5 | T | QT | 40 | - -40 | |
| 28dda1 | NE SE SE 28 | N. C. Hicks | 49 | 6 | S | QT | 34.0 | 10-13-39 | 2439 |
| 30aac1 | SW NE NE 30 | A. C. Baldwin | 210 | 12 | Ir | QT | 10 | - -57 | |
| 31bbb1 | NW NW NW 31 | C. H. Baldwin | 130 | 4 | D, S | QT | 100.1 | 10-12-39 | 2586 |
| 33cbd1 | SE NW SW 33 | J. W. Woods | 45 | 5 | D, S | QT | 29.7 | 10-12-39 | 2470 |
| **T1N-R27E** | | | | | | | | | |
| 6aab1 | NW NE NE 6 | N. G. Pitzer | 17 | 6 | N | A | 12.2 | 6- 5-40 | 2361 |
| 6abc1 | SW NW NE 6 | Calvin Jett | 84 | 18 | Ir | QT | | | |
| 6acd1 | SE SW NE 6 | ——— | 68 | 5 | S | QT | 37.0 | 11-10-53 | 2400 |
| 7bbb1 | NW NW NW 7 | P. P. Pim | 79 | 5 | N | QT | 68.3 | 10-16-39 | 2435 |
| 7ccc1 | SW SW SW 7 | C. A. Bourguin | 116 | 4.5 | S | QT | 107.2 | 6- 5-40 | 2484 |
| 9bbd1 | SE NW NW 9 | C. H. V. Earl | 31 | | S | QT | 11.4 | 6- 5-40 | 2375 |
| 9ccc1 | SW SW SW 9 | A. D. Copple | 122 | 3 | D, S | QT | 35 | - -40 | |
| 20dbb1 | NW SE SE 20 | E. Kunka | 79 | 23 | Ir | QT | 49 | - -40 | 2444 |
| 23bdd1 | SE SE NW 23 | Ralph Bedell | 281 | 4½ | D, S | QT | | | |
| 23cdb1 | NW SE SW 23 | Elmer Brown | 75 | 6 | D, S | QT | 69.6 | 6- 6-40 | 2617 |
| 27ddd1 | SE SE SE 27 | George Ruthpek | 99 | 6 | D, S | QT | 79.4 | 6- 5-40 | 2624 |
| 30baa1 | NE NE NW 30 | C. A. Bourguin | 140 | 3 | D, S | QT | 110.3 | 10-13-39 | 2511 |
| 30ddd1 | SE SE SE 30 | N. E. Jenning | 56 | 5 | N | QT | 50.6 | 6- 6-40 | 2481 |
| 34bba1 | NE NW NW 34 | ——— | | | | | 166.1 | 8- 6-56 | |
| **T1N-R28E** | | | | | | | | | |
| 2bbd1 | SE NW NW 2 | Harold Brewer | 244 | 16 | Ir | QT | 152 | - -53 | 2476 |
| 6bba1 | NE NW NW 6 | N. M. Gaydner | 59 | | S | QT | 41.3 | 6- 6-40 | 2464 |
| 14ada1 | NE SE NE 14 | Vida Ellison | 100 | 6 | D, S | QT | 97.0 | 6- 7-40 | 2418 |
| 16add1 | SE SE NE 16 | State of Oklahoma | 62 | 4½ | D, S | QT | 51.3 | 6- 7-40 | 2398 |
| 21bcb1 | NW SW NW 21 | Walter Roach | 34 | 5 | N | QT | 27.0 | 6- 6-40 | 2457 |
| 22bcc1 | SW SW NW 22 | Lovell School | 97 | 6 | Ps | QT | 89.6 | 6- 7-40 | 2439 |
| 22da1 | NE SE 22 | ——— | | 6 | | | 53.5 | 8- 6-56 | |
| 24bbc1 | SW NW NW 24 | Lemuel Lloyd | 24 | 5 | D, S | QT | 18.6 | 6- 7-40 | 2351 |
| 26ddc1 | SW SE SE 26 | J. E. Piersall | 122 | | D, S | QT | 104.8 | 6- 7-40 | 2478 |
| 28ccb1 | NW SW SW 28 | ——— | 37 | 5 | D, S | QT | 31.7 | 6- 7-40 | 2434 |
| 28dbd1 | SE NW SE 28 | R. D. Hennigh | 220 | 16 | Ir | QT | 48 | - -55 | |
| 31dab1 | NW NE SE 31 | C. L. Treat | 39 | 6 | D, S | QT | 32.3 | 6- 7-40 | 2514 |
| 35bbb1 | NW NW NW 35 | G. D. Piersall | 97 | | D, S | QT | 76.5 | 6- 7-40 | 2447 |
| **T2N-R20E** | | | | | | | | | |
| 1ddb1 | NW SE SE 1 | Louisa Buchanan | 26 | 5 | D, S | QT | 19.8 | 7-11-39 | 2750 |
| 9bbb1 | NW NW NW 9 | C. F. Campbell | 50 | 3 | S | R | 30.1 | 7-10-39 | 2750 |
| 11ccb1 | NW SW SW 11 | L. J. Cowan | 85 | 5 | N | R | 32.1 | 7-10-39 | 2722 |
| 13bdb1 | NW SE NW 13 | P. M. Condit | 25 | 24 | N | R | 19.4 | 7-11-39 | 2726 |
| 16abb1 | NW NW NE 16 | M. S. Pope | 49 | | S | R | 31.9 | 7-10-39 | 2692 |

| Well number[1] | Location | Owner or name | Depth (ft.) | Diameter (in.) | Use of water[2] | Probable aquifer[3] | Water level: Depth below land surface (ft.) | Water level: Date of measurement | Altitude of land surface (ft.) |
|---|---|---|---|---|---|---|---|---|---|
| **T2N-R20E** (cont.) | | | | | | | | | |
| 17aab1 | NW NE NE 17 | G. D. Pope | 49 | 5 | N | R | 21.0 | 7-10-39 | 2688 |
| 17ccd1 | SE SW SW 17 | C. A. Trimmell | 76 | 5 | S | R | 41.2 | 7-10-39 | 2719 |
| 18baa1 | NE NE NW 18 | C. R. Dethlefs | 60 | 4 | S | R | 31.7 | 7-10-39 | 2654 |
| 19aac1 | SW NE NE 19 | G. O. Krouse | | | D, S | R | 18.9 | 7- 8-39 | 2677 |
| 22bbb1 | NW NW NW 22 | William Henline | 21 | | N | R | 11.6 | 7-10-39 | 2730 |
| 22dcc1 | SW SW SE 22 | J. A. Cowan | 26 | | S | R | 23.4 | 7-10-39 | 2773 |
| 23cbb1 | NW NW SW 23 | L. H. Seaton | 143 | | S | R | 52.4 | 7-10-39 | 2798 |
| 23dda1 | NE SE SE 23 | Hannah Litke | 120 | 4½ | S | R | 85.2 | 7-10-39 | 2826 |
| 24cdc1 | SW SE SW 24 | R. Ravencroft | 564 | | T | R | | | |
| 25ada1 | NE SE NE 25 | W. R. Bryan | 114 | 4½ | D, S | QT | 105.7 | 7-10-39 | 2845 |
| 27ddd1 | SE SE SE 27 | R. D. Benscoter | 111 | 4½ | N | QT | 91.4 | 7- 8-39 | 2853 |
| 29ada1 | NE SE NE 29 | E. P. Fuller | 93 | 5 | N | R | 48.3 | 7- 8-39 | 2752 |
| 29caa1 | NE NE SW 29 | Robert Campbell | 19 | 5 | T | R | 16 | - -40 | |
| 32dad1 | SE NE SE 32 | G. S. Gillison | 59 | 4½ | D | R | 30.7 | 7- 7-39 | |
| 33abb1 | NW NW NE 33 | H. K. Lindsley | 26 | 42 | N | QT | 13.2 | 7- 8-39 | 2771 |
| 34dcc1 | SW SW SE 34 | Frank Leatherman | 81 | 5 | N | QT | 77.4 | 7- 7-39 | 2833 |
| 35aba1 | NE NW NE 35 | do. | 186 | 16 | Ir | QT | 128 | - -51 | |
| **T2N-R21E** | | | | | | | | | |
| 2ccb1 | NW SW SW 2 | Ed. Frantz | 119 | 6 | D,S | QT | 114.2 | 7-14-39 | 2831 |
| 4dcd1 | SE SW SE 4 | Harold James | 315 | 16 | Ir | QT | 202 | - -59 | |
| 5cbc1 | SW NW SW 5 | H. H. Jones | 104 | 6 | D,S | QT | 96.0 | 7-18-39 | 2824 |
| 7bbc1 | SW NW NW 7 | Lester Pyle | 36 | 4 | N | QT | 17.7 | 7-11-39 | 2761 |
| 8aab1 | NW NE NE 8 | B. Beck, E. Meyers | 63 | 4 | N | QT | 49.9 | 7-18-39 | 2779 |
| 9aad1 | SE NE NE 9 | Ed. Ollinberger | 119 | 4 | D,S | QT | 116.7 | 7-14-39 | 2855 |
| 10ddd1 | SE SE SE 10 | R. B. Frantz | 156 | | D,S | QT | 150.8 | 7-18-39 | 2866 |
| 11cda1 | SW SE NE 11 | Harold James | 332 | 16 | Ir | QT | 160 | - -59 | |
| 11ddc1 | SW SE SE 11 | do. | 180 | 5 | D,S | QT | 164.6 | 7-18-39 | 2873 |
| 12ddd1 | SE SE SE 12 | Ed Kliewer | 186 | | D,S | QT | 181.9 | 7-18-39 | 2876 |
| 16aad1 | SE NE NE 16 | E. D. Bartel | 135 | 4 | N | QT | 131.5 | 7-18-39 | 2854 |
| 18aaa1 | NE NE NE 18 | J. F. Duff | 111 | 5 | D,S | QT | 93.1 | 7-18-39 | 2822 |
| 20cbb1 | NW NW SW 20 | Bryan | 181 | 6⅝ | D,S | QT | 142 | - -50 | |
| 20dad1 | SE NE SE 20 | Griff Sumrall | 165 | 6 | D,S | QT | 144.3 | 8- 7-39 | 2871 |
| 21aaa1 | NE NE NE 21 | J. W. Ollenberger | 164 | | D,S | QT | 138.3 | 8- 7-39 | 2859 |
| 22dcd1 | SE SW SE 22 | ——— | | | | QT | 182.7 | 8-10-56 | |
| 23ccb1 | NW SW SW 23 | S. J. Ballard | 194 | | N | QT | 182.9 | 8- 7-39 | 2891 |
| 24bba1 | NE NW NW 24 | H. P. Kliewer | 219 | 6 | N | QT | 188.8 | 7-14-39 | 2888 |
| 25aba1 | NE NW NE 25 | do. | 210 | 6 | D,S | QT | 192.6 | 8- 7-39 | 2887 |
| 26aaa1 | NE NE NE 26 | Ora May Farm | 458 | | T | R | | | |
| 27ccc1 | SW SW SW 27 | Mamie Speer | 216 | 4 | D,S | QT | 202.0 | 8- 7-39 | 2917 |
| 30aaa1 | NE NE NE 30 | W. C. Bryan | 187 | 5 | D,S | QT | 147.2 | 8- 8-39 | 2880 |
| 32bbb1 | NW NW NW 32 | P. G. Bartel | 211 | 5 | D,S | QT | 179.2 | 8- 8-39 | 2918 |
| **T2N-R22E** | | | | | | | | | |
| 3aba1 | NE NW NE 3 | Ula Wright | 200 | 3 | D,S | QT | 191.3 | 8- 8-39 | 2853 |
| 8bbc1 | SW NW NW 8 | W. H. Cooper | 157 | | N | QT | 144.6 | 8-17-39 | 2828 |
| 9aad1 | SE NE NE 9 | A. M. Blackwelder | 176 | 6 | D,S | QT | 167.4 | 8-17-39 | 2855 |
| 11aaa1 | NE NE NE 11 | C. S. Pugh | 158 | | N | QT | 150.9 | 8-17-39 | 2811 |
| 14dcb1 | NW SW SE 14 | W. M. Deck | 379 | | Ir | QT | 110 | - -56 | |
| 16ddd1 | SE SE SE 16 | Balko School | 175 | 6 | Ps | QT | 162.8 | 11-28-39 | 2840 |
| 17cdd1 | SE SE SW 17 | Milton Newfield | 157 | 4 | D,S | QT | 149.9 | 8-17-39 | 2851 |
| 21cbb1 | NW NW SW 21 | R. W. Crowell | 130 | | S | QT | 126.2 | 7-14-39 | 2810 |
| 22bbb1 | NW NW NW 22 | Les Moorehead | 184 | | D | QT | 166.3 | 8-17-39 | 2843 |
| 23aba1 | NE NW NE 23 | do. | 250 | 16 | Ir | QT | 90 | - -50 | |
| 23abb1 | NW NW NE 23 | John Lawson | 117 | | D | QT | 98.6 | 8-17-39 | 2768 |
| 23abb2 | NW NW NE 23 | W. M. Deck | 115 | 8 | D,S | QT | 92 | - -50 | |
| 25aaa1 | NE NE NE 25 | ——— | 135 | | N | QT | 121.9 | 8-10-56 | |
| 26aaa1 | NE NE NE 26 | F. E. Phelps | 160 | | D,S | QT | 153.1 | 8-10-39 | 2820 |
| 31aaa1 | NE NE NE 31 | Federal Land Bank | 135 | | D,S | QT | 131.0 | 8-16-39 | 2876 |
| 31ddb1 | NW SE SE 31 | Nanie Huguley | 204 | 4¾ | D,S | QT | 197.6 | 8-16-39 | 2885 |
| 33ada1 | NE SE NE 33 | G. R. Case | 163 | | D,S | QT | 158.3 | 8-10-39 | 2840 |
| **T2N-R23E** | | | | | | | | | |
| 4dad1 | SE NE SE 4 | A. G. Seal | 43 | 44 | D,S | QT | 38.8 | 8-25-39 | 2668 |
| 6ccb1 | NW SW SW 6 | S. W. Kachel | 142 | 5½ | D,S | QT | 134.7 | 8-25-39 | 2789 |
| 9ddd1 | SE SE SE 9 | J. I. Jones | 27 | 5 | S | QT | 19.1 | 8-25-39 | 2646 |
| 10ddd1 | SE SE SE 10 | T. N. Groendyke | 55 | 4 | N | QT | 15.5 | 8-26-39 | 2623 |
| 13cbb1 | NW NW SW 13 | Nancy Cates | 53 | 14 | Ir | QT | 14.2 | 5-27-50 | |
| 13cbb2 | NW NW SW 13 | do. | 180 | 5 | N | QT | | | |
| 13dad1 | SE NE SE 13 | E. A. Ellis | 26 | 5 | D | QT | 22.8 | 8-26-39 | 2597 |
| 13dad2 | SE NE SE 13 | U. S. Geol. Survey | 14 | 1¼ | N | A | 8.8 | 10-29-46 | 2582 |
| 14baa1 | NE NE NW 14 | Forrest Yates | 23 | 6 | D,S | QT | 17.8 | 8-26-39 | 2620 |
| 16adc1 | SW SE NE 16 | R. W. Harrison | | 3 | S | QT | 26.3 | 10- 8-40 | 2658 |
| 18dcd1 | SE SW SE 18 | G. B. Lawson Estate | 152 | 6 | N | QT | 146.7 | 8-25-39 | 2803 |
| 21cbb1 | NW NW SW 21 | Wm. H. Jones | 85 | | N | QT | 79.2 | 8-25-39 | 2720 |
| 23bba1 | NE NW NW 23 | A. B. Ellis | 78 | | S | QT | 68.8 | 8-26-39 | 2679 |
| 25aaa1 | NE NE NE 25 | Alben | 140 | 6 | | QT | 119.7 | 11-25-38 | 2713 |
| 26ccd1 | SE SW SW 26 | W. A. Cates | 121 | | S | QT | 118.0 | 8-26-39 | 2745 |
| 33bba1 | NE NW NW 33 | O. E. Montgomery | 166 | 4 | S | QT | 156.0 | 8-26-39 | 2802 |
| 34ddd1 | SE SE SE 34 | Frank Langley | 144 | | D,S | QT | 136.2 | 8-26-39 | 2801 |
| 36aaa1 | NE NE NE 36 | Theodore Pruett | 150 | 4 | S | QT | 132.5 | 11-29-39 | 2743 |
| **T2N-R24E** | | | | | | | | | |
| 1aba1 | NE NW NE 1 | S. L. Woodbury | 132 | | S | QT | 125.1 | 8-31-39 | 2658 |
| 3bbb1 | NW NW NW 3 | G. W. Robinson | 27 | 5 | D,S | QT | | | 2377 |
| 4ccc1 | SW SW SW 4 | David & Minnie Hodson | 59 | 4 | D,S | QT | 26.0 | 8- 3-38 | 2562 |
| 4ddc1 | SW SE SE 4 | G. W. Robinson | 22 | 30 | Ir | QT | 13.9 | 9- 1-39 | 2534 |
| 6aab1 | NW NE NE 6 | E. A. Ellis | 75 | 5 | D,S | QT | 65.7 | 10-12-39 | 2637 |
| 6ddd1 | SE SE SE 6 | A. G. Kile | 49 | 5 | D,S | QT | 47.5 | 9- 1-39 | 2609 |
| 7ccd1 | SE SW SW 7 | J. W. Parker | 94 | 6 | S | QT | 76.8 | 5-15-46 | |
| 9cdc1 | SE SW SE 9 | L. Sprague Estate | 88 | 4 | D,S | QT | 72.8 | 9- 1-39 | 2615 |
| 11aab1 | NW NE NE 11 | Jim Bridges | 188 | 4½ | D,S | QT | 183.0 | 8-31-39 | 2713 |
| 11dda1 | NE SE SE 11 | Albert Bass | 153 | 4½ | D,S | QT | 145.6 | 8-31-39 | 2676 |
| 13aaa1 | NE NE NE 13 | W. E. Bass | 103 | 4½ | S | QT | 78.0 | 8-31-39 | 2604 |
| 15dcc1 | SW SW SE 15 | V. M. Partridge | 108 | 5 | N | QT | 95.1 | 8-31-39 | 2647 |
| 17acc1 | SW SW NE 17 | H. L. Bass | 300 | | T | QT | 32 | - -50 | |

| WELL NUMBER[1] | LOCATION | OWNER OR NAME | DEPTH (FT.) | DIAMETER (IN.) | USE OF WATER[2] | PROBABLE AQUIFER[3] | WATER LEVEL: DEPTH BELOW LAND SURFACE (FT.) | WATER LEVEL: DATE OF MEASUREMENT | ALTITUDE OF LAND SURFACE (FT.) |
|---|---|---|---|---|---|---|---|---|---|
| **T2N-R24E** (cont.) | | | | | | | | | |
| 18bbb1 | NW NW NW 18 | Elmwood School | 44 | | Ps | QT | 37.7 | 8- 2-38 | 2614 |
| 19bbc1 | SW NW NW 19 | Anton Maschino | 56 | 5 | T | | 27 | - -40 | |
| 24cbb1 | NW NW SW 24 | A. L. Evans | 228 | 4½ | D,S | QT | 187.5 | 8-30-39 | 2722 |
| 24cd | SE SW 24 | Northern Nat. Gas Co. No. 1 | 312 | 10¾ | In | QT | | | |
| 24cd | SE SW 24 | do. No. 2 | 317 | 10¾ | In | QT | | | |
| 24cd | SE SW 24 | do. No. 3 | 320 | 10 | In | QT | 221 | - -56 | |
| 27ccc1 | SW SW SW 27 | Federal Life Insurance Co. | 148 | | N | QT | 137.6 | 8-31-39 | 2760 |
| 28bbc1 | SW NW NW 28 | Alliance Insurance Co. | 136 | 6⅝ | D,S | QT | 105.4 | 8-31-39 | 2674 |
| 31ccb1 | NW SW SW 31 | F. S. Flynn | 57 | 4½ | S | QT | 49.2 | 8- 3-38 | 2669 |
| 33ccd1 | SE SW SW 33 | G. Hoggendon | 210 | 4 | D,S | QT | 188.2 | 8-30-39 | 2779 |
| 34aab1 | NW NE NE 34 | Maude Bridges | 106 | 4 | N | QT | 73.7 | 8-31-39 | 2706 |
| **T2N-R25E** | | | | | | | | | |
| 1dda1 | NE SE SE 1 | J. E. Nelson | 72 | 6 | N | QT | 53.7 | 9-11-39 | |
| 2bad1 | SE NE NW 2 | L .A. Eyer | 87 | 16 | Ir | QT | 10 | - -45 | |
| 3dda1 | NE SE SE 3 | D. T. & A. H. Redimer | 32 | | S | QT | 28.3 | 9- 9-39 | 2527 |
| 4bcb1 | NW SW NW 4 | Otto Barby | 94 | 6 | N | QT | 85.9 | 9- 9-39 | 2592 |
| 6cdd1 | SE SE SW 6 | S. T. Woodbury | 165 | 6 | S | QT | 136.2 | 9- 9-39 | |
| 9ada1 | NE SE NE 9 | Lloyd Barby | 25 | | S | QT | 21.4 | 9- 9-39 | 2516 |
| 9bbc1 | SW NW NW 9 | Hibbs School | 135 | 6 | Ps | QT | 103.8 | 9- 9-39 | 2613 |
| 12aba1 | NE NW NE 12 | H. B. Wright | 89 | | S | QT | 82.6 | 9-11-39 | 2591 |
| 13cdc1 | SW SE SW 13 | F. E. Millikon | 195 | 5 | D,S | QT | 188.4 | 9-11-39 | 2699 |
| 17bbc1 | SW NW NW 17 | Walter Davis | 100 | 5 | D,S | QT | 82.6 | 9- 9-39 | 2603 |
| 19aad1 | SE NE NE 19 | Fred Reiswig | 91 | 5½ | N | QT | 81.4 | 9- 9-39 | 2606 |
| 19aad2 | SE NE NE 19 | do. | 205 | 16 | Ir | QT | 84.4 | 2-19-53 | |
| 20ccd1 | SE SW SW 20 | do. | 108 | 4½ | S | QT | 87.2 | 8-31-39 | 2610 |
| 26ddc1 | SW SE SE 26 | J. G. Burditt | 247 | | D,S | QT | 229.5 | 9-11-39 | 2716 |
| 28aab1 | NW NE NE 28 | B. M. Kelly | 197 | 5 | D,S | QT | 185.0 | 9- 9-39 | 2692 |
| 30bab1 | NW NE NW 30 | L. G. Pierson | 140 | 5 | S | QT | 135.8 | 8-31-39 | |
| 32daa1 | NE NE SE 32 | Ida L. Staples | 220 | | D,S | QT | 215.7 | 9- 9-39 | 2741 |
| 34cbb1 | NW NW SW 34 | S. I. Spaulding | 197 | 5 | D,S | QT | 178.8 | 9-11-39 | 2702 |
| **T2N-R26E** | | | | | | | | | |
| 4cbc1 | SW NW SW 4 | O. C. Kleppner | 89 | 4 | S | QT | 84.4 | 5-31-40 | 2520 |
| 9bcd1 | SE SW NW 9 | Wilbur Petty | 61 | 6 | N | QT | 51.0 | 5-17-40 | 2489 |
| 10aba1 | NE NW NE 10 | Ralph Barby | 95 | 3 | D,S | QT | 91.1 | 5-17-40 | 2515 |
| 12aaa1 | NE NE NE 12 | Nelson | 47 | 8 | N | QT | 17.2 | 11-15-52 | |
| 12baa1 | NE NE NW 12 | Olive Blumer | 35 | | D | QT | 27.5 | 5-17-40 | 2437 |
| 13cbd1 | SE NW SW 13 | H. W. Henry | 93 | 4 | D,S | QT | 79.0 | 5-17-40 | 2482 |
| 16ddc1 | SW SE SE 16 | H. A. Henry | 125 | 5 | D,S | QT | 117.8 | 5-31-40 | |
| 18bab1 | NW NE NW 18 | F. L. Bayliff | 193 | 5 | D,S | QT | 177.6 | 9-11-39 | 2641 |
| 20bcc1 | SW SW NW 20 | C. Neff | 102 | 4 | S | QT | 94.6 | 5-31-40 | 2552 |
| 21ddd1 | SE SE SE 21 | J. F. Hosler | 150 | 5¾ | D,S | QT | 143.7 | 4- 5-40 | 2580 |
| 24dcc1 | SW SW SE 24 | ——— | 71 | 5 | N | QT | 44.2 | 2-21-51 | 2451 |
| 26aaa1 | NE NE NE 26 | P. B. Perkins | 72 | 5½ | S | QT | 62.1 | 10-16-39 | 2473 |
| 30ccd1 | SE SW SW 30 | J. G. Burditt | 205 | 4½ | S | QT | 198.1 | 5-31-40 | |
| 32daa1 | NE NE SE 32 | Pete McDaniels | 120 | 5 | D | QT | 95.0 | 5-31-40 | 2543 |
| 34ada1 | NE SE NE 34 | E. L. Donnell | 68 | 6 | N | QT | 62.0 | 5-31-40 | 2492 |
| **T2N-R27E** | | | | | | | | | |
| 2aad1 | SE NE NE 2 | G. T. Whitaker | 11 | 30 | S | A | 8.9 | 6- 4-40 | |
| 2aad2 | SE NE NE 2 | A. V. Whitaker | 82 | 16 | Ir | QT | | | |
| 6cad1 | SE NE SW 6 | J. E. Nelson | 75 | | D,S | QT | 13.5 | 5-17-40 | 2396 |
| 9abd1 | SE NW NE 9 | ——— | 30 | 6 | N | R | 9.0 | 10-22-52 | 2339 |
| 9dcc1 | SW SW SE 9 | F. P. Thorne | 31 | 6 | D | A | 18.6 | 6- 4-40 | 2314 |
| 12aaa1 | NE NE NE 12 | General Amer. Life Ins. Co. | 19 | 22 | S | A | 13.1 | 6-11-40 | 2271 |
| 12ccc1 | SW SW SW 12 | ——— | | 5 | N | R | 33.3 | 11- 6-52 | |
| 13ddc1 | SW SE SE 13 | Hazel Yates | 121 | 6 | N | QT | 101.2 | 6-11-40 | 2404 |
| 13ccd1 | SE SW SW 13 | ——— | 63 | 6 | N | QT | 26.2 | 11- 6-52 | |
| 15aba1 | NE NW NE 15 | John Miles | 24 | 6 | D,S | A | 13.2 | 6- 4-40 | 2301 |
| 15bcd1 | SE SW NW 15 | Roy H. Schukar | 70 | 18 | Ir | QT | 10.0 | 9- ?-52 | |
| 18add1 | SE SE NE 18 | V. M. Davis | 24 | 6 | D,S | QT | 12.2 | 6- 4-40 | 2385 |
| 21ddd1 | SE SE SE 21 | State Life Insurance Co. | 56 | 5½ | S | QT | 30.7 | 11-12-40 | 2357 |
| 22aab1 | NW NE NE 22 | ——— | 42 | 5 | S | QT | 30.1 | 10-28-52 | 2346 |
| 26ddd1 | SE SE SE 26 | Federal Land Bank | 45 | | D | QT | 33.5 | 6- 5-40 | 2459 |
| 27aab1 | NW NE NE 27 | Ray Anderson | 68 | 5½ | D,S | QT | 56.1 | 4- 5-40 | 2411 |
| 28bcc1 | SW SW NW 28 | W. G. Alexander | 30 | 16 | Ir | QT | 16 | - -54 | |
| 29dbc1 | SW NW SE 29 | J. H. Jett | 96 | 18 | Ir | QT | 21 | - -59 | |
| 29dcc1 | SW SW SE 29 | do. | 57 | 18 | Ir | QT | 9 | - -46 | 2341 |
| 32cdc1 | SW SE SW 32 | do. | 48 | 5 | N | QT | 44.1 | 6- 5-40 | 2296 |
| 35bbd1 | SE NW NW 35 | J. W. Baldwin | 296 | 16 | Ir | QT | 60 | - -52 | 2507 |
| **T2N-R28E** | | | | | | | | | |
| 3ada1 | NE SE NE 3 | ——— | 12 | 90 | N | A | 7.8 | 8-14-46 | |
| 9bab1 | NW NE NW 9 | Maude Bryan | 124 | 18 | N | QT | 51.6 | 6-11-40 | 2361 |
| 10bbb | NW NW NW 10 | M. E. McGregory | 10 | 66 | D | A | 5.8 | 4- 5-40 | 2281 |
| 11add1 | SE SE NE 11 | Adolph Heinz | 49 | 6 | D,S | QT | 28.2 | 6-10-40 | 2352 |
| 17dab1 | NW NE SE 17 | Charles Roberts | 14 | 5 | S | QT | 8.7 | 6-11-40 | 2349 |
| 20ccc1 | SW SW SW 20 | M. N. White | 97 | 5 | S | QT | 53.2 | 6-10-40 | 2398 |
| 26aac1 | SW NE NE 26 | J. H. Thompson | 115 | 6 | D,S | QT | 104.2 | 6- 7-40 | 2410 |
| 27baa1 | NE NE NW 27 | C. L. Eades | 86 | 6 | D | QT | 46.9 | 6-11-40 | 2407 |
| **T3N-R20E** | | | | | | | | | |
| 5aab1 | NW NE NE 5 | E. A. Wilkerson | 115 | 5 | D,S | QT | 105.8 | 7-27-38 | 2750 |
| 7dad1 | SE NE SE 7 | A. H. G. Jones | 128 | 5 | N | QT | 104.3 | 6-28-40 | 2739 |
| 9bba1 | NE NW NW 9 | W. G. Miller | 108 | 4 | D,S | QT | 97.6 | 6-29-40 | 2717 |
| 10aba1 | NE NW NE 10 | Lester Pyle | 115 | | S | QT | 94.6 | 7-27-38 | 2690 |
| 12cba1 | NE NW SW 12 | Corps of Engrs., US Army | 24 | 4 | N | QT | 23.2 | 4- 8-40 | 2575 |
| 22aab1 | NW NE NE 22 | T. H. Printz | 17 | 12 | S | A | 13.2 | 6-29-40 | 2573 |
| 23ccb1 | NW SW SW 23 | Trimmell Brothers | 20 | 48 | S | A | 17.0 | 7-11-39 | 2579 |
| 34ccd1 | SE SW SW 34 | J. H. Pierce | 75 | 6 | S | R | 46.8 | 7-11-39 | 2647 |
| 34ddc1 | SW SE SE 34 | J. M. Buchanan | 54 | | S | R | 37.7 | 7-11-39 | 2668 |
| **T3N-R21E** | | | | | | | | | |
| 1aca1 | NE SE NE 1 | L. C. Smith | 66 | 4½ | N | | 68.7 | 7-14-39 | 2690 |
| 2adb1 | NW SE NE 2 | J. L. Bobbitt | 112 | 6 | S | R | 54.9 | 7-12-39 | 2667 |
| 3bad1 | SE NE NW 3 | C. E. Husted | 103 | 4 | N | R | 89.3 | 7-12-39 | 2667 |
| 4bab1 | NW NE NW 4 | Jennie Savage | 15 | 6 | N | A | 10.3 | 7-12-39 | 2557 |

| Well number[1] | Location | Owner or name | Depth (ft.) | Diameter (in.) | Use of water[2] | Probable aquifer[3] | Water level: Depth below land surface (ft.) | Water level: Date of measurement | Altitude of land surface (ft.) |
|---|---|---|---|---|---|---|---|---|---|
| **T3N-R21E** (cont.) | | | | | | | | | |
| 4cdd1 | SE SE SW 4 | W. E. Husted | 70 | | N | R | 48.7 | 7-11-39 | 2616 |
| 7bad1 | SE NE NW 7 | W. W. Abell | 23 | 4½ | S | A | 17.4 | 7-11-39 | |
| 8bcc1 | SW SW NW 8 | J. F. Wilkerson | 92 | 4½ | D,S | R | 63.3 | 7-13-39 | 2677 |
| 12ddd1 | SE SE SE 12 | A. L. Buzzard | 52 | 4 | N | QT | 34.5 | 8-21-39 | 2708 |
| 19cdc1 | SW SE SW 19 | G. H. Law | 115 | | S | R | 81.6 | 7-11-39 | 2700 |
| 21aaa1 | NE NE NE 21 | Pleasant Valley School | 57 | 4½ | N | QT | 53.0 | 7-13-39 | 2723 |
| 21cba1 | NE NW SW 21 | M. A. Bayer | 54 | | S | QT | 49.5 | 7-13-39 | 2725 |
| 25bcb1 | NW SW NW 25 | J. W. Cardorph | 91 | | N | QT | 81.6 | 7-13-39 | 2764 |
| 27ddd1 | SE SE SE 27 | B. B. Kennedy | 60 | | D,S | QT | 56.0 | 7-13-39 | 2758 |
| 30aaa1 | NE NE NE 30 | F. B. Whittet | 81 | 6 | D,S | QT | 71.9 | 7-13-39 | 2759 |
| 34bbb1 | NW NW NW 34 | M. Winter | 110 | 5 | D,S | QT | 66.5 | 7-13-39 | 2793 |
| **T3N-R22E** | | | | | | | | | |
| 3cca1 | NW SW SW 3 | Harry Jackson | 63 | 5 | N | QT | 31 | - -40 | |
| 5dba1 | NE NW SE 5 | Sonny Williams | 16 | 4 | N | QT | 9.2 | 8-19-39 | 2600 |
| 11acd1 | SE SW NE 11 | H. C. Brinkman | 82 | 5 | N | QT | 30 | - -40 | |
| 11bbb1 | NW NW NW 11 | Lulu Pittman | 47 | 4½ | N | QT | 42.8 | 8-19-39 | 2660 |
| 14daa1 | NE NE SE 14 | W. J. Phelps | 50 | 5 | D,S | QT | 41.0 | 8-18-39 | 2620 |
| 17ccc1 | SW SW SW 17 | L. Boileau | 130 | | D,S | R | 73.1 | 8-21-39 | 2713 |
| 21aba1 | NE NW NE 21 | M. E. Huck | 116 | | N | QT | 98.2 | 8-21-39 | 2753 |
| 27bcc1 | SW SW NW 27 | R. O. Renfrew & Co. | 175 | | N | QT | 163.8 | 8-17-39 | 2821 |
| 32baa1 | NE NE NW 32 | Central Life Assurance Co. | 136 | | D,S | QT | 132.5 | 8-17-39 | 2801 |
| 35add1 | SE SE NE 35 | do. | 118 | | N | QT | 114.3 | 8-17-39 | 2771 |
| **T3N-R23E** | | | | | | | | | |
| 1cda1 | NE SE SW 1 | May Willis | 122 | 5 | D,S | R | 76 | 8-24-39 | 2598 |
| 3bcc1 | SW SW NW 3 | A. S. Brown | 138 | 5 | D,S | R | 81.9 | 8-24-39 | 2585 |
| 6dcd1 | SE SW SE 6 | ——— | 86 | | N | | 77.8 | 8-10-56 | |
| 7aad1 | SE NE NE 7 | Lloyd Benger | 78 | | N | QT | 62.8 | 8-24-39 | 2650 |
| 9aab1 | NW NE NE 9 | Gus Spangler | 52 | 5 | D,S | R | 30.4 | 8-23-39 | 2573 |
| 16dad1 | SE NE SE 16 | A. L. Reddick | 44 | 5 | D | R | 22.7 | 8-25-39 | 2652 |
| 18bba1 | NE NW NW 18 | W. H. Thomas | 110 | | S | QT | 99.9 | 8-18-39 | 2684 |
| 21cdd1 | SE SE SW 21 | R. A. Broadfoot | 84 | 4¾ | D,S | R | 34.7 | 8-24-39 | 2688 |
| 25bba1 | NE NW NW 25 | E. T. Venable | 155 | | N | | 144.9 | 8-24-39 | 2747 |
| 27bbb1 | NW NW NW 27 | Beaver County | 111 | 4 | N | R | 60.9 | 8-24-39 | 2719 |
| 30daa1 | NE NE SE 30 | W. F. Welch | 57 | 5 | N | QT | 53.6 | 8-18-39 | 2703 |
| 31aab1 | NW NE NE 31 | do. | 83 | 4 | D,S | QT | 70.6 | 8-18-39 | 2719 |
| 31cdc1 | SW SE SW 31 | School Land | 143 | 4 | D,S | QT | 134.5 | 8-18-39 | 2786 |
| 34daa1 | NE NE SE 34 | Albert Seal | 196 | 5 | D,S | QT | 181.4 | 8-25-39 | 2800 |
| 35daa1 | NE NE SE 35 | R. McNut | 110 | | S | QT | 104.1 | 8- 3-38 | 2721 |
| 36aac1 | SW NE NE 36 | J. A. Barker | 81 | 4 | N | QT | 72.4 | 8- 2-38 | 2660 |
| **T3N-R24E** | | | | | | | | | |
| 2bbb1 | NW NW NW 2 | A. T. Pittman | 82 | 5 | D,S | R | 20.5 | 9-23-39 | 2419 |
| 4bac1 | SW NE NW 4 | do. | 52 | 4¾ | S | R | 24.8 | 9- 2-39 | 2508 |
| 7ccd1 | SE SW SW 7 | E. D. Boston | 82 | | S | QT | 56.3 | 8- 2-38 | 2647 |
| 7daa1 | NE NE SE 7 | T. T. Yarnold | 141 | 5 | S | QT | 92.4 | 8- 2-38 | 2620 |
| 8dda1 | NE SE SE 8 | Angel Gettings | 41 | 5 | D,S | R | 24.2 | 9- 2-39 | 2537 |
| 10bbb1 | NW NW NW 10 | A. T. Pittman | 50 | 5½ | S | R | 39.5 | 9- 2-39 | 2488 |
| 16aab1 | NW NE NE 16 | V. E. Wilmuth Estate | 83 | 5½ | S | R | 54.8 | 9- 1-39 | 2529 |
| 19ccc1 | SW SW SW 19 | A. L. Brake | 113 | 5 | N | QT | 107.3 | 8- 2-38 | 2702 |
| 20ddd1 | SE SE SE 20 | J. E. Wilson | 96 | 5 | S | R | 44.7 | 9- 1-39 | 2604 |
| 22ccc1 | SW SW SW 22 | L. C. Starcher | 81 | 5 | D,S | R | 45.4 | 9- 1-39 | 2532 |
| 24aba | NE NW NE 24 | J. G. Krouse | 210 | 5 | S | R | 134.2 | 9- 6-39 | 2625 |
| **T3N-R25E** | | | | | | | | | |
| 1add1 | SE SE NE 1 | Otto Barby and others | 130 | 6 | N | QT | 119.4 | 8- 4-38 | 2460 |
| 2ccc1 | SW SW SW 2 | Jewell Bennett | 121 | 6 | D,S | QT | 110.0 | 9- 7-39 | 2457 |
| 3bbb1 | NW NW NW 3 | C. W. McDaniel | 121 | 6 | D,S | QT | 85.1 | 9- 7-39 | 2446 |
| 4caa1 | NE NE SW 4 | W. D. Hall | 59 | 5¾ | S | R | 37.6 | 9- 8-39 | 2423 |
| 9aad1 | SE NE NE 9 | Jay Bennett | 123 | 5 | D,S | R | 61.3 | 11-29-39 | 2490 |
| 11acb1 | NW SW NE 11 | Ralph Ridgeway | 16 | 6 | N | | 10.1 | 8- 4-38 | 2447 |
| 12ccd1 | SE SW SW 12 | N. J. Mosburg | 94 | 5½ | N | QT | 62.8 | 8- 4-38 | 2491 |
| 15dcc1 | SW SW SE 15 | L. D. Wood | 49 | 4½ | N | QT | 39.8 | 9- 8-39 | 2522 |
| 17dcc1 | SW SW SE 17 | E. D. Hendricks | 24 | 5½ | N | R | 21.1 | 9- 8-39 | 2501 |
| 18aad1 | SE NE NE 18 | Nella D. Mason | 12 | 5¾ | N | R | 8.3 | 9- 8-39 | 2488 |
| 19ccc1 | SW SW SW 19 | I. H. Shadden | 25 | 5 | D | R | 19.2 | 9- 8-39 | 2528 |
| 22aaa1 | NE NE NE 22 | Barby Ranch | 40 | 6 | S | QT | 32.0 | 6- 1-40 | 2511 |
| 26cbd1 | SE NW SW 26 | do. | 45 | 5 | S | QT | 27.3 | 9- 8-39 | 2511 |
| 30ddd1 | SE SE SE 30 | I. H. Shadden | 94 | 5 | N | QT | 87.9 | 9- 8-39 | 2628 |
| 31aba1 | NE NW NE 31 | do. | 150 | 6 | S | QT | 42.5 | 9- 8-39 | 2582 |
| 33aaa1 | NE NE NE 33 | ——— | | | | | 95.2 | 8-10-56 | |
| 33daa1 | NE NE SE 33 | C. V. Conner | 119 | | D,S | QT | 114.4 | 9- 8-39 | 2605 |
| 36abb1 | NW NW NE 36 | J. C. Burns | 14 | 5½ | N | QT | 8.7 | 9- 8-39 | 2485 |
| **T3N-R26E** | | | | | | | | | |
| 3baa1 | NE NE NW 3 | Barby Ranch | 85 | 6 | N | QT | 39.8 | 11-18-52 | |
| 3dca1 | NE SW SE 3 | do. | 30 | 6 | N | QT | 10.0 | 11-17-52 | |
| 6aab1 | NW NE NE 6 | W. J. Overton | 103 | 6 | N | QT | 93.3 | 10-14-39 | 2422 |
| 6bcc1 | SW SW NW 6 | Barby Ranch | 134 | 6 | S | QT | 126.5 | 4- 1-39 | 2466 |
| 7ada1 | NE SE NE 7 | Ralph Ridgeway | 31 | 5 | D,S | QT | 13.1 | 10-26-53 | 2368 |
| 8bad1 | SE NE NW 8 | do. | 18 | 5 | N | A | 10.7 | 10-19-53 | |
| 8ddc1 | SW SE SE 8 | State of Oklahoma | 134 | 6 | N | QT | 72.2 | 8- 4-38 | 2435 |
| 10aab1 | NW NE NE 10 | G. H. Button | 44 | 6 | S | QT | 28.0 | 8- 4-38 | 2369 |
| 11dcc1 | SW SW SE 11 | Otto Barby | 87 | 6 | S | QT | 57.7 | 6- 1-40 | 2350 |
| 12bba1 | NE NW NW 12 | Federal Land Bank | 47 | 5 | N | | 40.0 | 8- 4-38 | 2356 |
| 13bac1 | SW NE NW 13 | Bruce Weiser | 11 | 4½ | D | | 7.7 | 6- 1-40 | 2310 |
| 13bac2 | SW NE NW 13 | do. | 47 | | D | R | 18.6 | 6- 1-40 | 2310 |
| 15bbc1 | SW NW NW 15 | W. Hibbs and others | 145 | | S | QT | 116.8 | 8- 4-38 | 2481 |
| 16aaa1 | NE NE NE 16 | El Paso Natural Gas Co. | 365 | 8½ | In | QT | 121 | - -60 | |
| 18add1 | SE SE NE 18 | do. | 80 | 8½ | In | QT | 50 | - -59 | |
| 21bcb1 | NW SW NW 21 | W. A. Wilkerson | 137 | | D,S | QT | 113.6 | 6- 1-40 | 2532 |
| 22dba1 | NE NW SE 22 | ——— | | 4 | S | QT | 8.8 | 11-20-53 | |
| 23aaa1 | NE NE NE 23 | Frank Webb | 49 | 6 | D | R | 36.8 | 6- 1-40 | 2361 |
| 24aaa1 | NE NE NE 24 | Minneola School | 105 | 5 | Ps | R | 61.9 | 5-31-40 | 2423 |
| 25aaa1 | NE NE NE 25 | M. O. Hester | 50 | 6 | S | QT | 42.9 | 5-31-40 | 2421 |
| 25aab1 | NW NE NE 25 | do. | 375 | | Ir | | 43 | -55 | |

| Well number[1] | Location | Owner or name | Depth (ft.) | Diameter (in.) | Use of water[2] | Probable aquifer[3] | Water level: Depth below land surface (ft.) | Water level: Date of measurement | Altitude of land surface (ft.) |
|---|---|---|---|---|---|---|---|---|---|
| **T3N-R26E (cont.)** | | | | | | | | | |
| 27ada1 | NE SE NE 27 | G. W. Nicholson | 28 | 6 | N | QT | 25.8 | 6- 1-40 | 2411 |
| 29ddd1 | SE SE SE 29 | E. M. Pim | 109 | 5 | D | QT | 98.0 | 4- 5-40 | 2526 |
| 35dad1 | SE NE SE 35 | L. B. Benner | 99 | 6 | S | QT | 89.4 | 5-17-40 | 2499 |
| **T3N-R27E** | | | | | | | | | |
| 4dad1 | SE NE SE 4 | H. H. Richards | 62 | 6 | D | R | 35.5 | 6- 3-40 | 2294 |
| 13aab1 | NW NE NE 13 | B. E. Bozarth | 21 | 6 | D | QT | 19.4 | 6- 4-40 | 2318 |
| 15bab1 | NW NE NW 15 | W. G. Lane | 59 | 6 | S | | 24.2 | 8- 5-38 | 2367 |
| 17adc1 | SW SE NE 17 | Frank Hilderbrand | 61 | | S | | 45.8 | 6- 3-40 | 2405 |
| 19cdd1 | SE SE SW 19 | Ferguson | 210 | | S | QT | | | |
| 20bba1 | NE NW NW 20 | ——— | 62 | 5 | S | QT | 37.7 | 10-17-52 | 2403 |
| 22ada1 | NE SE NE 22 | Frank Hilderbrand | 89 | 6 | N | QT | 80.3 | 6- 3-40 | 2431 |
| 23daa1 | NE NE SE 23 | C. E. Andrews | 31 | 5 | S | QT | 28.8 | 8- 5-38 | 2372 |
| 25acc1 | SW SW NE 25 | C. E. Wells | 113 | 6 | D | R | 14.0 | 9- 5-39 | 2333 |
| 25dbb1 | NW NW SE 25 | do. | 23 | 6 | D,S | QT | 5.3 | 4- 5-40 | 2324 |
| 28ada1 | NE SE NE 28 | Happy Ridge School | 67 | 5½ | N | QT | 62.5 | 6- 3-40 | 2422 |
| 29aaa1 | NE NE NE 29 | F. P. Thorne | 84 | | D,S | QT | 69.6 | 6- 3-40 | 2441 |
| 30dac1 | SW NE SE 30 | ——— | 97 | 6 | N | QT | 78.2 | 11-20-52 | |
| 32cdc1 | SW SE SW 32 | Barby Ranch | 83 | 5¾ | N | QT | 45.4 | 10-18-52 | 2443 |
| 33acd1 | SE SW NE 33 | C. R. Nelson | 100 | | Ir | QT | 30 | - -54 | |
| 33ddd1 | SE SE SE 33 | Leon Courtney | 24 | 6 | S | QT | 12.7 | 6- 3-40 | 2362 |
| **T3N-R28E** | | | | | | | | | |
| 3ada1 | NE SE NE 3 | A. E. Sharp | 86 | 6 | N | QT | 81.8 | 8- 5-38 | 2275 |
| 3bcc1 | SW SW NW 3 | C. G. & W. A. Sawin | 45 | 6 | N | QT | 39.3 | 8- 5-38 | 2286 |
| 5aab1 | NW NE NE 5 | M. E. Killough | 93 | 6 | D,S | QT | 84.5 | 8- 5-38 | 2301 |
| 8ccc1 | SW SW SW 8 | Barby Ranch | 64 | 4 | S | QT | 44.2 | 10-17-52 | |
| 9aaa1 | NE NE NE 9 | N. W. Johnson | 116 | 6 | N | | 111.8 | 8- 5-38 | 2319 |
| 10dca1 | NE SW SE 10 | Carlile | 68 | 6 | S | QT | 55 | - -46 | |
| 16cdc1 | SW SE SW 16 | J. G. Coffman | 42 | 6 | S | QT | 16.6 | 6- 4-40 | 2290 |
| 17aaa1 | NE NE NE 17 | State of Oklahoma | 107 | 6 | D,S | QT | 103.6 | 6-11-40 | 2378 |
| 26aaa1 | NE NE NE 26 | ——— | 114 | 3 | N | R | 42.2 | 11- 7-52 | |
| 26bbc1 | SW NW NW 26 | Albert Carlile | 35 | 18 | N | A | | | |
| 28ccd1 | SE SW SW 28 | Federal Land Bank | 31 | 5½ | N | A | 11.7 | 6- 8-40 | 2234 |
| 30bbc1 | SW NW NW 30 | ——— | 52 | 6 | N | R | 31.7 | 8-27-46 | |
| 30daa1 | NE NE SE 30 | Tom Hawes | 31 | 6 | D,S | QT | 27.2 | 6- 8-40 | 2301 |
| 32aaa1 | NE NE NE 32 | J. D. Foresman | 30 | 5 | N | R | 15 | - -40 | |
| 33adc1 | SW SE NE 33 | E. B. Sitton | 42 | 6 | S | R | 26.4 | 6- 8-40 | 2243 |
| 34dda1 | NE SE SE 34 | E. C. Slaven | 26 | | S | QT | 14.1 | 6- 8-40 | 2246 |
| **T4N-R20E** | | | | | | | | | |
| 1aab1 | NW NE NE 1 | George Weiss | 103 | 4½ | D,S | QT | 95.1 | 6-27-40 | 2692 |
| 5cdc1 | SW SE SW 5 | E. J. Young | 133 | 5 | D,S | QT | 127.5 | 6-28-40 | 2784 |
| 7cbb1 | NW NW SW 7 | J. A. Rodgers | 140 | 6 | D,S | QT | 126.8 | 6-28-40 | 2797 |
| 10cbb1 | NW NW SW 10 | J. A. Ellexson | 142 | 4½ | D,S | QT | 132.2 | 6-27-40 | 2766 |
| 11dda1 | NE SE SE 11 | Jasper Martin | 120 | 5 | D,S | QT | 82.0 | 6-27-40 | 2701 |
| 17cbb1 | NW NW SW 17 | Mrs. Roy Stickler | | | D,S | QT | 109.2 | 6-28-40 | 2764 |
| 18bab1 | NW NE NW 18 | Lulu Randles | 150 | 6 | D,S,Ir | QT | 130 | - -36 | |
| 22cdd1 | SE SE SW 22 | L. H. Donley | 131 | 6 | D,S | QT | 123.0 | 4- 8-40 | 2753 |
| 25bab1 | NW NE NW 25 | L. G. Brown | 152 | 5 | S | QT | 130.9 | 11-17-40 | 2740 |
| 29bcc1 | SW SW NW 29 | C. D. Parmelee | 127 | 5 | D,S | QT | 112.6 | 6-29-40 | 2769 |
| 32add1 | SE SE NE 32 | W. B. Morris | 110 | | N | QT | 100.2 | 7-27-38 | 2747 |
| 36aca1 | NE SW NE 36 | Blakemore Brothers | 47 | 5 | D,S | QT | 26.8 | 10-29-40 | 2582 |
| **T4N-R21E** | | | | | | | | | |
| 1aac1 | SW NE NE 1 | George Plett | 145 | 5 | S | R | 129.2 | 8-19-40 | 2664 |
| 2bbb1 | NW NW NW 2 | John Plett | 153 | | D,S | QT | 126.4 | 8-19-40 | 2669 |
| 5cdd1 | SE SE SW 5 | A. E. Sharp | 142 | 5 | S | QT | 121.0 | 10-23-40 | 2684 |
| 19ccd1 | SE SW SW 19 | J. F. Hightower | 24 | 4½ | S | QT | 18.6 | 6-27-40 | 2614 |
| 21bb | NW NW 21 | Lloyd Brown | 102 | 5 | N | R | 44 | - -40 | |
| 24dcc1 | SW SW SE 24 | Central Life Assurance Co. | 57 | 5 | S | R | 37.2 | 7-12-39 | 2568 |
| 26ddd1 | SE SE SE 26 | Glenn Myers | 98 | 5 | D | R | 89.5 | 7-12-39 | 2619 |
| 26ddd2 | SE SE SE 26 | do. | 103 | 5 | S | R | 80.5 | 7-12-39 | |
| 27ddd1 | SE SE SE 27 | S. H. Myers | 33 | | D,S | R | 30.0 | 7-12-39 | 2596 |
| 34bcb1 | NW SW NW 34 | J. H. Davis | 87 | | N | | 59.6 | 7-12-39 | 2634 |
| **T4N-R22E** | | | | | | | | | |
| 12acd1 | SE SW NE 12 | Shelby Blakemore | 15 | 6 | D,S | A | 6.7 | 8-21-40 | |
| 14ddc1 | SW SE SE 14 | D. L. McCay | 67 | 4½ | S | R | 24.7 | 8-22-39 | 2470 |
| 15dad1 | SE NE SE 15 | Clyde Walker | 142 | 5 | | R | 42 | - -39 | |
| 21ddd1 | SE SE SE 21 | W. H. Thomas | 97 | 5 | D,S | R | 24.7 | 8-22-39 | 2542 |
| 22add1 | SE SE NE 22 | Clyde Walker | 70 | 5 | S | R | 45.7 | 8-22-39 | 2559 |
| 24bbc1 | SW NW NW 24 | J. W. Maple Estate | 76 | 5 | N | R | 60.6 | 8-22-39 | 2512 |
| 28aaa1 | NE NE NE 28 | Charles Gregg | 27 | 5 | N | | 9.4 | 8-22-39 | 2532 |
| 30aaa1 | NE NE NE 30 | Ira Wilson | 47 | 6 | | R | 36.2 | 8-21-39 | 2545 |
| 32bba1 | NE NW NW 32 | W. M. Wilson | 13 | | Ir | A | | | |
| 33ddc1 | SW SE SE 33 | J. M. Jones | 60 | 4½ | D,S | R | 53.5 | 8-19-39 | |
| 35dcd1 | SE SW SE 35 | H. F. James | 40 | 5 | D | R | 18.5 | 8-19-39 | 2582 |
| 36aac1 | SW NE NE 36 | J. F. Henderson | 25 | 5 | S | R | 16.4 | 8-21-39 | 2562 |
| 36ddd1 | SE SE SE 36 | do. | 72 | | N | R | 54.6 | 8-18-39 | 2612 |
| **T4N-R23E** | | | | | | | | | |
| 14ddd1 | SE SE SE 14 | Federal Land Bank | 19 | 4¼ | D,S | R | 14.2 | 8-23-39 | 2423 |
| 16bbb1 | NW NW NW 16 | T. J. Blakemore | 50 | | Ir | A | 10 | - -56 | |
| 17caa1 | NE NE SW 17 | Paul Hayes | 78 | 16 | Ir | QT | 28 | - -59 | |
| 17cdc1 | SW SE SW 17 | Mrs. Frank Henderson | 62 | 5 | S | R | 28.7 | 8-23-39 | 2468 |
| 18aad1 | SE NE NE 18 | George Ranch | 16 | 5 | S | QT | 9.9 | 8-23-39 | 2421 |
| 18cab1 | NW NE SW 18 | Paul Hayes | 70 | 16 | Ir | QT | 27 | - -59 | |
| 18cdc1 | SW SE SW 18 | J. H. McCall | 26 | 3½ | D,S | R | 9.7 | 8-22-39 | 2468 |
| 20cdd1 | SE SE SW 20 | D. F. Brown Estate | 78 | 6 | S | R | 39.5 | 8-23-39 | 2508 |
| 21daa1 | NE NE SE 21 | John Barragree | 84 | 6 | S | R | 48 | - -39 | |
| 22add1 | SE SE NE 22 | Leota Seal | 54 | 5 | N | R | 47.7 | 8-23-39 | 2488 |
| 26baa1 | NE NE NW 26 | M. E. Leonard | 40 | | S | R | 35.3 | 8-23-39 | 2470 |
| 27dad1 | SE NE SE 27 | J. H. Noble | 54 | | S | R | 51.5 | 8-23-39 | 2545 |
| 28cbb1 | NW NW SW 28 | O. A. Noble | 32 | 30 | N | QT | 28.8 | 8-23-39 | 2509 |
| 30daa1 | NE NE SE 30 | I. N. Phelps | 73 | | D,S | R | 28.7 | 8-23-39 | 2538 |

| WELL NUMBER[1] | LOCATION | OWNER OR NAME | DEPTH (FT.) | DIAMETER (IN.) | USE OF WATER[2] | PROBABLE AQUIFER[3] | WATER LEVEL: DEPTH BELOW LAND SURFACE (FT.) | WATER LEVEL: DATE OF MEASUREMENT | ALTITUDE OF LAND SURFACE (FT.) |
|---|---|---|---|---|---|---|---|---|---|
| **T4N-R23E** (cont.) | | | | | | | | | |
| 31dad1 | SE NE SE 31 | State of Oklahoma | 41 | 5 | S | R | 32.3 | 8-22-39 | 2616 |
| 33cbb1 | NW NW SW 33 | W. P. Evans | 79 | 6 | S | R | 29.1 | 8-23-39 | 2538 |
| 36dda1 | NE SE SE 36 | Pete Sanders Estate | 74 | 4½ | S | R | 38.4 | 8- 2-38 | 2545 |
| **T4N-R24E** | | | | | | | | | |
| 6dbb1 | NW NW SE 6 | Western Gas Serv. Co. No. 3 | 168 | 16 | Ps | | 30 | - -57 | |
| 7acb1 | NW SW NE 7 | J. O. Miles | 34 | 6 | S | A | 23.5 | 10- 5-39 | |
| 7acb2 | NW SW NE 7 | Western Gas Serv. Co. No. 1 | 54 | 12 | Ps | A | 26 | - -39 | |
| 7bac1 | SW NE NW 7 | do. No. 2 | 78 | 16 | Ps | QT | 11.4 | 5-16-46 | |
| 7bda1 | NE SE NW 7 | do. | 45 | 16 | N | A | 22 | - -38 | |
| 7dbb1 | NW NW SE 7 | do. | 34 | 192 | N | A | 12.9 | 5-28-38 | |
| 10abd1 | SE NW NE 10 | Charles Miles | 70 | | S | | 41.0 | 9- 5-40 | |
| 18dda1 | NE SE SE 18 | J. H. Noble | 72 | 5 | D | R | 36.3 | 8-23-39 | |
| 20cbb1 | NW NW SW 20 | Ezra Evans | 93 | 5 | S | R | 31 | - -39 | |
| 20cbb2 | NW NW SW 20 | do. | 31 | 44 | D | R | 28.4 | 9- 6-39 | 2433 |
| 21bba1 | NE NW NW 21 | J. M. Hewatt | 29 | 6 | S | R | 8.2 | 9- 6-39 | 2374 |
| 22bbc1 | SW NW NW 22 | C. T. McCune | 20 | 6 | S | QT | 18.7 | 8- 4-38 | 2411 |
| 23abd1 | SE NW NE 23 | Ben Allen | | | Ir | A | | | |
| 23baa1 | NE NE NW 23 | C. A. Allen | 21 | 5 | S | A | 15.2 | 9- 7-39 | 2363 |
| 24ccc1 | SW SW SW 24 | F. M. Hancock | 34 | 4 | S | A | 22.5 | 8- 4-38 | 2378 |
| 26abb1 | NW NW NE 26 | E. A. McGrew | 50 | 6 | Ir | A | 9.8 | 8- 4-38 | 2370 |
| 27daa1 | NE NE SE 27 | V. V. Cosner | 52 | 4 | N | R | 31.5 | 8- 4-38 | 2410 |
| 28ccc1 | SW SW SW 28 | B. B. Allen | 63 | 5 | S | R | 29.8 | 9- 2-39 | 2480 |
| 30bbc1 | SW NW NW 30 | E. F. Williams | 73 | 4 | S | R | 46.8 | 8- 2-38 | 2493 |
| 30cdc1 | SW SE SW 30 | E. E. Thompson | 48 | 48 | N | | 40.2 | 8- 2-38 | 2518 |
| 31cbc1 | SW NW SW 31 | ——— | 78 | | N | QT | 57.8 | 1- 3-57 | |
| 33dad1 | SE NE SE 33 | Ben Allen | 66 | 4½ | N | R | 51.2 | 9- 2-39 | 2493 |
| 34ddd1 | SE SE SE 34 | A. T. Pittman | 216 | 4 | N | R | 0.9 | 9- 2-39 | 2418 |
| 36bcc1 | SW SW NW 36 | James Thompson | 80 | 5 | S | R | 65.1 | 9- 6-39 | |
| **T4N-R25E** | | | | | | | | | |
| 2acc1 | SW SW NE 2 | Barby Ranch | 19 | 5 | S | QT | 16.1 | 9- 6-40 | 2413 |
| 6ddd1 | SE SE SE 6 | Mrs. Maple | 22 | | S | QT | 11.1 | 9- 5-40 | 2386 |
| 7cca1 | NE SW SW 7 | do. | 10 | 6 | S | A | 4.3 | 9- 5-40 | |
| 10cca1 | NE SW SW 10 | Lloyd Barby | 107 | 5 | N | QT | 85 | - -40 | |
| 12dac1 | NE SW SE 12 | Barby Ranch | 52 | 6 | S | QT | 25.9 | 9- 9-40 | 2408 |
| 14baa1 | NE NE NW 14 | Lloyd Barby | 129 | 5 | N | QT | | | |
| 17dcc1 | SW SW SE 17 | Harry Evans | 30 | 5 | S | A | 17.5 | 9- 7-39 | 2336 |
| 19bbb1 | NW NW NW 19 | James Thompson | 82 | 4½ | N | R | 27.0 | 9- 6-39 | 2393 |
| 21cbc1 | SW NW SW 21 | Ray Savoy | 27 | 6 | Ir | QT | 19 | - -39 | |
| 21cbc2 | SW NW SW 21 | do. | 45 | 5¾ | | QT | 36.9 | 9- 7-39 | 2348 |
| 21cda1 | NE SE SW 21 | do. | 102 | 10 | Ir | QT | 35 | - -55 | |
| 22acc1 | SW SW NE 22 | L. J. Barby | | | Ir | | 12 | | |
| 22dbb1 | NW NW SE 22 | do. | 22 | 6 | D | A | 5.9 | 9- 6-40 | |
| 22dbb2 | NW NW SE 22 | do. | 51 | 5 | N | A | 13.4 | 9- 7-40 | |
| 29bbb1 | NW NW NW 29 | Bertha McCool | 40 | 6 | D,S | QT | 37.8 | 9- 7-39 | 2403 |
| 29dbb1 | NW NW SE 29 | Ray Savoy | 21 | 22 | S | R | 16.0 | 9- 7-39 | 2412 |
| **T4N-R26E** | | | | | | | | | |
| 5cdb1 | NW SE SW 5 | Barby Ranch | 169 | 6 | S | QT | 125.8 | 7-23-56 | |
| 5cdc1 | SW SE SW 5 | do. | 145 | 5 | S | QT | 125.3 | 9- 9-40 | 2671 |
| 6cda1 | NE SE SW 6 | do. | 95 | 6 | S | QT | 65.8 | 9- 9-40 | 2466 |
| 14ddb1 | NW SE SE 14 | Otto Barby | 21 | 6 | N | QT | 13.4 | 6-18-40 | |
| 16cad1 | SE NE SW 16 | Barby Ranch | 15 | 4 | N | QT | 8.6 | 10-24-51 | |
| 16dcc1 | SW SW SE 16 | do. | 50 | 6 | N | QT | 11.2 | 9- 9-40 | 2336 |
| 18bab1 | NW NE NW 18 | do. | 185 | 6 | S | QT | 80 | - -40 | 2466 |
| 31cbb1 | NW NW SW 31 | Earl Overton | 150 | 6 | D | QT | 46 | - -53 | |
| 32abc1 | SW NW NE 32 | ——— | 24 | 5½ | N | A | 15.1 | 10-14-53 | |
| **T4N-R27E** | | | | | | | | | |
| 2bdc1 | SW SE NW 2 | Glenn Carrier | 230 | 16 | Ir | QT | 35 | - -53 | |
| 2cda1 | NE SE SW 2 | Commercial Trust Co. | 20 | 6 | N | QT | 2.4 | 6-15-40 | 2362 |
| 10baa1 | NE NE NW 10 | W. A. Preist | 120 | 6 | D,S | QT | 98.2 | 4- 4-40 | 2466 |
| 13acd1 | NW SW NE 13 | T. W. Davidson | 80 | 6 | S | R | 45.1 | 6-15-40 | 2275 |
| 15cac1 | SW NE SW 15 | W. A. Preist | 59 | 6 | S | QT | 31.5 | 6-19-40 | 2361 |
| 16cbb1 | NW NW SW 16 | State of Oklahoma | 90 | 6 | D,S | R | 41.2 | 6-18-40 | 2400 |
| 18ada1 | NE SE NE 18 | Ralph Barby | 81 | 6 | D,S | R | 28.5 | 6-19-40 | 2401 |
| 19cca1 | NE SW SW 19 | Barby Ranch | 139 | 6 | S | R | 71.9 | 6-18-40 | 2388 |
| 20acc1 | SW SW NE 20 | C. Smothermon | 84 | | S | R | 37.5 | 10-21-50 | |
| 21bbd1 | SE NW NW 21 | Federal Land Bank | 97 | 5 | N | R | 63.7 | 6-18-40 | 2364 |
| 23bab1 | NW NE NW 23 | Leon Allen | 118 | 6 | D | R | 59 | - -40 | |
| 23cdd1 | SE SE SW 23 | ——— | 146 | 5 | S | R | 50.5 | 9-12-46 | |
| 25dcc1 | SW SW SE 25 | ——— | 17 | 6 | S | A | 3.0 | 9- 9-46 | |
| 31abc1 | SW NW NE 31 | Ralph Barby | 35 | 6 | D,S | A | 5.6 | 6-18-40 | 2237 |
| **T4N-R28E** | | | | | | | | | |
| 2abb1 | NW NW NE 2 | Neil Luckie | 115 | 3½ | S | QT | 13.0 | 6-12-40 | 2182 |
| 2abb2 | NW NW NE 2 | do. | 155 | | Ir | QT | | | |
| 2baa1 | NE NE NW 2 | E. C. Luckie | 180 | 16 | Ir | QT | 20 | - -55 | |
| 3bba1 | NE NW NW 3 | Wayne Dunn | 75 | 6 | D,S | R | 19.2 | 6-12-40 | 2179 |
| 4abd1 | SE NW NE 4 | MK&T Railroad | 24 | 150 | In | QT | 9.4 | 6-13-40 | 2198 |
| 4cbb1 | NW NW SW 4 | George Heglin | 47 | 6 | Ir | QT | 40 | - -46 | |
| 4dbc1 | SW NW SE 4 | Fred Harvey | 54 | 5 | N | QT | | | |
| 5abd1 | NW SE NE 5 | Burns Murray | 50 | 8 | S | R | 31.6 | 9-10-46 | |
| 5dbc1 | SW NW SE 5 | George Heglin | 65 | 8 | S | QT | 30 | - -54 | |
| 6ada1 | NE SE NE 6 | H. H. Holtkamp | 70 | 6 | S | QT | 58.5 | 6-15-40 | 2292 |
| 7bbb1 | NW NW NW 7 | T. W. Davidson | 132 | 5 | S | | 89.1 | 6-12-40 | 2332 |
| 8ada1 | NE SE NE 8 | ——— | 115 | 6 | S | R | 48.5 | 7-17-46 | |
| 8bcc1 | SW SW NW 8 | George Heglin | 118 | 5½ | N | R | 65.7 | 9-10-46 | |
| 8ccc1 | SW SW SW 8 | P. B. Collins | 130 | 6 | D,S | R | 84.6 | 6-12-40 | 2290 |
| 10bbb1 | NW NW NW 10 | P. H. Mitchell | 56 | | D,S | QT | 22.6 | 6-12-40 | 2183 |
| 10ccc1 | SW SW SW 10 | Barby Ranch | 37 | 6 | N | QT | 27.2 | 6-12-40 | 2182 |
| 18bbb1 | NW NW NW 18 | Pleasant Valley School | 60 | 6 | Ps | R | 39.9 | 6-12-40 | 2254 |
| 18cdc1 | SW SE SW 18 | ——— | 50 | 5 | N | | 46.4 | 9- 7-46 | |
| 21acb1 | NW SW NE 21 | D. E. Wolf | 17 | 6 | S | A | 5.4 | 6-11-40 | 2169 |
| 22caa1 | NE NE SW 22 | J. J. Koran | 25 | 6 | S | A | 4.0 | 6-11-40 | 2164 |

| Well number[1] | Location | Owner or name | Depth (ft.) | Diameter (in.) | Use of water[2] | Probable aquifer[3] | Water level: Depth below land surface (ft.) | Water level: Date of measurement | Altitude of land surface (ft.) |
|---|---|---|---|---|---|---|---|---|---|
| **T4N-R28E** (cont.) | | | | | | | | | |
| 26adc1 | SW SE NE 26 | L. K. Mulberry | 40 | 18 | Ir | A | 9.3 | 5- 8-51 | |
| 26dac1 | SE NE SW 26 | W. A. Mulberry | 43 | | N | A | 15 | - -40 | |
| 26dcb1 | NW SW SE 26 | Clarence Lamaster | 34 | 15 | Ir | A | 9.3 | 7-27-41 | 2162 |
| 26dda1 | NE SE SE 26 | do. | 40 | 18 | Ir | A | 9.2 | 7-23-56 | |
| 27cab1 | NW NE SW 27 | T. S. Whisenhunt | 55 | 16 | Ir | A | 6 | 6- 8-40 | |
| 27cad1 | SE NE SW 27 | Ralph Barby | 115 | 16 | Ir | | 7 | - -59 | |
| 32bab1 | NW NE NW 32 | Albert Laverty | 38 | 6 | S | A | 18.8 | 6-11-40 | 2196 |
| 34bbb1 | NW NW NW 34 | Barby Ranch | 30 | 6 | S | A | 14.9 | 8- 5-38 | 2183 |
| 34ddd1 | SE SE SE 34 | N. R. Graham | 57 | 6 | N | QT | 53.8 | 8- 5-38 | 2244 |
| 35ddc1 | SW SE SE 35 | Perry Spicer | 42 | 5 | N | QT | 22 | - -40 | |
| **T5N-R20E** | | | | | | | | | |
| 2cdd1 | SE SE SW 2 | J. C. Peters | 171 | 4½ | N | QT | 159.9 | 7-29-38 | 2774 |
| 6ddd1 | SE SE SE 6 | R. B. Barnes | 145 | | S | QT | 119.7 | 6-27-40 | 2804 |
| 9aaa1 | NE NE NE 9 | George Stone | 153 | 5 | N | QT | 145.1 | 6-27-40 | 2788 |
| 17daa1 | NE NE SE 17 | Marie Vogt | 145 | | D,S | QT | 132.4 | 6-27-40 | 2779 |
| 19daa1 | NE NE SE 19 | W. A. Naylor | 157 | | N | QT | 141.1 | 7-29-38 | 2799 |
| 27daa1 | NE NE SE 27 | James Smith | 165 | 6⅝ | D | QT | 139 | - -50 | 2740 |
| 27dac1 | SW NE NE 27 | J. A. Hershey | 150 | | Ps | QT | 139.1 | 4- 8-40 | 2748 |
| 27dbd1 | SE NW SE 27 | Lewis Duerson | 165 | 6⅝ | D | QT | 137 | 5-20-50 | |
| 30ddd1 | SE SE SE 30 | ——— | 133 | 5 | S | QT | 112.3 | 5-20-50 | |
| 33bbb1 | NW NW NW 33 | W. F. Groves | 148 | 4 | D,S | QT | 128.6 | 6-28-40 | 2758 |
| 34abb1 | NW NW NE 34 | J. M. Cleek | 160 | | N | QT | 141.9 | 7-29-38 | 2752 |
| 34bbb1 | NW NW NW 34 | Lyle Wheeler | 452 | 16 | Ir | QT | 110 | - -59 | |
| 35bbb1 | NW NW NW 35 | W. V. Arnold | 230 | 4 | D,S | QT | 131.8 | 10- 6-39 | 2738 |
| **T5N-R21E** | | | | | | | | | |
| 3aad1 | SE NE NE 3 | K. W. Dick | 215 | | D,S | QT | 194.1 | 8-19-40 | 2741 |
| 5dca | NW SW SE 5 | J. W. Baughman | 210 | | D,S | QT | 192.7 | 8-19-40 | 2757 |
| 12ddd1 | SE SE SE 12 | A. J. Isaac | 207 | 5 | N | QT | 192.6 | 7-29-38 | 2705 |
| 15ada1 | NE SE NE 15 | J. J. Tretbar | 178 | | N | QT | 174.8 | 7-29-38 | 2711 |
| 17ddd1 | SE SE SE 17 | Ada Allred | 180 | 4 | N | QT | 172.4 | 7-29-38 | 2724 |
| 23ddc1 | SW SE SE 23 | Minnie Patterson | 175 | | D,S | QT | 162.4 | 8-19-40 | 2702 |
| 25ddd1 | SE SE SE 25 | J. E. Watson | 162 | | D,S | QT | 154.8 | 8-19-40 | 2666 |
| 28bbc1 | SW NW NW 28 | J. T. Dirks | 180 | | D,S | QT | 155.0 | 4- 8-40 | 2706 |
| 30ccc1 | SW SW SW 30 | J. E. Arnold | 155 | 6 | D,S | QT | 138.4 | 6-27-40 | 2698 |
| **T5N-R22E** | | | | | | | | | |
| 2add1 | SE SE NE 2 | Dave Potter | 195 | 5 | D,S | QT | 180.4 | 7-30-38 | 2641 |
| 2ddd1 | SE SE SE 2 | A. A. Potter | 179 | | N | QT | 162.3 | 7-30-38 | 2617 |
| 3cdc1 | SW SE SW 3 | John Long | 205 | | N | QT | 197.6 | 8-21-40 | |
| 4cbc1 | SW NW SW 4 | Still | 230 | 6⅝ | D,S | QT | 210.0 | 5-26-50 | |
| 8bbc1 | SW NW NW 8 | O. H. Rushton | 212 | | D,S | QT | 203.3 | 8-21-40 | 2708 |
| 12ada1 | NE SE NE 12 | State of Oklahoma | 72 | | S | QT | 61.8 | 8-20-40 | 2563 |
| 13ddd1 | SE SE SE 13 | T. J. Trew | 84 | | N | QT | 66.1 | 7-30-38 | 2575 |
| 14ddc1 | SW SE SE 14 | Mrs. B. W. Lewis | 103 | 4½ | D,S | QT | 91.1 | 7-30-38 | 2589 |
| 16aaa1 | NE NE NE 16 | S. M. Calhoun | 173 | 4½ | N | QT | 170.4 | 7-30-38 | 2668 |
| 16ddd1 | SE SE SE 16 | W. C. Fincher | 163 | 4¾ | N | QT | 158.4 | 7-30-38 | 2660 |
| 20aac1 | SW NE NE 20 | Minnie B. Dorman et al. | 186 | | N | QT | 169.1 | 7-29-38 | 2678 |
| 21aab1 | NW NE NE 21 | Central Life Insurance Co. | 166 | | S | QT | 155.6 | 7-30-38 | 2659 |
| 21bbb1 | NW NW NW 21 | C. E. Jones | 447 | 15 | Ir | QT | 175 | - -55 | |
| 23ddd1 | SE SE SE 23 | Bank of Idana, Kansas | 89 | 4 | N | QT | 82.3 | 7-30-38 | 2595 |
| 29cba1 | NE NW SW 29 | Town of Floris | 180 | | D | QT | 164.0 | 4- 8-40 | 2672 |
| 31dad1 | SE NE SE 31 | Grant Harryman | 145 | 5 | D,S | QT | 136.4 | 8-21-40 | 2658 |
| 32acc1 | SW SW NE 32 | P. H. Janzen | 136 | 4 | S | QT | 122.0 | 6-20-40 | 2649 |
| 33aba1 | NE NW NE 33 | ——— | 147 | | N | QT | 114.8 | 8-21-40 | 2643 |
| 34aaa1 | NE NE NE 34 | Charles Topinka | 108 | | D,S | QT | 87.4 | 8-20-40 | 2614 |
| **T5N-R23E** | | | | | | | | | |
| 1add1 | SE SE NE 1 | A. E. Grady | 59 | | D,S | QT | 51.2 | 9- 4-40 | 2504 |
| 4cdd1 | SE SE SW 4 | G. W. DuBois | 203 | 4 | S | | 110.7 | 7-30-38 | 2561 |
| 13baa1 | NE NE NW 13 | Western Gas Serv. Co. No. 1 | 85 | 72-10 | Ps | QT | 60.9 | 11-29-39 | 2527 |
| 13baa2 | NE NE NW 13 | do. No. 2 | 85 | 10 | Ps | QT | 57.0 | - -38 | |
| 13baa3 | NE NE NW 13 | do. No. 3 | 87 | 10 | Ps | QT | 57 | - -45 | |
| 13baa4 | NE NE NW 13 | do. No. 4 | 93 | 8 | Ps | QT | 55 | - -53 | |
| 13bab1 | NE NE NW 13 | Geo. Angleton | 80 | 5 | D,S | QT | 72.2 | 8- 1-38 | 2539 |
| 18aaa1 | NE NE NE 18 | Central Life Assurance Co. | 131 | | N | QT | 111.7 | 7-30-38 | 2579 |
| 21aba1 | NE NW NE 21 | C. A. Dowdel | 131 | 4 | N | QT | 126.1 | 9- 2-40 | 2641 |
| 22ccd1 | SE SW SW 22 | R. C. Bixler | 117 | | D,S | QT | 102.9 | 9- 3-40 | 2639 |
| 23ccd1 | SE SW SW 23 | H. W. Brooks | 48 | 5½ | D,S | QT | 44.9 | 9- 3-40 | 2594 |
| 24ccc1 | SW SW SW 24 | T. B. Shillingburg | 77 | 5 | N | QT | 71.6 | 8- 1-38 | 2545 |
| 25bab1 | NW NE NW 25 | A. E. Shillingburg | 72 | 5 | N | QT | 62.1 | 8- 1-38 | 2535 |
| 25dac1 | SW NE SE 25 | Ernest Roberson | 75 | 15 | Ir | QT | 5 | - -53 | |
| 29ddd1 | SE SE SE 29 | Lillie Davis | 159 | 4 | N | QT | 82.7 | 9- 3-40 | 2588 |
| 30aaa1 | NE NE NE 30 | Victoria Hodges | 92 | 5½ | N | QT | 77.9 | 9- 2-40 | 2592 |
| 34aad1 | SE NE NE 34 | Marie Elston | 72 | 5 | S | QT | 67.7 | 9- 3-40 | 2541 |
| **T5N-R24E** | | | | | | | | | |
| 1bab1 | NW NE NW 1 | G. V. Girk | 145 | | S | QT | 72.0 | 10-26-50 | 2593 |
| 2cdd1 | SE SE SW 2 | do. | 240 | | N | QT | 191.9 | 9- 4-40 | 2667 |
| 5bcc1 | SW SW NW 5 | R. S. Durhan | 91 | | N | | 82.8 | 8- 1-38 | 2526 |
| 8abb1 | NW NW NE 8 | Jay Hollenbeck | 135 | 6 | D,S | QT | 114.7 | 9- 4-40 | 2566 |
| 8ccc1 | SW SW SW 8 | Gilbert Hodges | 72 | | N | QT | 52.6 | 8- 1-38 | 2531 |
| 10cdc1 | SW SE SW 10 | John Goodfellow Jr. | 215 | 5 | D,S | QT | 161.9 | 4- 3-40 | 2665 |
| 13baa1 | NE NE NW 13 | A. W. Mundell | 230 | 5 | N | QT | 181.1 | 9- 4-40 | 2674 |
| 17aab1 | NW NE NE 17 | Frank Hinkle | 106 | 5 | S | QT | 86.4 | 3-26-41 | 2571 |
| 17cdd1 | SE SE SW 17 | I. W. Moore | 97 | 6 | N | QT | 81.5 | 9- 4-40 | 2566 |
| 19ccc1 | SW SW SW 19 | John Angleton | 17 | 5 | N | QT | 7.7 | 8- 1-38 | 2481 |
| 30bcc1 | SW SW NW 30 | Alpha Anderson | 97 | 16 | Ir | QT | 5.8 | 5-27-50 | |
| 30ccc1 | SW SW SW 30 | Western Gas Serv. Co. No. 4 | 100 | 16 | Ps | QT | 10 | - -61 | |
| 30ccb1 | NW SW SW 30 | Arthur Williams | 16 | 6 | N | R | 8.7 | 8- 1-38 | 2475 |
| 31ccb1 | NW SW SW 31 | J. O. Miles | 30 | 5 | S | QT | 15.4 | 10-22-40 | 2465 |
| 32bbb1 | NW NW NW 32 | R. T. Newman | 61 | 6 | D | R | 43.4 | 9-12-40 | 2555 |
| 33abb1 | NW NW NE 33 | A. C. Glasscock | 146 | 5 | N | | 140.9 | 9- 5-40 | 2666 |

| WELL NUMBER[1] | LOCATION | OWNER OR NAME | DEPTH (FT.) | DIAMETER (IN.) | USE OF WATER[2] | PROBABLE AQUIFER[3] | WATER LEVEL: DEPTH BELOW LAND SURFACE (FT.) | WATER LEVEL: DATE OF MEASUREMENT | ALTITUDE OF LAND SURFACE (FT.) |
|---|---|---|---|---|---|---|---|---|---|
| **T5N-R25E** | | | | | | | | | |
| 2ccc1 | SW SW SW 2 | S. G. Kamas | 80 | | S | R | 75.1 | 9-12-40 | 2428 |
| 4bac1 | SW NE NW 4 | T. A. Judy | 2400 | 5 | N | | 53.4 | 10-11-50 | |
| 4ccc1 | SW SW SW 4 | do. | 74 | | S | R | 69.2 | 9-11-40 | 2437 |
| 4daa1 | NE NE SE 4 | S. G. Kamas | 193 | 6 | N | | 162.4 | 9-12-40 | 2518 |
| 5adb1 | NW SE NE 5 | T. A. Judy | | 3 | D | | 77.8 | 9-11-40 | 2439 |
| 5ccc1 | SW SW SW 5 | do. | 42 | 5 | S | QT | 32.8 | 10-18-50 | |
| 10bac1 | SW NE NW 10 | S. G. Kamas | 77 | | S | | 67.3 | 9-12-40 | 2468 |
| 11adc1 | SW SE NE 11 | do. | 99 | | N | | 95.2 | 9-12-40 | 2466 |
| 13dcd1 | SE SW SE 13 | C. E. Free | 210 | 6 | N | | 168.9 | 9- 6-40 | 2614 |
| 15dda1 | NE SE SE 15 | Harold Whitmarsh | 153 | | S | QT | 148.3 | 3-26-41 | 2608 |
| 16abb1 | NW NW NE 16 | T. A. Judy | 235 | 6 | N | R | 132.1 | 10-15-50 | 2602 |
| 17dad1 | SE NE SE 17 | May Eubank | 179 | 6 | D,S | QT | 155.7 | 4- 3-40 | 2635 |
| 18bca1 | NE SW NW 18 | Warren Petroleum Corp. | 428 | 10 | In | QT | 163 | - -59 | |
| 18bd | NW SE 18 | do. | 310 | 10 | In | QT | 169 | - -59 | |
| 18cbb1 | NW NW SW 18 | E. E. Evans | 175 | | S | R | 94.5 | 9- 7-40 | 2568 |
| 31ada1 | NE SE NE 31 | Mrs. Robert Maple | 34 | 6 | D,S | R | 13.0 | 9- 5-40 | |
| 35acc1 | SW SW NE 35 | Barby Ranch | 57 | 6 | S | R | 52.6 | 9- 6-40 | 2497 |
| **T5N-R26E** | | | | | | | | | |
| 2cda1 | NE SE SW 2 | ——— | 93 | 4 | S | | 40.2 | 10-22-49 | |
| 3bdd1 | SE SE NW 3 | ——— | 57 | 4 | T | R | 53.0 | 7-26-40 | 2409 |
| 5caa1 | NE NE SW 5 | Buis Brothers | 18 | 6 | S | A | 10.8 | 9-12-40 | 2402 |
| 12cca1 | NE SW SW 12 | Lillie Haack | 125 | 5 | D,S | QT | 102.7 | 7-26-41 | |
| 13add1 | SE SE NE 13 | ——— | 156 | | D | QT | 64.4 | 10-17-49 | |
| 15aba1 | NE NW NE 15 | Earn Davis | 75± | 5 | S | QT | 53.3 | 7-26-41 | 2452 |
| 23cda1 | NE SE SW 23 | Barby Ranch | 150 | 6 | N | QT | 145.6 | 6-19-40 | 2558 |
| 25aac1 | SW NE NE 25 | Charles Smothermon | 190 | 6 | D | QT | 116 | - -39 | |
| 25adb1 | NW SE NE 25 | Town of Knowles | 215 | 6 | Ps | QT | 115.8 | 4- 4-40 | 2531 |
| 30bba1 | NE NW NW 30 | Barby Ranch | 138 | 6 | N | | 116.7 | 9- 7-40 | 2567 |
| 32cdc1 | SW SE SW 32 | do. | 154 | | S | QT | 127.0 | 9- 7-40 | 2556 |
| 34cbb1 | NW NW SW 34 | do. | 113 | 6 | S | QT | 103.2 | 6-19-40 | 2531 |
| 35aac1 | SW NE NE 35 | W. Y. Alexander | 66 | 6 | S | QT | 45.0 | 6-19-40 | 2468 |
| 36cdd1 | SE SE SW 36 | W. B. Dugan | 117 | 6 | N | | 106.6 | 6-19-40 | 2527 |
| **T5N-R27E** | | | | | | | | | |
| 1cbc1 | SW NW SW 1 | J. C. Sizelove | 163 | 6 | N | | 157.2 | 6-15-40 | 2257 |
| 3 | 3 | L. Perkins | 171 | 16 | Ir | QT | 38 | - -55 | |
| 7dcd1 | SE SW SE 7 | Casey Grimm | 36 | 7 | D,S | QT | 25.0 | 6-15-40 | 2365 |
| 8cdd1 | SE SE SW 8 | G. W. Bond | 122 | | D | | 94.1 | 6-15-40 | 2390 |
| 9add | SE SE NE 9 | M. Schampel | 100 | | D,S | QT | 62.1 | 4-23-56 | 2280 |
| 11bdd1 | SE SE NW 11 | E. W. Green | 58 | 6 | N | QT | 37.5 | 6-15-40 | 2187 |
| 13cda1 | NE SE SW 13 | C. H. Landers | 91 | 6 | D,S | QT | 43.7 | 6-14-40 | 2201 |
| 13cdc1 | SW SE SW 13 | do. | 22 | 5½ | Ir | A | 6.6 | 6-14-40 | 2175 |
| 15cdc1 | SW SE SW 15 | Ira Bratton | 87 | 6 | D,S | QT | 68.8 | 6-14-40 | 2320 |
| 19bcb1 | NW SW NW 19 | M. C. Mason | 188 | | D,S | QT | 162.3 | 6-15-40 | 2531 |
| 20ada1 | NE SE NE 20 | Owler Cowshow | 105 | | D,S | QT | 73 | - -38 | |
| 31ddc1 | SW SE SE 31 | Elsie Poorbaugh | 219 | 6 | D,S | QT | 127.2 | 6-15-40 | 2518 |
| 35cdc1 | SW SE SW 35 | S. W. Houk | 121 | 6 | N | QT | 61.1 | 6-15-40 | 2367 |
| **T5N-R28E** | | | | | | | | | |
| 4caa1 | NE NE SW 4 | Walter Lewis | 100 | 16 | Ir | QT | 42 | - -47 | |
| 5acd1 | SE SW NE 5 | do. | 50 | 24 | Ir | QT | 21.0 | 10-25-50 | |
| 5ada1 | NE SE NE 5 | do. | 52 | 42 | Ir | QT | 22.1 | 6-13-40 | 2062 |
| 5add1 | SE SE NE 5 | Lewis Brothers | 90 | | Ir | QT | 39.5 | 10-25-50 | |
| 6aaa1 | NE NE NE 6 | Charles Berends | 71 | 10 | Ir | QT | 46 | - -50 | |
| 10add1 | SE SE NE 10 | Union School | 110 | 6 | Ps | QT | 84.8 | 6-13-40 | 2196 |
| 11ddd1 | SE SE SE 11 | Leroy Stanley | 90 | 6 | N | QT | 85.4 | 6-13-40 | 2199 |
| 15cdb1 | NW SE SW 15 | Wesley Hein | 175 | 16 | Ir | QT | 60 | - -56 | |
| 15dca1 | NE SW SE 15 | Federal Life Insurance Co. | 36 | 6 | S | QT | 31.8 | 4- 4-40 | 2164 |
| 18aab1 | NW NE NE 18 | V. A. Oats | 140 | | N | QT | 133.1 | 6-14-40 | 2226 |
| 21dcd1 | SE SW SE | Ida J. Long | 49 | 6 | S | QT | 38.7 | 6-14-40 | 2161 |
| 22cdd1 | SE SE SW 22 | Kenneth Long | 250 | 15 | Ir | QT | 51.5 | 10-25-50 | |
| 26ddd1 | SE SE SE 26 | T. V. Terbush | 44 | 6 | D,S | QT | 30.2 | 6-13-40 | 2156 |
| 27a | NE 27 | Ed Schoenhals | 137 | | Ir | QT | | | |
| 27aaa1 | NE NE NE 27 | Oracle Collins | 145 | 15 | Ir | QT | 33.2 | 10-25-50 | |
| 27abb1 | NW NW NE 27 | Fred Borns | 136 | 16 | Ir | QT | 35 | - -59 | |
| 27bcd1 | SE SW NW 27 | Oracle Collins | 92 | 15 | Ir | QT | 32 | - -50 | |
| 27bcd1 | SE SW NW 27 | Orville Stanley | 140 | 16 | Ir | QT | 30 | - -50 | |
| 32cdd1 | SE SE SW 32 | Town of Gate | 70 | 16 | Ps | QT | 52 | - -60 | |
| 32ddc1 | SW SE SE 32 | J. P. Whisenhunt | 40 | | | QT | 33 | - -53 | |
| 32ddc2 | SW SE SE 32 | do. | 70 | | | QT | 48 | - -53 | |
| 32ddc3 | SW SE SE 32 | Town of Gate | 50 | 18 | Ps | QT | 40 | - -38 | |
| 32ddc4 | SW SE SE 32 | Town of Gate | 50 | 24 | Ps | QT | 40 | - -38 | |
| 33cca1 | NE SW SW 33 | Oral Hankins | 94 | 5½ | D | QT | 65.5 | 6-13-40 | |
| 33ddc1 | SW SE SE 33 | E. L. Newby | 27 | 5 | T | QT | 18 | - -40 | |
| 34cac1 | SW NE SW 34 | Wayne Dunn | 132 | 16 | Ir | QT | 40 | - -55 | |
| 35bbb1 | NW NW NW 35 | R. A. Patton | 147 | 16 | Ir | QT | | | |
| 35c | SW 35 | Gerald Graves | 147 | 16 | Ir | | 38 | - -59 | |
| **T6N-R20E** | | | | | | | | | |
| 7dbd1 | SE NW SE 7 | Mid Plains Drilling Co. and R. B. Vaughn | 139 | 4½ | N | QT | 107.0 | 7-22-41 | 2839 |
| 9ccb1 | NW SW SW 9 | Geo. Schneider | 133 | | S | QT | 122.0 | 6-20-40 | 2828 |
| 19aaa1 | NE NE NE 19 | ——— | 144 | 6 | N | QT | 112.3 | 6-20-40 | 2840 |
| 20daa1 | NE NE SE 20 | H. H. Matkin | 159 | 5 | D,S | QT | 141.9 | 4- 8-40 | 2833 |
| 23daa1 | NE NE SE 23 | A. E. Becker | 275 | | D,S | | 169 | - -39 | |
| 26aaa1 | NE NE NE 26 | N. M. Smith | 170 | | D,S | QT | 158.0 | 6-20-40 | 2770 |
| 27dda1 | NE SE SE 27 | Charles Maschmeier | 180 | 6 | N | QT | 156.2 | 6-20-40 | 2794 |
| 31add1 | SE SE NE 31 | C. F. Hartman | 149 | 6 | D | QT | 125.0 | 6-21-40 | 2812 |
| 33cbc1 | SW NW SW 33 | Federal Life Insurance Co. | 173 | 4 | D,S | QT | 138.4 | 6-21-40 | 2805 |
| 36ada1 | NE SE NE 33 | Charles Maschmeier | 200 | 5 | N | QT | 178.3 | 6-21-40 | 2773 |

| WELL NUMBER[1] | LOCATION | OWNER OR NAME | DEPTH (FT.) | DIAMETER (IN.) | USE OF WATER[2] | PROBABLE AQUIFER[3] | WATER LEVEL: DEPTH BELOW LAND SURFACE (FT.) | WATER LEVEL: DATE OF MEASUREMENT | ALTITUDE OF LAND SURFACE (FT.) |
|---|---|---|---|---|---|---|---|---|---|
| **T6N-R21E** | | | | | | | | | |
| 13dcb1 | NW SW SE 13 | T. R. Lofland & Rufus Clay | 242 | 6½ | N | QT | | | |
| 15cdd1 | SE SE SW 15 | Isabelle Bay | 208 | 5 | N | QT | 201.7 | 6-21-40 | 2740 |
| 18ccc1 | SW SW SW 18 | F. H. Stoker | 196 | 5 | S | QT | 178.0 | 6-21-40 | 2771 |
| 27cdd1 | SE SE SW 27 | G. S. Jones | 222 | | D,S | QT | 216.1 | 2-21-40 | 2759 |
| 29ddc1 | SW SE SE 29 | A. T. Dirks | 189 | 5 | D,S | QT | 183.0 | 4- 8-40 | 2747 |
| **T6N-R22E** | | | | | | | | | |
| 13dcd1 | SE SW SE 13 | Federal Land Bank | 131 | 5 | N | QT | 114.2 | 8-20-40 | 2650 |
| 15dda1 | NE SE SE 15 | do. | 234 | 5 | N | QT | 178.7 | 4- 9-40 | 2668 |
| 16aaa1 | NE NE NE 16 | State of Oklahoma | 230 | 4 | S | QT | 208.9 | 8-20-40 | 2698 |
| 18cca1 | NE SW SW 18 | Sid Sharp | 220 | | S | QT | 189.9 | 8-20-40 | 2665 |
| 25bbc1 | SW NW NW 25 | L. C. Buffalo | 226 | | D,S | QT | 220.2 | 8-20-40 | 2664 |
| 28aaa1 | NE NE NE 28 | L. H. McBroom | 195 | | N | QT | 188.9 | 8-20-40 | 2688 |
| 29cdc1 | SW SE SW 29 | Greenough School | 220 | 5 | Ps | QT | 215 | - -40 | 2710 |
| 30ddd1 | SE SE SE 30 | E. E. Jones | 119 | 5 | | QT | 213.5 | 4- 9-40 | 2721 |
| **T6N-R23E** | | | | | | | | | |
| 14ddd1 | SE SE SE 14 | G. W. Elliot | 172 | | S | QT | 153.2 | 8- 1-38 | 2547 |
| 19bab1 | NW NE NW 19 | J. S. Washburn | | 5 | D,S | QT | 90.8 | 9- 2-40 | 2637 |
| 21bdc1 | SW SE NW 21 | ——— | 158 | 5 | S | QT | 70.3 | 5-30-52 | |
| 24aad1 | SE NE NE 24 | R. F. LeCrone | 197 | 6 | N | | 76.9 | 8- 1-38 | 2545 |
| 27aad1 | SE NE NE 27 | R. B. Harrington | 155 | | D,S | QT | 140.4 | 9- 2-40 | 2546 |
| 27abb1 | NW NW NE 27 | C. C. Harrington | 19 | 4½ | S | QT | 6.1 | 9-10-40 | 2463 |
| 28dbd1 | SE NW SE 28 | E. W. Groves | 28 | 5 | S | QT | 25.4 | 9- 2-40 | 2443 |
| 32bcb1 | NW SW NW 32 | E. H. Thompson | 188 | 4¾ | N | QT | 176.9 | 4- 9-40 | 2611 |
| 33abc1 | SW NW NE 33 | ——— | 92 | 5 | S | QT | 55.0 | 5-28-52 | |
| 34bba1 | NE NW NW 34 | Jennetta Childress | 114 | 5½ | D,S | QT | 102.2 | 4- 9-40 | 2526 |
| 35ddd1 | SE SE SE 35 | S. R. Arnett | | | D,S | QT | 98.7 | 9- 2-40 | 2540 |
| **T6N-R24E** | | | | | | | | | |
| 14cda1 | NE SE SW 14 | XIT Ranch | 37 | 4 | S | QT | 19.8 | 9- 4-40 | 2424 |
| 17bcc1 | SW SW NW 17 | Olive M. Clement | 122 | 3 | D,S | QT | 115.3 | 8- 1-38 | 2493 |
| 20dcb1 | NW SW SE 20 | J. H. Neese | 36 | 4 | N | QT | 29.8 | 8- 1-38 | 2446 |
| 20dcc1 | SW SW SE 20 | do. | 258 | 5 | S | QT | 45.6 | 9-21-39 | 2447 |
| 25cac1 | SW NE SW 25 | XIT Ranch | 86 | 6 | S | | 47.5 | 9-11-40 | 2508 |
| 26dac1 | SW NE SE 26 | Girk | 70 | 4 | S | QT | 53.3 | 4-25-51 | 2508 |
| 28bcb1 | NW SW NW 28 | H. S. Turner | 19 | 4 | N | QT | 15.7 | 9- 3-40 | 2462 |
| 29ccc1 | SW SW SW 29 | J. H. Neese | 78 | | N | QT | 68.4 | 9- 4-40 | 2477 |
| 30cdd1 | SE SE SW 30 | Larry Hodges | 140 | 6 | Ir | QT | 30 | - -59 | |
| 31cbb1 | NW NW SW 31 | ——— | 90 | | | QT | 71.5 | 5-24-52 | |
| 32cdc1 | SW SE SW 32 | Garland McNabb | 140 | 8 | Ir | QT,R | 93.3 | 5-27-50 | |
| 33bbb1 | NW NW NW 32 | Leona Turner | 165 | 4 | D,S | | 97.7 | 9- 3-40 | 2512 |
| **T6N-R25E** | | | | | | | | | |
| 17aac1 | SW NE NE 17 | R. E. Adams | 205 | 16 | Ir | QT | 5 | - -55 | |
| 17adb1 | NW SE NE 17 | XIT Ranch | 25 | 4½ | N | A | 11.5 | 4- 3-40 | 2260 |
| 18cdd1 | SE SE SW 18 | do. | 113 | 6 | S | | 109.3 | 10-20-50 | |
| 30ccc1 | SW SW SW 30 | do. | 80 | 4 | S | QT | 46.7 | 9-11-40 | |
| 33bab1 | NW NE NW 33 | do. | 40 | 4½ | S | QT | 14.0 | 4- 3-40 | |
| 35ccd1 | SE SW SW 35 | ——— | 130 | 4 | S | QT | 51.2 | 6-27-49 | |
| **T6N-R26E** | | | | | | | | | |
| 13dcd1 | SE SW SE 13 | ——— | 44 | 5 | S | QT | 35.5 | 6-20-49 | |
| 15bda1 | NE SE NW 15 | ——— | 74 | 7 | N | R | 22.0 | 11-11-48 | |
| 16bab1 | NW NE NW 16 | Arch Fronk | 138 | 3 | S | QT | 75.£ | 11-10-48 | |
| 17dab1 | NW NE SE 17 | W. M. Anshutz | 44 | 6 | N | | 7.7 | 9-16-40 | 2190 |
| 18dbc1 | SW NW SE 18 | Will Schmoker | 58 | 6 | Ir | QT | 35.2 | 9-11-40 | 2231 |
| 19cbb1 | NW NW SW 19 | ——— | 93 | 5 | S | QT | 50.0 | 6-22-49 | |
| 22bcc1 | SW SW NW 22 | Albert Barby | 41 | 6 | D,S | QT | 28.9 | 4- 3-40 | 2197 |
| 27dad1 | SW NE SW 27 | Barby Ranch | 98 | 6 | S | R | 62.0 | 7-26-41 | 2276 |
| 31bcd1 | SE SW NW 31 | W. A. Cramer | 45 | 6 | N | | 41.1 | 9-12-40 | 2362 |
| **T6N-R27E** | | | | | | | | | |
| 7dcb1 | NW SW SE 7 | Phoenix Joint Stock Ld. Bk. | 201 | 6 | S | R | 168.3 | 9-17-40 | |
| 9cdb1 | NW SE SW 9 | G. A. Haver | 23 | 6 | S | A | 4.1 | 6-17-40 | 2116 |
| 10cdd1 | SE SE SW 10 | ——— | 103 | 6 | N | R | 74.4 | 9-24-46 | |
| 14cbd1 | SE NW SW 14 | J. E. Bragg | 43 | 6 | D,S | R | 23.9 | 6-17-40 | 2092 |
| 20caa1 | NE NE SW 20 | ——— | 37 | 5 | S | QT | 18.0 | 6-21-49 | |
| 23cba1 | NE NW SW 23 | ——— | 25 | 4 | S | A | 6.2 | 9-24-46 | |
| 27adc1 | SW SE NE 27 | T. F. Bounds | 50 | | T | QT | 16 | - -40 | |
| 30dab1 | NW NE SE 30 | Otto Barby | 65 | 6 | D,S | QT | 30.5 | 4- 4-40 | 2150 |
| 33 | 33 | Jinx Sutherland | 65 | 16 | Ir | QT | 12 | - -53 | |
| 34bbb1 | NW NW NW 34 | Julius Krage | 19 | 24 | S,D | A | 13.7 | 6-14-40 | 2101 |
| 34daa1 | NE NE SE 34 | Leonard Bailey | 54 | 6 | | QT | 31.6 | 6-14-40 | 2111 |
| 36caa1 | NE NE SW 36 | W. A. Lonker | 22 | 6 | S | A | 7.8 | 6-14-40 | 2065 |
| **T6N-R28E** | | | | | | | | | |
| 15ccc1 | SW SW SW 15 | School | 56 | 6 | N | R | 52.4 | 6-17-40 | 2035 |
| 28aca1 | NE SW NE 28 | W. D. Hennigh | 93 | 6 | N | R | 72.7 | 6-17-40 | 2082 |
| 32cdc1 | SW SE SW 32 | Chas. Berends | 50 | 6 | Ir | QT | 17.0 | 6-13-40 | 2054 |
| 32dcd1 | SE SW SE 32 | F. E. Rowley | 36 | 6 | N | A | 15.8 | 6-13-40 | 2057 |
| 34acd1 | SE SW NE 34 | W. D. Hennigh | 26 | 5 | N | A | 21.5 | 10-10-39 | |

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