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The investigation that was the basis for this report was made in 1951-52 by the U.S. Geological Survey in cooperation with the Division of Water Resources, Oklahoma Planning and Resources Board. A report summarizing the results of the investigation was prepared and released to the open file in 1953. Because of an increase in the use of water for agricultural and industrial purposes and because of the importance of ground water in the terrace deposits, the report has been duplicated by the Oklahoma Water Resources Board. The report is intended to make available to the public basic ground-water data that will be useful in planning and developing the area's ground-water resources.

Oklahoma Water Resources Board

GROUND WATER IN TERRACE DEPOSITS OF CENTRAL
BECKHAM COUNTY, OKLAHOMA

By

Lee C. Burton

Prepared by the U.S. Geological Survey
in cooperation with the
Oklahoma Water Resources Board

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nomenclature and editorial standards of
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ABSTRACT

Terrace deposits consisting of stream-laid sand, gravel, and clay occur both north and south of the North Fork of Red River in Beckham County. The largest known area of such deposits is south of the river. Three towns, a refinery, an irrigation well, and many rural domestic and stock wells draw water from the terrace deposits in this area.

During the study 145 wells were inventoried, 20 samples of ground water were collected and analyzed for their mineral content, and 53 test holes were drilled. Information from the test holes indicates that the terrace deposits have an average thickness of about 68 feet and an average saturated thickness of about 33 feet. About 60 percent of the saturated material is moderately to highly permeable.

Ground-water recharge is derived chiefly from the infiltration of precipitation that is readily absorbed by dune sand that covers the surface of the terrace deposits in much of the area.

The movement of ground water is northward and eastward toward the river, making it a gaining stream in this area.

INTRODUCTION

This report summarizes results of a test-drilling program in terrace deposits of central Beckham County, Okla., south of the North Fork of Red River (fig. 1). It presents information on wells and test holes, and gives chemical analyses of representative samples of ground water. Maps show the geology of the area, the approximate thickness of the terrace deposits, the water table, and the configuration of the bedrock surface beneath the younger deposits.

Purpose of Study

The purpose of the test-drilling program was to obtain information on the lithology and thickness of water-bearing sand, gravel, and clay, known geologically as terrace deposits. Such materials are regarded as having been laid down by a stream, which since the time of deposition has shifted its channel laterally and has cut down to a lower level. The terrace deposits, therefore, are adjacent to and topographically higher than the present stream. The beds of sand, gravel, and clay are irregular, and occur in different proportions at different places. The terrace deposits yield water to wells more freely than does the bedrock, and on the whole the water in the terrace deposits is of better quality than that in the bedrock.

Terrace deposits occur in Beckham County both north and south of the North Fork of Red River. The largest area of the deposits is south of the river. Ground water in this area has been developed for municipal and industrial purposes and for rural domestic and stock use. The cities of Elk City, Sayre, and Erick draw upon this underground reservoir for public-water supplies, and a refinery of the Shell Oil Co. draws upon it for both industrial and domestic purposes. In 1951 only one well in the terrace deposits was being used for irrigation.

Test holes drilled by the Shell Oil Co. and by the city of Elk City in the eastern part of the area, and by the city of Erick in the north-central part of the area yielded much information about the deposits. This information was utilized in the preparation of this report.

With respect to reservoir capacity and present utilization, the terrace deposits south of the North Fork of Red River are the most important source of ground water in Beckham County, and an appraisal of the deposits is desirable before demand for water exceeds the perennial supply.

The investigation that was the basis for this report was made in 1951-52 as a cooperative project of the United States Geological Survey and the Division of Water Resources of the Oklahoma Planning and Resources Board. It was conducted under the general supervision of A. N. Sayre, Chief, Ground Water Branch, U.S. Geological Survey; and Ira C. Husky, Director, Division of Water Resources, of the Oklahoma Planning and Resources Board.

quarter-quarter section (40-acre tract), and the third the quarter-quarter-quarter section (10-acre tract). Within each 10-acre tract the wells are numbered serially as indicated by the final digit of the number. Thus, the number 8N-23W-1ddd1, which was assigned to a test hole 6 miles east and a mile north of Delhi, indicates that the test hole is in the $SE\frac{1}{4}SE\frac{1}{4}SE\frac{1}{4}$ sec. 1, T. 8 N., R. 23 W (fig. 2).

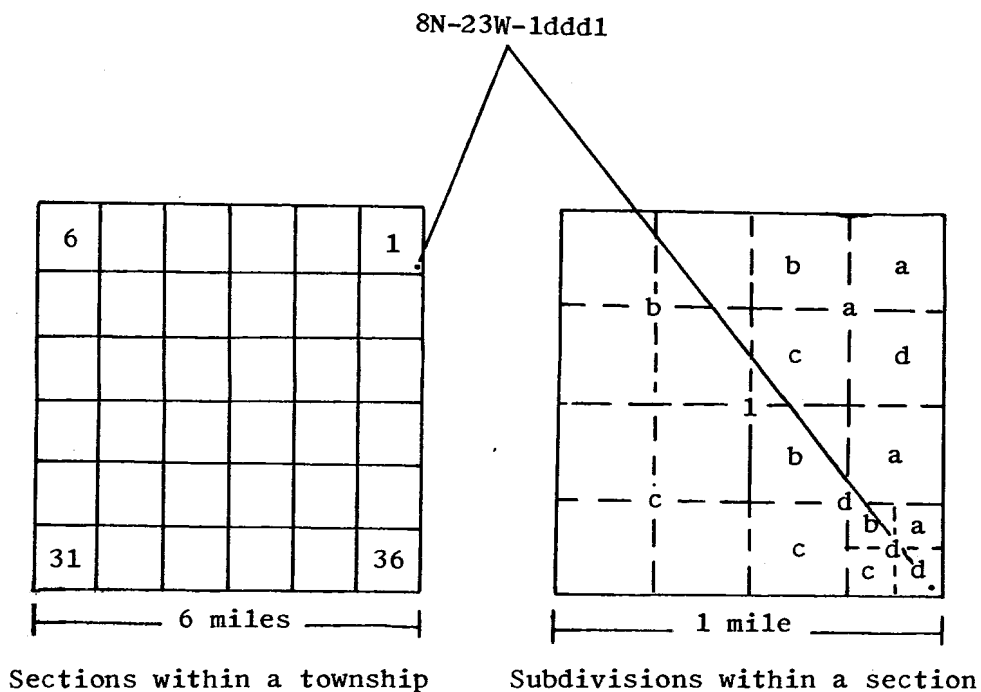


Figure 2.--Diagram showing well-numbering system

GEOGRAPHY

The area considered in this report is in parts of Tps. 8 to 10 N., Rs. 22 to 26 W., Indian meridian (fig. 1 and pl. 1). It is bounded on the north and east by the North Fork of Red River, on the west by the boundary between Texas and Oklahoma, and on the south by an east-west line drawn along the south boundary of T. 8 N. The area has a maximum width from north to south of about 10 miles and a maximum length from east to west of about 25 miles, and covers about 200 square miles. Erick and Texola are the principal towns within the area. Both are in the western half and near the southern boundary. Sayre, the county seat of Beckham County, is on the north side of the river, outside the report area. Elk City, the largest city in the county, is 17 miles northeast of Sayre.

The Chicago, Rock Island and Pacific Railroad and U.S. Highway 66 cross the area from east to west, passing through Sayre, Erick, and Texola. The highway closely parallels the railroad westward from the NW cor. sec. 14, T. 9 N., R. 24 W. U.S. Highway 283, a north-south highway, enters the area from Sayre.

The southern part of the study area is a flat, cultivated plain. The northern part is hilly, being characterized by stabilized sand dunes that occupy a belt 3 to 6 miles wide. The land surface rises from east to west. The lowest recorded altitude, 1,713 feet above sea level, is on the bed of North Fork of Red River, near the SW cor. sec. 20, T. 9 N., R. 22 W. The highest recorded altitude, 2,147 feet above sea level, is at a bench mark in the S $\frac{1}{2}$ sec. 30, T. 9 N., R. 26 W (Wolfard, 1938). The maximum relief, as indicated by these two stations, is 434 feet.

Only four streams cross the area; they are ill defined and drain northward or eastward into North Fork of Red River. Some of the flat areas far from these streams probably contribute little or no surface runoff to the river. In the sand-dune belt, sandy soils soak up most of the water and the dunes enclose small areas having no exterior surface drainage. Spring Creek is the only perennial stream. Little Turkey Creek flows during a part of the year.

The average annual precipitation at Sayre is 23.07 inches, and the mean annual temperature is 60°F.

GEOLOGY AND WATER-BEARING CHARACTERISTICS
OF THE ROCKS

The rocks exposed in the report area include bedrock of Permian age; and terrace deposits, alluvium, and dune sand of Quaternary age (pl. 1).

Permian Bedrock

The Permian bedrock, as exposed at the surface, is made up of interstratified shale, sandstone, and gypsum. The shale is red and gray and on weathering becomes crumbly. The sandstone beds are fine grained, lenticular, and red to maroon. Freshly exposed beds of sandstone generally are very hard and well cemented, but on weathering become soft. The gypsum commonly is gray to white and occurs both as thin layers and as thick massive beds interbedded with shale and sandstone.

The ground water in the Permian bedrock generally is of poor quality, suitable only for stock use although a few people use it for domestic purposes where better water from another source is not available. The yields of wells tapping the bedrock commonly are low. In places, however, as in well 8N-23W-9ddal (3 miles west of Delhi), wells tapping the bedrock may yield enough water for irrigating crops.

Concealed bedrock surface--The configuration, or topography, of the bedrock surface concealed beneath the terrace deposits is illustrated on plate 5 by contour lines. The bedrock surface was identified in most of the test holes, including those drilled for the Shell Oil Co., and its altitude was determined by subtracting the depth to bedrock from the land-surface altitude at the test-hole site. To supplement this information and fill in gaps, altitudes at the contact between terrace deposits and bedrock in surface exposures were determined by an altimeter survey. The resulting map (pl. 5) suggests that, before the terrace deposits were laid down, there was a valley trending southeastward across the area. The axis of the buried valley is a few miles south of the present course of North Fork of Red River. Because the terrace deposits have a gently sloping surface, the location and trend of the ancient valley is clearly shown on maps showing the thickness and saturated thickness of the terrace deposits (pl. 3 and 4).

Terrace Deposits

The terrace deposits extend from the alluvial bottom lands of North Fork of Red River southward to the heads of the streams that drain south into Elm Fork of Red River; and they extend westward beyond the Texas state line. The 53 test holes drilled during this study show that the terrace

deposits range in thickness from 18 to 195 feet, and average about 68 feet (pl. 3). About 45 percent of the material is moderately permeable sand and gravel and about 55 percent is poorly permeable clay, silt, silty sand, and gravelly clay. As determined from test-hole data the saturated part of the terrace deposits ranged in thickness from 2 to 148 feet, and averaged about 33 feet (pl. 4). The terrace deposits are more extensive than the alluvium and yield water more freely than the bedrock; hence, they constitute the most important aquifer in the area of this report.

Alluvium

Alluvium is the material deposited by a stream. It may consist of gravel, sand, and clay in any proportion, and it underlies the flood plain or bottom land. It is generally thickest near the middle of a valley and thinnest at the sides.

In the area of this report deposits mapped as alluvium include the unconsolidated materials in the channel and beneath the flood plain of North Fork of Red River, and alluvial and colluvial materials in the narrow valleys of tributary streams draining northward or eastward into the river.

Where it has sufficient thickness, the alluvium transmits water freely and allows recharge derived from precipitation to percolate rapidly down to the zone of saturation. Also, water in the alluvium may be replenished by underflow from the terrace deposits where the alluvium and terrace deposits are in contact, by flood waters that overflow streambanks and spread across flood plains, and by surface runoff.

In this area the alluvium has been tapped by several domestic and stock wells, and it is the source of water pumped from two wells for municipal use by the city of Sayre.

Dune Sand

The dune sand is wind-blown sand in irregular hills forming a thin mantle on top of a part of the terrace deposits and locally on top of the alluvium. It is largely above the water table and therefore is not a source of water for wells, but it is hydrologically significant because it absorbs a relatively large fraction of the rain that falls on it. The water thus received percolates downward, replenishing the ground-water supply in the underlying deposits. Dune sand that overlies the alluvium is clearly younger than the alluvium; dune sand that overlies the terrace deposits is younger than the terrace deposits but may be in part older than, and in part equivalent to, the alluvium.

GROUND WATER

Occurrence

The rocks within reach of drilling machines contain many open spaces, called voids or interstices. These open spaces are the receptacles for the water found below the land surface and recovered in part through wells and springs. Rocks differ greatly in the number, size, and arrangement of their interstices, and hence in their properties as containers for water. The occurrence of ground water, therefore, is determined by the character, distribution, and structure of the rocks, together with the climate and topography.

The amount of water that can be stored in a rock depends on the volume of pore spaces in the rock--that is, the porosity, which is expressed as a percentage of the total volume of the rock. Well-sorted deposits of unconsolidated silt, sand, or gravel have high porosity regardless of the size of the constituent mineral grains. Poorly sorted deposits have lower porosities because small grains fill the openings between the large grains, reducing the amount of open space. The openings in some well-sorted deposits of sand and gravel may be partially filled with cementing material, reducing the porosity. Hence sandstone and conglomerate, which are consolidated rocks, are likely to have less porosity than sand and gravel, which are unconsolidated. Solution openings and fractures may give an otherwise dense rock a high porosity and, hence, may be of great practical importance.

Although the capacity of a rock to contain water is determined by its porosity, its capacity to yield water is determined by its permeability, which is defined as the ability to transmit water under hydraulic head. Rocks that will not transmit water are said to be impermeable. Silt, clay, or shale may be well sorted and have a high porosity, but because of the minute size of their pores will transmit water only very slowly. If shale is fractured, however, the fractures may transmit water in moderate quantities. Well-sorted gravel or sand containing relatively large openings that communicate freely with one another will transmit water readily. Sandstone will also transmit water readily if its openings have not been obstructed by cementing material. Part of the water in any deposit is not available to wells because it is held against the force of gravity by molecular attraction--that is, the water adheres to the walls of the pores.

The amount of water available to wells depends on the saturated thickness, the lateral extent, and the permeability of the water-bearing material. It also depends on how much of the water contained in the rock will be released, in contrast to the water held in the rock by molecular attraction. The amount of water that can be pumped perennially without progressive depletion of ground water in storage depends on the amount of replenishment.

Water Table

The water table in the terrace deposits is illustrated on plate 2 by means of contour lines, each of which represents a certain altitude above sea level and is supposed to pass through all points on the water table that have that altitude. Actually, however, the lines are approximations at best because the control points afforded by the test holes and measured water wells are 1 to 2 miles apart. Nevertheless, the lines serve to show that the water table slopes generally toward North Fork of Red River--that is, northward in the western part of the area and eastward in the extreme eastern part. The water table is depressed along streams that flow part of the time, so that locally the slope of the water table and the movement of the ground water is toward those streams. If the control points were more closely spaced in the vicinity of pumping wells and if the altitude of the water table at those points had been determined at times of heavy pumping, the map would also show cones of depression caused by the pumping. The map makes it evident that the ground-water reservoir in the terrace deposits is not replenished by water coming from the river. At points remote from the river, the water table is many feet above the river and water from the river would have to flow uphill if it were to effect replenishment. Instead, the principal movement of ground water is toward the river, where the water may appear as surface flow, or may be used by plants growing on the bottom lands, or may be evaporated from the soil.

Recharge

The most important source of water in the earth is precipitation, which comes mainly as rain or snow. With respect to a given water-bearing formation, the principal source of ground water is the precipitation on the outcrop of that formation. Other sources are influent seepage from streams crossing the outcrop and movement of water underground from outside areas--water that may not have fallen to the earth in the area under consideration but nevertheless has come as precipitation somewhere.

The replenishment of ground water is known as recharge. It is often expressed as a percentage of the annual precipitation, or as being equivalent to a layer of water, usually measured in inches of depth, spread uniformly over an area. It may range from an inch or less in some areas to many inches in others. In the same county, it will differ from township to township, from section to section, and from acre to acre, but the movement of water underground tends to equalize the recharge for large areas and to render estimates of recharge useful.

The amount of water entering the ground depends first on the amount of precipitation. Obviously, little rain means little opportunity for recharge. If rain comes as gentle to moderate showers, a larger fraction of the water can go into the soil and rock than if it comes in heavy or protracted storms that quickly fill the uppermost openings and furnish water faster than it can be absorbed. Light, loose, sandy soils like those in the area

covered by this report will absorb more of the water than will heavy clay soils. The absorption will be higher on flat, gentle slopes than on steep slopes. Vegetation favors absorption by retarding runoff and loosening the soil, making it more permeable; but vegetation also uses part of the water, and transpires a part of the water it uses to the atmosphere. In winter a larger fraction of the precipitation will reach the zone of saturation than in the heat of summer because evaporation from the land surface is less and transpiration by vegetation virtually ceases. The first rain after a prolonged drought will add little or nothing to the ground-water reservoir because the moisture deficiency of the soil must be made up before any water can percolate down to the water table. Streams crossing outcrop areas will contribute water if their channels are above the water table, but otherwise will receive water from the saturated zone. In the report area, North Fork of Red River gains water from the terrace deposits; and during periods of above average precipitation, streams tributary to the river also gain water from the terrace deposits.

To estimate how much of the annual precipitation becomes ground water in any area requires a great deal of data. Records of fluctuations of ground-water levels and of natural and artificial discharge of ground water must be obtained for comparison with records of precipitation. Because the amount of recharge varies from year to year, the records for several years are needed if a reasonably close average is to be obtained. The accumulation of the necessary records in Beckham County has only begun, and it cannot be hurried. It will be several years, therefore, before an acceptable estimate of ground-water recharge can be made. Meanwhile, it may be helpful to consider the possibilities of recharge.

In a preliminary estimate for the Pond Creek basin (now called Cobb Creek) of western Caddo County, Okla., Davis (1950, p. 22) found that about 3 percent of the precipitation became ground-water recharge. According to Reed and others (1952, p. 28), ground-water recharge in an area of terrace deposits in the Cimarron River valley west of Enid, Okla., was about 14 percent. The area west of Enid is geologically similar to the part of Beckham County considered in this report. However, the average annual precipitation in Beckham County is less than in either the area west of Enid or in the Pond Creek basin. If ground-water recharge in Beckham County were as low as 3 percent, only about 0.7 inch of water, or 0.06 acre-foot per acre, would be added annually to the ground-water reservoir. If the recharge were as high as 14 percent, about 3.3 inches, or about 0.3 acre-foot per acre, would be added annually. Probably the actual recharge to the terrace deposits of Beckham County is between these extremes, but where it falls is yet to be determined.

QUALITY OF WATER

All natural waters contain mineral matter dissolved from the rocks and soils with which they have come in contact. The quantity of dissolved mineral matter in the water depends primarily on the type of rock or soil through which the water has passed, the length of time of contact, and the pressure and temperature conditions. In addition to these natural factors are others connected with human activities, such as use of streams and wells for disposal of sewage and industrial waste, diversion and use of water for many purposes, and drainage of oil-field brines.

The mineral constituents and physical properties of ground waters reported in the analyses of Appendix B are those having a practical bearing on the value of the waters for most purposes: silica, iron, calcium, magnesium, sodium, potassium (or sodium and potassium reported together as sodium), carbonate, bicarbonate, sulfate, chloride, fluoride, nitrate, dissolved solids, hardness, pH, specific conductance, and temperature. The source and significance of these different constituents and properties of ground waters are discussed in the following paragraphs, which are adapted from publications of the U.S. Geological Survey.

Silica (SiO_2)--Silica is dissolved from practically all rocks. Some ground waters contain less than 5 ppm (parts per million) of silica and a few contain more than 50 ppm. Silica affects the usefulness of a water because it contributes to the formation of boiler scales and is usually removed from feed water for high-pressure boilers. Silica also forms troublesome deposits on the blades of steam turbines.

Iron (Fe)--Iron is dissolved from many rocks and soils. On exposure to the air, normal basic waters that contain more than a few tenths of a part per million of iron soon become turbid with the insoluble reddish ferric oxide produced by oxidation. Iron causes reddish-brown stains on white porcelain or enameled ware and fixtures and on clothing or other fabrics washed in the water.

Calcium (Ca)--Calcium is dissolved from practically all rocks, but the highest concentrations are usually found in waters that have been in contact with limestone, dolomite, and gypsum. Calcium and magnesium make water hard and are largely responsible for the formation of boiler scale.

Magnesium (Mg)--Magnesium is dissolved primarily from dolomitic rocks. Its effect is similar to that of calcium. The magnesium in soft waters may amount to only 1 or 2 ppm.

Sodium and Potassium (Na and K)--Sodium and potassium are dissolved from practically all rocks. Natural waters that contain only 3 or 4 ppm of the two together are likely to carry almost as much potassium as sodium. As the total quantity of these constituents increases, the proportion of sodium becomes much greater. Moderate quantities of sodium and potassium have

little effect on the usefulness of water for most purposes, but water that carries more than 50 to 100 ppm of the two may require careful operation of steam boilers to prevent foaming. More highly mineralized waters in which the proportion of sodium is high in relation to all other basic constituents may be unsatisfactory for irrigation.

Carbonate and Bicarbonate (CO_3 and HCO_3)--Carbonate as such is not present in appreciable quantities in most natural waters. Bicarbonate occurs in waters largely through the action of carbon dioxide, which enables the water to dissolve carbonates of calcium and magnesium. Bicarbonate in moderate concentrations in water has no affect on its value for most uses.

Sulfate (SO_4)--Sulfate is dissolved from many rocks and soils and in especially large quantities from gypsum and beds of shale. It is also formed by the oxidation of sulfides of iron. Sulfate in water that contains much calcium and magnesium causes the formation of hard scale in steam boilers and may increase the cost of softening the water.

Chloride (Cl)--Chloride is present in practically all waters, being dissolved from rocks or from natural salt deposits. Sodium chloride is a common constituent in sewage, and any appreciable pollution is marked by an increase of chlorides. Chlorides in appreciable quantities in water for processing foodstuffs or beverages tend to give a salty taste, and excessive concentrations must be avoided. In some ground waters sodium chloride is the principal chemical constituent and occurs in such concentrations as to cause the water to be unsatisfactory for most industrial, agricultural, and domestic uses.

Fluoride (F)--The importance of fluoride in water for domestic use is becoming more widely recognized (Burwell and others, 1945). In concentrations up to about 1 ppm, fluoride in drinking water is considered by many health authorities to be beneficial in the prevention of tooth decay, especially in growing children. As the concentration increases above 1.5 ppm, fluoride may cause permanent mottling of tooth enamel when used continuously by young children.

Nitrate (NO_3)--Nitrate in water is considered a final oxidation product of nitrogenous material and, in some instances, may indicate previous contamination by sewage or other organic matter. Quantities of nitrate exceeding 45 ppm are believed by some authorities (Walling and others, 1951, p. 19) to be associated with cyanosis in infants who drink such water, and it has been reported that as much as 2 ppm of nitrate in boiler water tends to decrease intercrystalline cracking of boiler steel.

Dissolved Solids--The residue left on evaporation of water consists primarily of the mineral constituents that were dissolved in the water, and it may also contain some organic matter and water of crystallization. These are reported as dissolved solids. Waters with less than 500 ppm dissolved solids generally are satisfactory for domestic and some industrial uses.

Hydrogen-Ion Concentration (pH)--The acidity or alkalinity of water is indicated by the hydrogen-ion concentration expressed as pH. This value is useful in determining the proper treatment for coagulation that may be necessary at water-treating plants. A pH value of 7.0 indicates that the water is neutral, being neither acid nor alkaline. Values below 7.0 denote acidity and corrosiveness, whereas values above 7.0 denote alkalinity.

Specific Conductance--The specific conductance of a water is a measure of its ability to conduct a current of electricity. The conductance varies with the concentration and degree of ionization of the different minerals in solution and with the temperature of the water. The specific conductance, as an indication of dissolved-solids content, is one of the characteristics to be considered when selecting a water for use in irrigation.

Hardness--Hardness is the characteristic of water that receives the most attention with reference to industrial and domestic use. It is usually recognized by the quantity of soap required to produce lather. Hard water is objectionable because of the formation of scale in boilers, water heaters, radiators, and pipes, with a resultant decrease in the rate of heat transfer, the possibility of boiler failure, and reduction of flow. Hardness is caused mostly by compounds of calcium and magnesium. Other constituents such as iron, manganese, aluminum, barium, strontium, and free acid also cause hardness, but they are not usually found in appreciable quantities so far as hardness is concerned in most natural waters. Water that has a total hardness of less than 50 ppm is usually rated as soft, and its treatment for removal of hardness is seldom justified. Hardness between 50 and 150 ppm does not seriously interfere with the use of water for most household uses, but softening may be profitable for laundries and other industries. When the hardness exceeds 150 ppm, softening generally is desirable for most uses.

Corrosiveness--The corrosiveness of a water is that property which makes it aggressive to metal surfaces. Oxygen, carbon dioxide, free acid and acid-generating salts are the principal corrosive constituents in water. In a general way, very soft waters of low mineral content are more corrosive than hard waters containing appreciable quantities of carbonates and bicarbonates of calcium and magnesium. Corrosiveness is measured roughly by the pH and may result in "red water" which is caused by solution of iron. Corrosion causes the deterioration of water pipes, steam boilers, and water-heating equipment. Many waters that do not appreciably corrode cold-water lines will aggressively attack hot-water lines.

Quality in Relation to Use

The general chemical character of the ground water in central Beckham County is indicated by analyses of water samples from 13 public-supply, 6 domestic, and 2 industrial wells and from 1 spring (App. B). The analyses were made by standard methods in the laboratory of the Quality of Water Branch of the U.S. Geological Survey. Among the constituents given in the analyses are calcium, magnesium, sodium, bicarbonate, sulfate, and chloride. These constituents make up most of the dissolved mineral matter in natural

waters, and they largely determine the usefulness of water for industrial, agricultural and domestic use, without reference to sanitary considerations. In the samples from the terrace deposits of central Beckham County, the dissolved solids ranged from 281 to 994 ppm; calcium from 57 to 206; magnesium from 9 to 76; sodium and potassium (calculated as sodium) from 15 to 66; bicarbonate from 161 to 38; sulfate from 15 to 504; and chloride from 4 to 38 ppm. The hardness ranged from 173 to 670 ppm, and most people would regard the water as very hard. The analyses of water from the bedrock show relatively high concentrations of chloride, sulfate, and dissolved solids.

Domestic use--Chemical-quality standards for water used for drinking and culinary purposes on interstate commerce carriers have been recommended by the U.S. Public Health Service (1946). These standards were revised in 1962, and since the Public Health Service Standards are commonly used to judge the suitability of waters for human consumption, this section has been revised to conform with the standards of 1962. Some of the limits suggested by the Public Health Service are iron (Fe), 0.3 ppm; sulfate (SO₄), 250 ppm; chloride (Cl), 250 ppm; nitrate (NO₃), 45 ppm; total dissolved solids, 500 ppm. The recommended limit for fluoride (F) in drinking water depends upon the annual average of the maximum daily air temperatures. In the central part of Beckham County it is 1.6 ppm. Although these are the recommended limits, most individuals can tolerate drinking water that contains most of the listed constituents in considerably higher concentrations than those specified in the Public Health Service Standards.

In all samples analyzed, the content of iron ranged from 0 to 0.04 ppm. Sulfate ranged from 15 to 1,930 ppm, but only 5 samples contained more than 250 ppm. The chloride content ranged from 3.2 to 171 ppm.

Nitrate has little effect on the use of water for most purposes; however, concentrations of nitrate in amounts greater than about 45 ppm in water used for infant feeding may cause methemoglobinemia, the so-called "blue-baby" disease. Two of the samples contained more than 45 ppm.

Although fluoride is desirable in small amounts in drinking water because it reduces dental caries in children, in large amounts it causes mottled enamel. Water from one well contained more than 1.6 ppm.

Arbitrarily, water has been classified with regard to hardness as follows: 60 ppm or less, soft; 61-120 ppm, moderately hard; 121-180 ppm, hard, more than 180 ppm, very hard. Judged by these standards, the water in central Beckham County is very hard.

Dissolved solids ranged from 349 to 3,470 ppm; 14 samples contained more than 500 ppm and 3 samples contained more than 2,700 ppm.

Irrigation--The suitability of water for irrigation depends on several factors in addition to the mineral content of the water, among them the amount of water applied to the soil, the precipitation, the drainage and the physical and chemical characteristics of the soil. This subject is

discussed rather fully by Smith (1942, p. 16-18). The total amount of dissolved mineral matter, and the percent of sodium in the water suggest whether a water may be used satisfactorily in irrigation. Figure 3 affords a graphical method of appraising a water to be used for irrigation.

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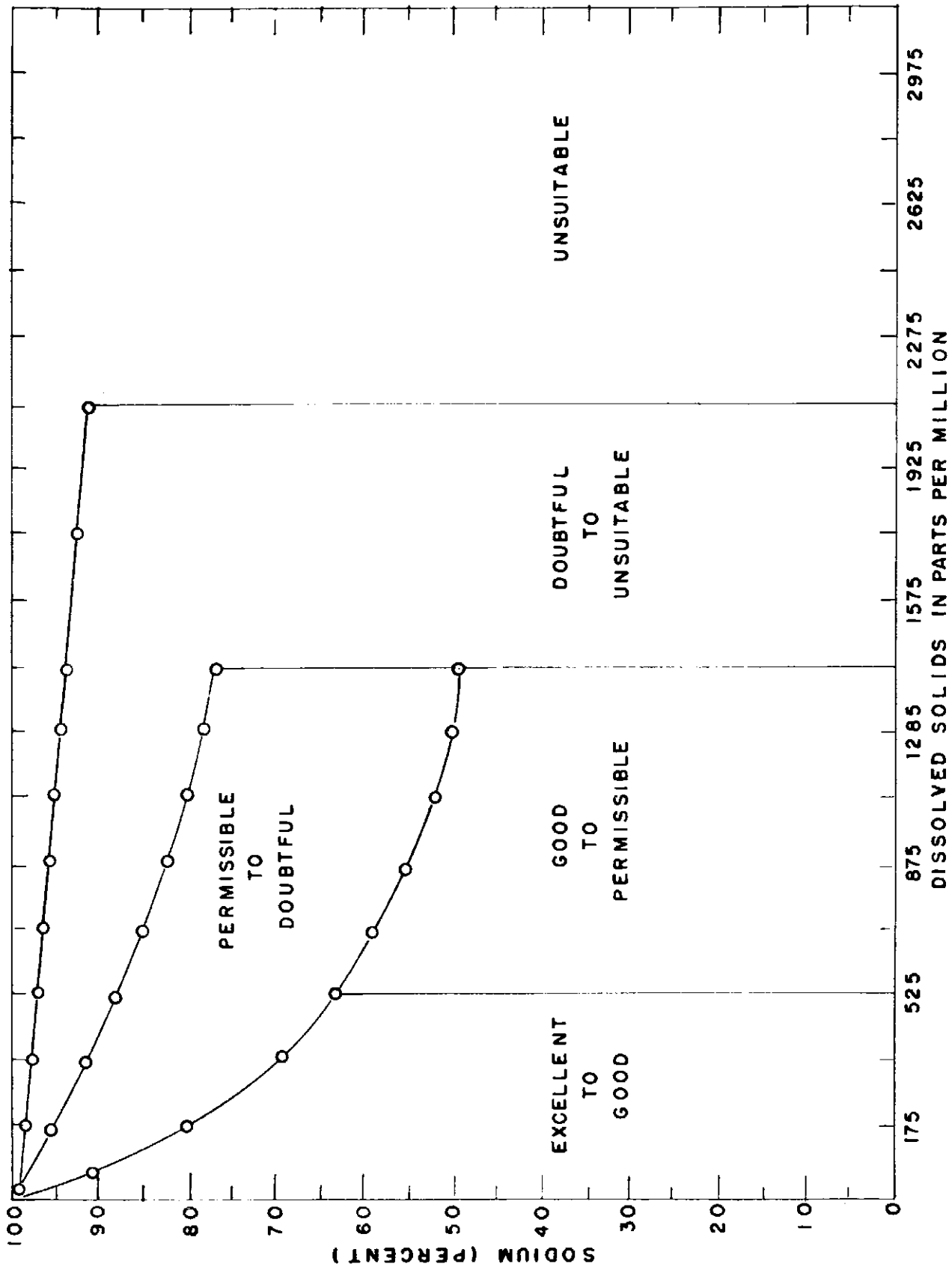


Figure 3.--Diagram for interpreting analysis of irrigation water. (From Chemical and Engineering News, 1951. Modified by T. B. Dover.)

Appendix A.. Records of wells and test holes in central Beckham County, Okla.

Well number: Well numbering system described on page 4.

well locations shown on plate 2.

Type of well: B, bored; D, drilled; Dg, dug.

Geologic source: P, bedrock of Permian age;

Qt, terrace deposits; Qal, alluvium.

Pump and power: B, bucket; C, cylinder; J, jet, T, turbine; N, none;

b, butane; e, electric; g, gasoline; h, hand, w, wind.

Use: D, domestic; I, irrigation; In, industrial; O, observation;

P, public supply; N, none; T, test hole.

Other data: C, chemical analysis in Appendix B; L, log in Appendix C.

Well number	Location in section	Owner or tenant	Type of well	Pump and power	Use	Geologic source	Depth of well (feet)	Water level		Altitude above mean sea level (feet)			Other data
								Depth below land surface (feet)	Date of measurement	Land surface	Water-level surface	Permian surface	
8N-23W-1ddd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ SE $\frac{1}{2}$	U.S. Geol. Survey	D	N	T	Qt	54	4.00	7- 5-51	1,722	1,718	1,679	L
3ddd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ SE $\frac{1}{2}$	do	D	N	T	Qt	58	3.30	7- 5-51	1,813	1,810	1,718	L
4ccd1	SE $\frac{1}{2}$ SW $\frac{1}{2}$ SW $\frac{1}{2}$	A. F. Wells	D	B,h	D	Qt	97	39.32	2-28-52	.....	.....	.....
5aabl	NE $\frac{1}{2}$ NW $\frac{1}{2}$ NE $\frac{1}{2}$	U.S. Geol. Survey	D	N	T	Qt	135	47.80	7- 5-51	1,910	1,862	1,775	L
6dd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$	Clarence Cherry	Dg	J,e	D,S	Qt	36	25.37	3- 1-52	.....	.....	.....
6cc1	SW $\frac{1}{2}$ SW $\frac{1}{2}$	W. O. Hood	D	J,e	D	Qt	26	.....	.....	.....	.....	.....
7aaa1	NE $\frac{1}{2}$ NE $\frac{1}{2}$ NE $\frac{1}{2}$	U.S. Geol. Survey	D	N	T	Qt	40	25.00	7- 5-51	1,909	1,884	1,874	L
8bbb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ NW $\frac{1}{2}$	Dr. Bonfield	Dg	J,e	S	...	30	.....	.....	.....	.....	.....
9bbb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ NW $\frac{1}{2}$	U.S. Geol. Survey	D	N	T	Qt	52	27.40	7- 5-51	1,902	1,875	1,853	L
15bbb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ NW $\frac{1}{2}$	Jack Bonfield	D	C,w	O	...	52	30.28	2- 9-52	.....	.....	.....
16baa1	NE $\frac{1}{2}$ NW $\frac{1}{2}$ NW $\frac{1}{2}$	Garland Gurley	D	C,w	S	Qt	...	.....	.....	.....	.....	.....
8N-24W-1dcc1	SW $\frac{1}{2}$ SW $\frac{1}{2}$ SE $\frac{1}{2}$	Ralph Moore	D	J,e	D	Qt	...	.....	.....	.....	.....	.....
2ddd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ SE $\frac{1}{2}$	Mrs. C. E. Waters	D	N	O	Qt	29	16.70	3- 3-52	.....	.....	.....
9dda1	NE $\frac{1}{2}$ SE $\frac{1}{2}$ SE $\frac{1}{2}$	G. O. McDonald	D	T,g	I	P	107	46.60	5-10-51	.....	.....	.....
11ddd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ SE $\frac{1}{2}$	U.S. Geol. Survey	D	N	T	Qt	32	25.00	7- 5-51	1,928	1,903	1,897	L
12bbb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	N	T	Qt	98	13.50	7- 5-51	1,914	1,901	1,819	L
8N-25W-4abb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ NE $\frac{1}{2}$	Guy Brock	Dg	C,w	S	Qt	14	9.60	3- 4-52	.....	.....	.....
4bcc1	SW $\frac{1}{2}$ SW $\frac{1}{2}$ NW $\frac{1}{2}$	.....	Dg	N	O	Qt	...	15.43	3- 4-52	.....	.....	.....
8N-26W-2bb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$	J. P. Johnson	Dg	C,w	S	Qt	45	.....	.....	.....	.....	.....
9N-22W-19aaa1	NE $\frac{1}{2}$ NE $\frac{1}{2}$ NE $\frac{1}{2}$	Shell Oil Co.	D	N	T	Qal	34	6.00	1950	1,747	1,741	1,713	L
19aad1	SE $\frac{1}{2}$ NE $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	N	T	Qal	33	7.00	1950	1,745	1,738	1,712	L
19aad2	SE $\frac{1}{2}$ NE $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	N	T	Qal	32	6.00	1950	1,744	1,738	1,712	L
19add1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	N	T	Qal	44	5.00	1950	1,742	1,737	1,710	L
19add2	SE $\frac{1}{2}$ SE $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	N	T	Qal	33	6.00	1950	1,741	1,735	1,708	L
19aac1	SW $\frac{1}{2}$ SW $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	N	T	Qal	23	2.00	1950	1,745	1,743	1,722	L
19cac1	SW $\frac{1}{2}$ NE $\frac{1}{2}$ SW $\frac{1}{2}$	do	D	N	T	Qt	32	26.00	1950	1,802	1,776	1,770	L
19cad1	SE $\frac{1}{2}$ NE $\frac{1}{2}$ SW $\frac{1}{2}$	do	D	N	T	Qt	18	12.00	1950	1,769	1,757	1,751	L
19cad2	NE $\frac{1}{2}$ SE $\frac{1}{2}$ SW $\frac{1}{2}$	do	D	N	T	Qt	23	12.00	1950	1,762	1,750	1,739	L
19cdd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ SW $\frac{1}{2}$	John Edwards	D	B,h	D	Qt	22	14.00	2-27-51	.....	.....	.....
20cbb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ SW $\frac{1}{2}$	Shell Oil Co.	D	N	T	Qal	33	5.00	1950	1,741	1,736	1,708	L
20cbc1	SW $\frac{1}{2}$ NW $\frac{1}{2}$ SW $\frac{1}{2}$	do	D	N	T	Qal	35	6.00	1950	1,741	1,735	1,706	L
20ccb1	NW $\frac{1}{2}$ SW $\frac{1}{2}$ SW $\frac{1}{2}$	do	D	N	T	Qal	32	6.00	1950	1,740	1,734	1,708	L
29bbb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	N	T	Qal	33	3.00	1950	1,737	1,734	1,704	L
29bbc1	SW $\frac{1}{2}$ NW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	N	T	Qal	31	3.00	1950	1,735	1,732	1,704	L
30aaa1	NE $\frac{1}{2}$ NE $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	N	T	Qal	34	5.00	1950	1,739	1,734	1,705	L
30abb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	N	T	Qt	55	22.00	1950	1,775	1,753	1,720	L
30abc1	SW $\frac{1}{2}$ NW $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	N	T	Qt	41	18.00	1950	1,773	1,755	1,732	L
30bbd1	SE $\frac{1}{2}$ NW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	N	T	Qt	33	24.00	1950	1,789	1,765	1,756	L
30abc1	SW $\frac{1}{2}$ NW $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	N	T	Qt	34	11.00	1950	1,767	1,755	1,733	L
30bac1	SW $\frac{1}{2}$ NE $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	N	T	Qt	41	25.00	1950	1,788	1,762	1,747	L
30add1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	N	T	Qal	32	2.00	1950	1,736	1,734	1,704	L
30acc1	SW $\frac{1}{2}$ SW $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	N	T	Qt	44	6.00	1950	1,761	1,755	1,717	L
30bcd1	SE $\frac{1}{2}$ SW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	T,e	In,D	Qt	67	17.00	11- 1-51	1,776	1,761	1,714	C,L
30acc2	SW $\frac{1}{2}$ SW $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	N	T	Qt	29	24.00	1950	1,777	1,753	1,748	L
30bcd1	SE $\frac{1}{2}$ SW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	N	T	Qt	90	.....	.....	1,785	.....	1,707	L
30dbb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ SE $\frac{1}{2}$	do	D	N	T	Qt	45	14.00	1950	1,757	1,743	1,712	L
30cba1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ SW $\frac{1}{2}$	do	D	T,e	In,D	Qt	58	24.50	8-23-51	1,782	1,758	1,724	C
30cbb1	NW $\frac{1}{2}$ SW $\frac{1}{2}$ SE $\frac{1}{2}$	do	D	N	T	Qt	57	17.00	1950	1,763	1,745	1,710	L
30cca1	NE $\frac{1}{2}$ SW $\frac{1}{2}$ SW $\frac{1}{2}$	do	D	N	T	Qt	40	24.00	1950	1,780	1,756	1,740	L
30dcc1	SW $\frac{1}{2}$ SW $\frac{1}{2}$ SE $\frac{1}{2}$	do	D	N	T	Qt	65	27.00	1950	1,773	1,746	1,708	L
30ccd1	SE $\frac{1}{2}$ SW $\frac{1}{2}$ SW $\frac{1}{2}$	do	D	N	T	Qt	30	24.00	1950	1,779	1,755	1,749	L
30cbb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ SW $\frac{1}{2}$	Morrison	D	B,h	D	Qt	36	29.50	2-28-52	.....	.....	.....
31abb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ NE $\frac{1}{2}$	Shell Oil Co.	D	N	T	Qt	43	.....	.....	1,755	.....	1,712	L
31bbb1	NW $\frac{1}{2}$ NW $\frac{1}{2}$ NW $\frac{1}{2}$	Nellie Brown	D	B,h	D	Qt	53	34.66	2-28-52	.....	.....	.....
9N-23W-4ddd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ SE $\frac{1}{2}$	.....	D	N	O	Qt	33	12.10	2-27-52	.....	.....	.....
4-dcc1	SW $\frac{1}{2}$ SW $\frac{1}{2}$ SE $\frac{1}{2}$	Duggard	D	C,w	S	Qal	15	6.40	8-31-51	.....	.....	.....
4ccd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ SW $\frac{1}{2}$	Nellie Stinnett	D	C,w	D	Qal	9	4.28	8-31-51	.....	.....	.....
4ccd1	SE $\frac{1}{2}$ SW $\frac{1}{2}$ SW $\frac{1}{2}$	Therman Howard	D	C,w	D	Qal	21	8.52	8-31-51	.....	.....	.....
8dd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$	L. C. Woolsey	Dg	B,h	D	Qt	57	51.57	2-13-52	.....	.....	.....
8ada1	NE $\frac{1}{2}$ SE $\frac{1}{2}$ NE $\frac{1}{2}$	Yandell	D	N	O	Qal	14	12.74	2-28-52	.....	.....	.....
9ddd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ SE $\frac{1}{2}$	J.W. Williams	D	C,w	D,S	Qt	...	.....	.....	.....	.....	.....
9aab1	NW $\frac{1}{2}$ NE $\frac{1}{2}$ NE $\frac{1}{2}$	O. H. Thompson	D	B,h	S	Qal	20	11.05	9- 1-51	.....	.....	.....
9aab2	NW $\frac{1}{2}$ NE $\frac{1}{2}$ NE $\frac{1}{2}$	do	D	B,h	D	Qt	36	16.47	9- 1-51	.....	.....	.....
9bcc3	SW $\frac{1}{2}$ SW $\frac{1}{2}$ NW $\frac{1}{2}$	Sayre, Okla.	D	T,e	P	Qt	33	.....	.....	.....	.....	.....
9bcc2	SW $\frac{1}{2}$ SW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	T,e	P	Qt	68	.....	.....	.....	.....	.....	C
9bcc1	SW $\frac{1}{2}$ SE $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	T,e	P	Qt	80	.....	.....	.....	.....	.....	C
9bcc1	SW $\frac{1}{2}$ SW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	T,e	P	Qt	57	.....	.....	.....	.....	.....	C
9bcc1	SE $\frac{1}{2}$ SW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	T,e	P	Qal	35	.....	.....	.....	.....	.....	C
9bdd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	T,e	P	Qt	96	.....	.....	.....	.....	.....
9bcc4	SW $\frac{1}{2}$ SW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	T,e	P	Qt	45	.....	.....	.....	.....	.....
9bcc1	SW $\frac{1}{2}$ NW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	T,e	P	Qal	35	.....	.....	.....	.....	.....
9bcc2	NW $\frac{1}{2}$ SW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	T,e	P	Qal	...	.....	.....	.....	.....	.....
9bcc3	SE $\frac{1}{2}$ SW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	T,e	P	Qt	78	.....	.....	.....	.....	.....	C
9bcc2	SE $\frac{1}{2}$ SW $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	T,e	P	Qt	60	.....	.....	.....	.....	.....	C
9bdd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ NW $\frac{1}{2}$	do	D	T,e	P	Qt	55	.....	.....	.....	.....	.....	C
10abd1	SE $\frac{1}{2}$ NW $\frac{1}{2}$ NE $\frac{1}{2}$	R. E. Bohannon	D	B,h	D	Qt	30	24.67	2-27-52	.....	.....	.....
10ada1	NE												

Well number	Location in section	Owner or tenant	Type of well	Pump and power	Use	Geologic source	Depth of well (feet)	Water level		Altitude above mean sea level (feet)			Other data
								Depth below land surface (feet)	Date of measurement	Land surface	Water-level surface	Permian surface	
13bbal	SW $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$	Elk City, Okla.	D	N	T	Qt	26	2.00	1950	1,766	1,764	1,740	
13cccl	NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$	.....	D	C,w	S	Qt	32	23.50	2-27-52	.....	.....	.....
13ddcl	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	B,h	D,O	Qt	47	39.75	2-27-52	.....	.....	.....
14aaa1	SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	Morrison	D	B,h	D	Qt	49	45.58	2-26-52	.....	.....	.....
14add1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	Elk City, Okla	D	N	T	Qt	28	17.00	1950	1,809	1,792	1,781	
14baa1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	43	39.00	1950	1,829	1,790	1,786	
14cbb1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	do	D	N	T	Qt	51	35.00	1950	1,837	1,802	1,786	
14ccd1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$	do	D	T,e	P	Qt	110	53.00	1950	1,853	1,800	1,743	
14cca1	SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	do	D	T,e	P	Qt	115	.....	.....	.....	.....	.....
14caa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$	do	D	N	T	Qt	48	.....	.....	1,841	.....	1,792	
15aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	55	41.00	1950	1,850	1,809	1,795	
15add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	77	42.00	1950	1,844	1,802	1,767	
15bbb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	Ben Green	D	J,e	D,S	Qt	50	.....	.....	.....	.....	.....
15caa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$	Elk City, Okla.	D	N	N	Qt	95	39.00	1950	1,851	1,812	1,756	
16aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	95	39.00	1950	1,856	1,817	1,761	
16add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	104	51.00	1950	1,867	1,816	1,763	
17aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	53	37.00	1950	1,849	1,809	1,795	
17add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	.....	D	B,h	O	Qt	49	41.20	2-28-52	.....	.....	.....
17dda1	NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	W. G. Blevins	D	B,h	D	Qt	54	48.79	2-13-52	.....	.....	.....
18ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	U.S. Geol. Survey	D	N	O	Qt	59	32.52	7- 5-51	1,839	1,806	1,785	
18aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	.....	D	C,w	S,O	Qt	28	16.50	11-14-51	.....	.....	.....
19bcc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$	.....	D	N	O	Qt	62	52.10	2-14-52	.....	.....	.....
20aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	Elk City, Okla.	D	N	T	Qt	129	47.00	1950	1,877	1,830	1,747	
20aaa2	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	Paul Watson	D	J,e	D,S	Qt	100	.....	.....	.....	.....	.....
21aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	Elk City, Okla.	D	N	T	Qt	120	46.00	1950	1,866	1,820	1,746	
22aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	110	53.00	1950	1,853	1,800	1,743	
22aaa2	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	113	49.00	1950	1,852	1,803	1,739	
22aab1	NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	120	48.00	1950	1,852	1,804	1,732	
22aba1	NE $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	95	48.00	1950	1,853	1,805	1,758	
22abb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	113	49.00	1950	1,857	1,808	1,744	
22add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	98	42.00	1950	1,847	1,805	1,749	
22baa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	130	53.00	1950	1,863	1,810	1,733	
22baa2	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	do	D	N	T	Qt	102	50.00	1950	1,866	1,816	1,764	
23aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	70	39.00	1950	1,832	1,793	1,762	
23add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	48	33.00	1950	1,826	1,793	1,778	
23baa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	do	D	N	T	Qt	77	45.00	1950	1,841	1,796	1,764	
23bbc1	SW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	do	D	T,e	P	Qt	95	.....	.....	.....	.....	.....
24aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$	Shell Oil Co.	D	N	T	Qt	26	16.00	1950	1,797	1,781	1,771	
24add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	18	13.00	1950	1,792	1,779	1,774	
25aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	38	22.00	1950	1,801	1,778	1,763	
25aad1	SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	39	21.00	1950	1,796	1,775	1,757	
25aad2	SE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	68	16.00	1950	1,787	1,771	1,719	
25add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	62	20.00	1950	1,789	1,769	1,727	
25add2	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	55	20.00	1950	1,788	1,768	1,733	
25daa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$	do	D	N	T	Qt	55	22.00	1950	1,789	1,767	1,734	
25dad1	SE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$	do	D	N	T	Qt	42	27.00	1950	1,792	1,765	1,750	
25dda1	NE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	do	D	N	T	Qt	31	29.00	1950	1,796	1,767	1,765	
26aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	Elk City, Okla.	D	N	T	Qt	70	50.00	1950	1,841	1,791	1,771	
26bcc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$	Williams Estate	D	N	O	Qt	75	64.00	2-28-52	.....	.....	.....
27aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	Elk City, Okla.	D	N	T	Qt	90	48.00	1950	1,860	1,812	1,770	
27add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	88	54.00	1950	1,866	1,812	1,778	
28aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	75	63.00	1950	1,891	1,828	1,816	
28bbb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	do	D	C,w	D,S	Qt	86	71.00	2-13-52	.....	.....	.....
28baa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	Okla. Nat. Gas Co.	D	J,e	In	Qt	80	47.96	2-28-52	.....	.....	.....
28baa2	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	do	D	J,e	In	Qt	80	63.59	2-28-52	.....	.....	.....
28ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	120	59.50	7- 5-51	1,901	1,841	1,788	
29aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	Elk City, Okla.	D	N	T	Qt	70	53.00	1950	1,891	1,838	1,821	
29add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	E. W. Barker	D	C,w	D,S	Qt	78	61.95	2-13-52	.....	.....	.....
32ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	Ralph Moore	D	C,w	S	Qt	63	35.76	2-12-52	.....	.....	.....
32ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$	do	D	N	O	Qt	49	45.11	2-13-52	.....	.....	.....
34aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	Elk City, Okla.	D	N	T	Qt	112	69.00	1950	1,882	1,813	1,770	
35baa1	NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	.....	D	C,w	S	Qt	100	69.44	2-28-52	.....	.....	.....
35ccd1	SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	C,w	S	Qt	89	83.47	2-28-52	.....	.....	.....
36aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	Shell Oil Co.	D	.....	.....	Qt	30	28.00	1950	1,802	1,774	1,772	
9N-24W-6ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	55	23.50	7- 5-51	1,934	1,911	1,885	
7cc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	C,h	D	Qt	21	17.53	4- 8-52	.....	.....	.....
9add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	W. L. Dowdell	D	C,w	S	Qt	27	13.85	2-26-52	.....	.....	.....
10ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	M. A. Berry	D	C,w	D,S	Qt	27	.....	.....	.....	.....	.....
12ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	60	16.50	7- 5-51	1,847	1,830	1,793	
12ddd2	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	Fred Stagg	D	J,e	D	Qt	33	16.64	9- 6-51	.....	.....	.....
14bbb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	61	19.00	7- 5-51	1,854	1,835	1,795	
14cda1	NE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	.....	D	N	O	Qt	26	25.66	2-14-52	.....	.....	.....
14cbb1	NW $\frac{1}{4}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$	.....	D	C,w	T	Qt	31	.....	.....	.....	.....	.....
16ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	U.S. Geol. Survey	D	N	O	Qt	67	39.46	7- 5-51	1,908	1,860	1,843	
16ccb1	NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	R. W. Sanders	D	B,h	D	Qt	39	34.47	8-29-51	.....	.....	.....
16ccb2	NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	do	D	J,e	D	Qt	83	33.40	6- 7-51	.....	.....	.....
17aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	50	20.00	7- 5-51	1,899	1,869	1,852	
18ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	do	D	N	T	Qt	98	35.00	7- 5-51	1,931	1,896	1,835	
18bbb1	NW<												

Well number	Location in section	Owner or tenant	Type of well	Pump and power	Use	Geologic source	Depth of well (feet)	Water level		Altitude above mean sea level (feet)			Other data
								Depth below land surface (feet)	Date of measurement	Land surface	Water-level surface	Permian surface	
9N-24W-30ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	N	O	Qt	73	65.00	2-26-62	.....	.....	.....
31bbb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	50	37.20	7- 5-51	1,992	1,954	1,943	L
32ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	do	D	N	T	Qt	20	.....	.....	1,978	.....	1,960	L
32baa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	Henry Flanagan	D	S,e	S	Qt	53	.....	.....	.....	.....	.....
33aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	115	49.00	7- 5-51	1,943	1,894	1,830	L
33ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	.....	Dg	B,h	S,O	Qt	12	7.70	2-26-62	.....	.....	.....
35cdc1	SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	45	20.20	7- 5-51	1,928	1,908	1,885	L
9N-25W-1aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	62	31.00	7- 5-51	1,943	1,904	1,886	L
1aab1	NW $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	John Catlott	D	C,w,h	D,S	Qt	...	.....	.....	.....	.....	.....
1ccd1	SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	John Bronbreak	B	C,w,h	D,S	Qt	48	38.37	12- 4-51	.....	.....	.....
1ccd2	SE $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	do	D	N	O	Qt	46	38.63	12- 4-51	.....	.....	.....
2ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	90	39.00	7- 5-51	1,987	1,948	1,904	L
2ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	C,w	N	Qt	43	.....	.....	.....	.....	.....
2dcd1	SE $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$	.....	D	C,h	O	Qt	56	38.50	12- 4-51	.....	.....	.....
3ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	150	54.00	7- 5-51	1,984	1,929	1,857	L
3aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	O	Qt	40	14.91	12- 3-51	1,943	1,927	1,905	L
3abb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$	T. H. Pirtle	Dg	B,h	S	Qt	51	30.02	12-11-51	.....	.....	.....
4bc1	SW $\frac{1}{4}$ NW $\frac{1}{4}$	Erick, Okla.	D	N	O	Qt	53	40.38	11-26-51	.....	.....	.....
4bdd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$	do	D	N	T	Qt	62	37.50	.....	.....	.....	.....
4cab1	NW $\frac{1}{4}$ NE $\frac{1}{4}$ SW $\frac{1}{4}$	do	D	N	T	Qt	54	33.00	1946	.....	.....	.....	L
4cbb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$	do	D	N	T	Qt	55	26.00	1946	.....	.....	.....	L
4ccb1	NW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	do	D	N	T	Qt	46	.....	.....	.....	.....	.....	L
4ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	do	D	N	T	Qt	60	41.00	1946	.....	.....	.....	L
5ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	H. E. Russel, Sr.	D	B,h	O	Qt	45	34.41	11-15-51	.....	.....	.....
6ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	35	22.70	7- 5-51	1,974	1,951	1,943	L
6da1	NE $\frac{1}{4}$ SE $\frac{1}{4}$	W. A. Amend	D	B,h	D	Qt	24	13.39	11-28-51	.....	.....	.....
6db1	NW $\frac{1}{4}$ SE $\frac{1}{4}$	do	D	C,w	S	Qt	20	9.98	11-28-51	.....	.....	.....
7ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	27	16.50	7- 5-51	2,014	1,948	1,988	L
7add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	Sally Pigg	D	J,e	D	Qt	40	.....	.....	.....	.....	.....
8bd1	SE $\frac{1}{4}$ NW $\frac{1}{4}$	G. R. Pigg	D	J,e	D,S	Qt	56	.....	.....	.....	.....	.....
8dcc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$	G. R. Crosby	D	C,w	S	Qt	60	.....	.....	.....	.....	.....
8add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	Erick, Okla.	D	N	T	Qt	65	46.00	1946	.....	.....	.....	L
8ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	do	D	N	T	Qt	72	54.00	1946	.....	.....	.....	L
9aa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$	H. L. Wolfe	D	C,w	D,S	Qt	64	.....	.....	.....	.....	.....
9bab1	NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	.....	D	N	O	Qt	61	48.81	11-26-51	.....	.....	.....
9bbb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	L. D. Ramsey	D	B,h	D,S	Qt	57	41.03	11-26-51	.....	.....	.....
9ddc1	SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	Roy Spencer	D	C,h	O	Qt	64	56.39	11-29-51	.....	.....	.....
10cb1	NW $\frac{1}{4}$ SW $\frac{1}{4}$	F. L. Reed	B	C,w	S	Qt	56	.....	.....	.....	.....	.....
10cb2	NW $\frac{1}{4}$ SW $\frac{1}{4}$	do	B	C,h	D	Qt	70	.....	.....	.....	.....	.....
103bc1	SW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$	G. G. Murray	D	C,w	D,S	Qt	...	.....	.....	.....	.....	.....
11ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	128	50.20	7- 5-51	1,989	1,939	1,869	L
11aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	Clancy	D	C,w	D,S	Qt	...	.....	.....	.....	.....	.....
11bbd1	SE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	Clarence Murray	D	N	O	Qt	109	37.64	12-12-51	.....	.....	.....
11bbb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	do	Dg	Gas	I	Qt	...	.....	.....	.....	.....	.....
12ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	C,w	D,S	Qt	...	.....	.....	.....	.....	.....
12ccc2	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	C,w	S	Qt	46	44.13	12- 4-51	.....	.....	.....
12daa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$	.....	D	C,w	D,S	Qt	...	.....	.....	.....	.....	.....
13add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	Hugh House	D	C,h	D,S	Qt	...	.....	.....	.....	.....	.....
14add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	.....	D	C,w	D,S	Qt	...	.....	.....	.....	.....	.....
14dd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$	A. J. Jones	B	C,h	D,S	Qt	75	.....	.....	.....	.....	.....
16add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	Mrs. Bingham	D	C,w	D,S	Qt	...	.....	.....	.....	.....	.....
17add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	S. F. Sarkey	D	C,w	D	Qt	77	59.91	11-26-51	.....	.....	.....
17add2	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	Erick, Okla.	D	N	T	Qt	75	62.00	1946	.....	.....	.....	L
17bc1	SW $\frac{1}{4}$ NW $\frac{1}{4}$	J. W. Van	D	J,e	D,S	Qt	...	.....	.....	.....	.....	.....
17da1	NE $\frac{1}{4}$ SE $\frac{1}{4}$	.....	D	N	N	Qt	74	.....	.....	.....	.....	.....
17ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	Erick, Okla.	D	N	T	Qt	80	70.00	1946	.....	.....	.....	L
18ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	60	.....	.....	1,999	.....	1,947	L
18aa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$	George Davis	D	C,w	S	Qt	49	29.57	11-28-51	.....	.....	.....
18aa2	NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	C,w	S	Qt	42	17.82	11-28-51	.....	.....	.....
19bac1	SW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	E. T. Davis	Dg	C,w	S	Qt	21	.....	.....	.....	.....	.....
19bda1	NE $\frac{1}{4}$ SE $\frac{1}{4}$ NW $\frac{1}{4}$	do	Dg	C,w	S	Qt	33	.....	.....	.....	.....	.....
19ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	N	O	Qt	36	18.25	11-15-51	.....	.....	.....
20bbb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	.....	D	B,h	D	Qt	63	54.68	11-15-51	.....	.....	.....
20ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	H. E. Russel, Jr.	D	C,w	D,S	Qt	68	56.47	11-27-51	.....	.....	.....
20cdc1	SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	N	O	Qt	80	70.68	11-23-51	.....	.....	.....
20add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	Erick, Okla.	D	N	T	Qt	70	55.70	1946	.....	.....	.....	L
20ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	do	D	N	T	Qt	70	64.00	1946	.....	.....	.....	L
21aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	195	.....	.....	.....	2,036	.....	L
21cd1	SE $\frac{1}{4}$ SW $\frac{1}{4}$	R. C. Bloodworth	D	C,w	D	Qt	...	.....	.....	.....	.....	.....
21ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	C. L. Strong	D	C,w	T	Qt	...	.....	.....	.....	.....	.....
22ddd1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	Barnell	D	C,h	S	Qt	65	47.00	12-11-51	.....	.....	.....
23aaa1	NE $\frac{1}{4}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	.....	D	C,w	S	Qt	35	30.70	12-12-51	.....	.....	.....
23bbb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	W. E. Brown	D	C,w	D,S	Qt	60	.....	.....	.....	.....	.....
23cdc1	SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	C,h	O	Qt	51	26.20	12-12-51	.....	.....	.....
23ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	C,h	D,S	Qt	48	27.52	12-12-51	.....	.....	.....
24bbb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	54	19.00	7- 5-51	1,995	1,974	1,926	L
24ab1	NW $\frac{1}{4}$ NE $\frac{1}{4}$	.....	D	C,e	D,S	Qt	...	.....	.....	.....	.....	.....
24bab1	NW $\frac{1}{4}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	.....	D	N	O	Qt	66	52.35	12-12-51	.....	.....	.....
26bbb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	70	37.70	7- 5-51	1,972	2,009	1,954	L
26bb1	NW $\frac{1}{4}$ NW $\frac{1}{4}$	.....	D	C,w	D,S	Qt	...	.....	.....	.....	.....	.....
26cdc1	SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$	Caudill	D	C,h	D,S	Qt	20	9.30	12-13-51	.....	.....	.....
26ddc1	SW $\frac{1}{4}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	Charley Simons	D	C,w	D,S	Qt	34	17.97	12-13-51	.....	.....	.....
27add1	SE $\frac{1}{4}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	.....	D	C,w	S	Qt	47						

Well number	Location in section	Owner or tenant	Type of well	Pump and power	Use	Geologic source	Depth of well (feet)	Water level		Altitude above mean sea level (feet)			Other data
								Depth below land surface (feet)	Date of measurement	Land surface	Water-level surface	Permian surface	
9N-25W-29ddd1	SE $\frac{1}{2}$ SE $\frac{1}{2}$ SE $\frac{1}{4}$	Erick, Okla	D	N	T	Qt	49	23.50	1940	.....	.....	.....	L
30ba1	NE $\frac{1}{2}$ NW $\frac{1}{4}$	.....	D	N	O	Qt	47	37.26	11-15-51	.....	.....	.....	L
31da1	SE $\frac{1}{2}$ NE $\frac{1}{4}$	.....	D	N	O	Qt	42	32.25	11-15-51	.....	.....	.....	L
31bcb1	NW $\frac{1}{2}$ SW $\frac{1}{4}$ NW $\frac{1}{4}$	.....	D	C,w	S,O	Qt	35	15.57	11-15-51	.....	.....	.....	L
31cc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	C,w	S	P	63	30.40	11-27-51	.....	.....	.....	L
32baa1	NE $\frac{1}{2}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	G. B. Foshee	D	B,h	D	Qt	36	20.02	11-23-51	.....	.....	.....	L
32ba1	NE $\frac{1}{2}$ NW $\frac{1}{4}$	Jones	D	B,h	D	Qt	33	20.63	11-23-51	.....	.....	.....	L
32cb1	NW $\frac{1}{2}$ SW $\frac{1}{4}$	L. W. Lakey	D	C,w	S	Qt	48	.....	.....	.....	.....	.....	L
32cca1	NE $\frac{1}{2}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	Walter Harrison	D	N	O	Qt	31	21.12	11-27-51	.....	.....	.....	L
32cc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$	H. P. Bullard	D	B,h	D	Qt	32	21.83	11-27-51	.....	.....	.....	L
32ccd1	SE $\frac{1}{2}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	G. C. Harkins	D	C,h	D	Qt	28	.....	.....	.....	.....	.....	L
32cc2	SW $\frac{1}{4}$ SW $\frac{1}{4}$	C. O. Howard	D	B,h	D,S	Qt	31	24.38	11-27-51	.....	.....	.....	L
33ada1	NE $\frac{1}{2}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	67	.....	.....	2,022	.....	1,957	L
33ab1	NW $\frac{1}{2}$ NE $\frac{1}{4}$	George Stephen	Dg	J,e	D	Qt	35	16.16	12-18-51	.....	.....	.....	L
33ac1	SW $\frac{1}{4}$ NE $\frac{1}{4}$	Ernie Ivsters	D	J,e	D,S	Qt	30	10.06	12-18-51	.....	.....	.....	L
33acb1	NW $\frac{1}{2}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$	J. T. Flowers	B	B,h	D	Qt	22	12.03	12-18-51	.....	.....	.....	L
33cb1	NW $\frac{1}{2}$ SW $\frac{1}{4}$	Hall Meese	D	C,h	D	Qt	23	8.85	11-26-51	.....	.....	.....	L
33cc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$	Erick, Okla.	D	C,h	S	Qt	42	12.42	11-26-51	.....	.....	.....	L
34bbb2	NW $\frac{1}{2}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	J. H. Hester	D	C,w	D	Qt	60	.....	.....	.....	.....	.....	L
34bbb1	NW $\frac{1}{2}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	do	Dg	C,h	S,O	Qt	79	43.43	8-29-51	.....	.....	.....	L
34bab1	NW $\frac{1}{2}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	J. H. Van Horn	Dg	B,h	D,S	Qt	64	54.25	12-11-51	.....	.....	.....	L
34acb1	NW $\frac{1}{2}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$	.....	D	B,h	S	Qt	24	18.11	12-18-51	.....	.....	.....	L
34ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	James Turner	Dg	J,e	D,S	Qt	11	7.50	12-13-51	.....	.....	.....	L
34aaa1	NE $\frac{1}{2}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	L. T. Kelley	D	N	O	Qt	19	6.64	11-12-51	.....	.....	.....	L
34bb1	NW $\frac{1}{2}$ NW $\frac{1}{4}$	do	D	B,h	S	Qt	22	6.86	12-12-51	.....	.....	.....	L
35baa1	NE $\frac{1}{2}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	A. P. Burkhalter	Dg	J,e	D	Qt	22	18.03	12-13-51	.....	.....	.....	C
35ba1	NE $\frac{1}{2}$ NW $\frac{1}{4}$	do	Dg	N	O	Qt	9	7.31	11-13-51	.....	.....	.....	C
35baa2	NE $\frac{1}{2}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	do	D	C,h	D	Qt	27	.....	.....	.....	.....	.....	L
35ada1	NE $\frac{1}{2}$ SE $\frac{1}{4}$ NE $\frac{1}{4}$	Sam Holmberg	D	C,w	S	Qt	31	24.29	12-13-51	.....	.....	.....	L
35dd1	SE $\frac{1}{2}$ SFP	Henry Gibson	D	S,e	S	Qt	.....	.....	.....	.....	.....	.....	L
35cdb1	NW $\frac{1}{2}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$	S. H. Wester	D	C,w	S	Qt	35	12.32	12-13-51	.....	.....	.....	L
35ca1	NE $\frac{1}{2}$ SW $\frac{1}{4}$	do	D	C,w	S	Qt	40	.....	.....	.....	.....	.....	L
36dcc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$	D. M. Elms	D	N	O	Qt	.....	28.16	12-13-51	.....	.....	.....	L
36dcb1	NW $\frac{1}{2}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$	do	D	C,w	S	Qt	50	.....	.....	.....	.....	.....	L
36dc1	SW $\frac{1}{4}$ SE $\frac{1}{4}$	do	D	J,e	D,S	Qt	75	.....	.....	.....	.....	.....	L
36dc2	SW $\frac{1}{4}$ SE $\frac{1}{4}$	J. S. Holmberg	D	J,e	D,S	Qt	108	36.54	12-13-51	.....	.....	.....	L
9N-26W-6abb1	NW $\frac{1}{2}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	25	.....	.....	2,040	.....	2,019	L
7abb1	NW $\frac{1}{2}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	160	.....	.....	2,070	.....	1,918	L
8aaa1	NE $\frac{1}{2}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	88	.....	.....	2,009	.....	1,922	L
8bc1	SW $\frac{1}{4}$ NW $\frac{1}{4}$	.....	D	C,w	O	Qt	63	56.32	11-6-51	.....	.....	.....	L
9ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	140	.....	.....	2,042	.....	1,907	L
10ddd1	SE $\frac{1}{2}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	do	D	N	T	Qt	20	7.00	7-10-51	2,014	2,007	.....	L
11cc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$	Ross Simmons	D	B,h	D	Qt	18	.....	.....	.....	.....	.....	L
12dd1	SF $\frac{1}{2}$ SE $\frac{1}{4}$	.....	Dg	N	O	Qt	14	12.69	11-8-51	.....	.....	.....	L
14bc1	SW $\frac{1}{4}$ NW $\frac{1}{4}$	.....	D	N	N	Qt	58	46.28	11-8-51	.....	.....	.....	L
15bbb1	NW $\frac{1}{2}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	91	28.00	7-10-51	2,040	2,012	1,955	L
15aaa1	NE $\frac{1}{2}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	L. D. McDermott	D	N	O	Qt	44	15.42	11-7-51	.....	.....	.....	L
15aa1	NE $\frac{1}{2}$ NE $\frac{1}{4}$	.....	D	N	O	Qt	25	15.07	11-7-51	.....	.....	.....	L
16ccc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	40	.....	.....	2,090	.....	2,054	L
18aaa1	NE $\frac{1}{2}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	N	T	Qt	67	.....	.....	2,083	.....	2,001	L
18aa1	NE $\frac{1}{2}$ NE $\frac{1}{4}$	.....	D	C,w	S	Qt	78	47.82	11-6-61	.....	.....	.....	L
18cdd1	SE $\frac{1}{2}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$	H. B. Doss	D	C,g	S	.....	85	.....	.....	.....	.....	.....	L
19cd1	SE $\frac{1}{2}$ SW $\frac{1}{4}$	A. E. Lusby	D	C,g	S	Qt	20	12.75	11-6-51	.....	.....	.....	L
19dac1	SW $\frac{1}{4}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$	Tommy Brooks	D	C,w	D,S	.....	100	.....	.....	.....	.....	.....	L
21add1	SF $\frac{1}{2}$ SF $\frac{1}{4}$ NE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	20	.....	.....	2,054	.....	2,037	L
22dcc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$	Namy Ward	D	C,w	D,S	Qt	48	18.86	3-30-51	.....	.....	.....	L
23bb1	NW $\frac{1}{2}$ NW $\frac{1}{4}$	Della Vann James	D	C,h	O	Qt	58	44.51	11-8-51	.....	.....	.....	L
23cc1	SW $\frac{1}{4}$ SW $\frac{1}{4}$	G. C. Hobart	B	N	D	Qt	48	34.94	3-30-51	.....	.....	.....	L
24ddd1	SE $\frac{1}{2}$ SE $\frac{1}{4}$ SE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	32	14.75	7-5-51	2,001	1,986	1,970	L
24bbb1	NW $\frac{1}{2}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	do	D	N	T	Qt	110	34.00	7-5-51	2,033	1,999	1,928	L
24bab1	NW $\frac{1}{2}$ NE $\frac{1}{4}$ NW $\frac{1}{4}$	R. A. Rodgers	B	C,w	D,S	Qt	63	.....	.....	2,073	.....	2,024	L
26bbb1	NW $\frac{1}{2}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	50	.....	.....	2,111	.....	2,076	L
28bbb1	NW $\frac{1}{2}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	do	D	N	T	Qt	35	.....	.....	.....	.....	.....	L
29bc1	SW $\frac{1}{4}$ NW $\frac{1}{4}$	C. M. Ballew	D	N	O	Qt	33	18.94	11-6-51	.....	.....	.....	L
29dd1	SF $\frac{1}{2}$ SE $\frac{1}{4}$	C. T. Nickels	D	C,w	S	P	85	35.00	3-30-51	.....	.....	.....	L
30abc1	SW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$	Texola, Okla.	Dg	T,e	S	Qt	18	10.00	11-2-51	.....	.....	.....	C
31abc1	SW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$	do	D	T,e	S	P	112	.....	.....	.....	.....	.....	C
32dd1	SE $\frac{1}{2}$ SE $\frac{1}{4}$	.....	Dg	C,w	S	Qt	.....	13.97	11-7-51	.....	.....	.....	C
33bbb1	NW $\frac{1}{2}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$	.....	D	N	O	Qt	33	13.73	11-7-51	.....	.....	.....	L
35bc1	SW $\frac{1}{4}$ NW $\frac{1}{4}$	.....	Dg	N	O	Qt	25	14.07	11-8-51	.....	.....	.....	L
35cdc1	SE $\frac{1}{2}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$	.....	Dg	C,w	S	.....	38	27.06	11-8-51	.....	.....	.....	L
36cdc1	SW $\frac{1}{4}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$	.....	D	N	O	.....	27	9.09	11-8-51	.....	.....	.....	L
10N-25W-33daa1	NE $\frac{1}{2}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$	U.S. Geol. Survey	D	N	T	Qt	25	12.00	7-5-51	1,928	1,918	1,910	L
35cbb1	NW $\frac{1}{2}$ NW $\frac{1}{4}$ SW $\frac{1}{4}$	Stovall	D	C,w	D	Qt	.....	.....	.....	.....	.....	.....	C

Appendix B.--Chemical analyses of water from wells and one spring in central Beckham County, Okla.

Well number: Well-numbering system explained on p. 4 ; well locations shown on pl. 2.

Geologic source: P, bedrock of Permian age; Qt, terrace deposits; Qal, alluvium.

Analytical results in parts per million except as indicated

Location	Depth (feet)	Geologic source	Date of collection	Temperature (°F)	Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO ₃)	Dissolved solids	Hardness as CaCO ₃		Percent sodium	Specific conductance
																	Total	Noncarbonate		
8N-23W-10aa1	Spg.	P	3- 7-52	63	..	....	622	87	..	..	262	1,600	56	...	16	2,750	1,910	1,700	3	2,780
9N-22W-30bcd1	67	Qt	11- 1-51	63	28	0.00	130	27	33	1.1	336	180	23	0.3	14	609	436	160	14	894
30cba1	58	Qt	11- 1-51	63	28	.00	130	28	33	1.1	337	181	24	.3	14	620	440	164	14	897
9N-23W-9bcc2	68	Qt	11- 2-51	62	28	.00	98	23	29	2.4	263	142	10	.3	28	495	339	124	16	721
9bcd1	80	Qt	11- 2-51	64	29	.00	128	29	32	2.7	273	235	21	.3	24	631	438	215	14	892
9bcc1	57	Qt	11- 2-51	65	28	.02	135	28	26	3.5	297	192	14	.3	20	591	430	186	12	838
9bcd1	35	Qal	11- 2-51	64	28	.00	110	24	16	2.9	247	168	10	.3	19	503	373	170	9	720
9bcd3	78	Qt	11- 2-51	62	30	.00	206	38	29	2.4	219	504	13	.3	20	964	670	490	9	1,210
9bcd2	60	Qt	11- 2-51	58	28	.04	77	16	15	1.4	249	56	9.8	.3	22	349	258	54	11	537
9bdd1	55	Qt	11- 2-51	62	30	.02	104	22	24	2.9	245	160	11	.1	26	503	350	149	13	716
14cbb1	110	Qt	11- 1-51	62	26	.00	75	16	31	1.3	280	48	14	.3	19	366	253	24	21	585
14ccd1	126	Qt	11- 1-51	62	24	.00	175	35	29	1.6	207	426	18	.1	3.2	836	580	411	10	1,070
14cca1	115	Qt	11- 1-51	62	24	.00	169	36	31	1.6	161	448	16	.1	2.2	840	570	438	11	1,060
23bbc1	95	Qt	11- 1-51	63	24	.00	100	18	23	1.6	235	135	11	.3	22	454	324	131	13	672
32ccc1	63	Qt	2-26-52	62	..	....	84	8.5	33	..	194	109	15	...	28	406	244	86	23	614
9N-24W-10ddd1	27	Qt	2-14-52	61	..	....	84	29	26	..	298	58	16	...	71	486	328	84	14	749
9N-25W-35baa1	22	Qt	2-26-52	61	..	....	85	28	66	..	368	118	20	...	22	549	327	26	30	863
9N-26W-24bab1	63	Qt	3- 5-52	60	..	....	57	76	33	..	248	15	3.2	...	27	281	173	0	29	474
30abc1	18	Qt	11- 2-51	58	23	.00	518	173	178	6.0	328	1,830	122	2.6	10	3,250	2,000	1,740	16	3,350
31abc1	112	P	11- 2-51	61	17	.00	614	155	177	8.0	265	1,930	171	.7	60	3,470	2,170	1,950	15	3,640
35cbb1	...	Qt	3- 2-52	60	..	....	108	29	36	..	288	153	30	...	36	583	388	152	17	879

Appendix C.--Logs of test holes in central Beckham County, Okla.

Altitudes shown are in feet above mean sea level and refer to land surface at the mouth of the test hole, and to the concealed surface of the bedrock at the test-hole site. All test-hole logs, except those drilled by Shell Oil Co. and the city of Erick, were made by field and microscopic analysis of drill cuttings by L. C. Burton. Location of test holes is shown on plate 2. The well-numbering system is explained on page 4.

Description	Thick-ness	Depth	Description	Thick-ness	Depth
8N-23W-1dd1. 140 feet north and 20 feet west of SE cor. sec. 1. Altitudes: land surface, 1,722; bedrock, 1,670.			8N-24W-12bbb1. 50 feet east and 15 feet south of NW cor. sec. 12. Altitudes: land surface, 1,914; bedrock, 1,819.		
Sand, medium	10	10	Sand, brown, silty, clayey	5	5
Clay, gray, yellow stains, sandy	5	15	Sand, fine, reddish-brown, calcareous	5	10
Clay, gray, sandy, calcareous, sand lenses	5	20	No sample	10	20
No sample	5	25	Sand, fine; caliche	10	30
Gravel, fine, caliche, coarse sand	18	43	Clay, reddish-brown, sandy; caliche	29	59
Bedrock	11	54	Sand, reddish-brown, medium; caliche	8	67
			Gravel, medium	3	70
			No sample	10	80
8N-23W-3ddd1. 50 feet north and 15 feet west of SE cor. sec. 3. Altitudes: land surface, 1,813; bedrock, 1,718.			Gravel, medium; sand, coarse	10	90
Sand, medium, brown, caliche	5	5	Gravel, medium; sand, coarse; caliche	5	95
Sand, medium, brown; caliche; gray clay	5	10	Bedrock	3	98
Sand, medium, brown; caliche, gravel, fine	5	15			
Sand, coarse; silt; caliche	15	30	9N-22W-19aaa1. NE cor. sec. 19. Shell Oil Co. test-hole 28. Altitudes: land surface; 1,747; bedrock, 1,713.		
Sand, coarse; reddish-brown	3	33	Sand, fine	20	20
Sand, coarse; reddish-brown; caliche	4	37	Sand, coarse; clay balls	14	34
Sand, coarse, reddish-brown	3	40	Bedrock	..	..
Sand, coarse, reddish-brown; caliche; clay, reddish-brown	20	60			
No sample	5	65	9N-22W-19aad1. 660 feet south of NE cor. sec. 19. Shell Oil Co. test-hole 46. Altitudes: land surface, 1,745; bedrock, 1,712.		
Sand, medium, reddish-brown; caliche; clay, reddish-brown and gray	5	70	Clay, brown	5	5
Sand, medium, reddish-brown; caliche	5	75	Sand, fine	10	15
Clay, dark-gray, sandy	5	80	Sand, coarse	18	33
Gravel, fine; sand, coarse; clay, gray streaks	10	90	Bedrock	..	..
Clay, reddish-brown, sandy	5	95			
Bedrock	3	98	9N-22W-19aad2. 1,320 feet south of NE cor. sec. 19. Shell Oil Co. test-hole 47. Altitudes: land surface, 1,744; bedrock 1,712.		
			Clay, brown	2	2
8N-23W-5aab1. 135 feet west of U.S. Highway 283 and 15 feet south of section line. Altitudes: land surface, 1,910; bedrock, 1,775.			Sand, fine	13	15
Sand, reddish-brown, medium, silty, clayey, calcareous	5	5	Sand; gravel; clay	3	18
No sample	5	10	Sand, coarse	14	32
Sand, fine, reddish-brown, calcareous	5	15	Bedrock	..	..
Sand, medium, clayey, reddish-brown, calcareous	10	25			
No sample	10	35	9N-22W-19add1. 660 feet north of E $\frac{1}{2}$ sec. 19. Shell Oil Co. test-hole 48. Altitudes: land surface, 1,742; bedrock, 1,710.		
Sand, medium, reddish-brown, clayey, calcareous	15	50	Clay, red	6	6
No sample	10	60	Sand, fine	7	13
Sand, medium, clayey, reddish-brown	20	80	Sand, coarse	11	24
Sand, medium, reddish-brown, calcareous	5	85	Sand; gravel; clay	4	28
Gravel, medium	5	90	Sand, coarse	4	32
No sample	10	100	Sand, fine, red (bedrock)	12	44
Sand, coarse, brown, calcareous	25	125			
Gravel, fine; sand, coarse	10	135	9N-22W-19add2. E $\frac{1}{2}$ cor. sec. 19. Shell Oil Co. test-hole 26. Altitudes: land surface, 1,741; bedrock, 1,708.		
Bedrock	..	..	Sand, fine	8	8
			Clay, blue	2	10
8N-23W-7aaa1. 160 feet west and 15 feet south of NE cor. sec. 7. Altitudes: land surface, 1,909; bedrock, 1,874.			Sand, coarse; gravel; clay balls	23	33
Sand, reddish-brown, medium	5	5	Bedrock	..	..
Sand, reddish-brown, medium, clayey	10	15			
Sand, coarse	5	20	9N-22W-19acc1. Center of sec. 19. Shell Oil Co. test-hole 12. Altitudes: land surface, 1,745; bedrock, 1,722.		
Gravel, fine; clay, reddish-brown; sand coarse	5	25	Sand, medium; gravel	23	23
Sand, medium; gravel, fine	10	35	Bedrock	..	..
Bedrock	5	40			
			9N-22W-19cac1. Center of SW $\frac{1}{4}$ sec. 19. Shell Oil Co. test-hole 30. Altitudes: land surface, 1,802; bedrock, 1,770.		
8N-23W-9bbb1. 160 feet east and 15 feet south of NW cor. sec. 9. Altitudes: land surface, 1,902; bedrock, 1,853.			Sand, fine, brown	9	9
Sand, medium, reddish-brown; clay, gray and reddish-brown, sandy streaks	15	15	Clay, sandy	11	20
Clay, brown, sandy	5	20	Sand, medium	2	22
Sand, coarse, reddish-brown; clay, reddish-brown, streaks; silt	5	25	Sand, fine; clay, streaks	8	30
Gravel, medium; sand, coarse	15	40	No sample	2	32
Sand, medium, reddish-brown	5	45	Bedrock	..	..
Gravel, medium	4	49			
Bedrock	3	52	9N-22W-19cad1. 1,320 feet north of S $\frac{1}{4}$ cor. sec. 19. Shell Oil Co. test-hole 31. Altitudes: land surface, 1,769; bedrock, 1,751.		
			Sand, fine, brown	11	11
8N-24W-11ddd1. 85 feet north and 15 feet west of SE cor. sec. 11. Altitudes: land surface, 1,928; bedrock, 1,879.			Sand, coarse; gravel	1	12
Sand, medium, silty, reddish-brown; caliche	10	10			
Clay, reddish-brown, sandy; caliche	17	27			
Limestone, crystalline, sugary, porous, honeycombed to massive, gray	4	31			
Bedrock	1	32			

Appendix C

Description	Thick- ness	Depth	Description	Thick- ness	Depth
<u>9N-22W-19cad1.</u> --Continued			<u>9N-22W-30abc1.</u> 660 feet south of N $\frac{1}{2}$ cor. sec. 30. Shell Oil Co. test-hole 33. Altitudes: land surface, 1,773; bedrock, 1,732.		
Clay, red	1	13	Sand, fine	14	14
Clay, sandy, red	5	18	Sand, coarse	2	16
Bedrock	..	..	Sand, fine	9	25
<u>9N-22W-19cdal.</u> 660 feet north of S $\frac{1}{2}$ cor. sec. 19. Shell Oil Co. test-hole 32. Altitudes: land surface, 1,762; bedrock, 1,739.			Sand, coarse; gravel; clay	5	30
Sand, fine, brown	5	5	Sand, fine	5	35
Sand, medium	7	12	Sand, coarse; gravel, large	6	41
Clay, sandy, red	2	14	Bedrock	..	..
Sand, medium; gravel	9	23	<u>9N-22W-30bbd1.</u> 1,320 feet east and 660 feet south of NW cor. sec. 30. Shell Oil Co. test-hole 45. Altitudes: land surface, 1,789; bedrock, 1,756.		
Bedrock	..	..	Sand, fine, brown	20	20
<u>9N-22W-20cbb1.</u> 660 feet south and 264 feet east of W $\frac{1}{2}$ cor. sec. 20. Shell Oil Co. test-hole 49. Altitudes: land surface, 1,741; bedrock, 1,708.			Clay, sandy	5	25
Clay, brown	5	5	Sand, fine	3	28
Sand, coarse	9	14	Sand, coarse; gravel	5	33
Clay, blue	2	16	Bedrock	..	..
Sand, coarse	17	33	<u>9N-22W-30abc1.</u> 1,320 feet south of N $\frac{1}{2}$ cor. sec. 30. Shell Oil Co. test-hole 34. Altitudes: land surface, 1,767; bedrock, 1,733.		
Bedrock	..	..	Sand, fine, brown	10	10
<u>9N-22W-20cbl1.</u> 1,320 feet north and 264 feet east of SW cor. sec. 20. Shell Oil Co. test-hole 50. Altitudes: land surface, 1,741; bedrock, 1,706.			Sand, fine	5	15
Clay, brown	5	5	Clay, blue	2	17
Sand, coarse	7	12	Sand, coarse; gravel; clay streaks	6	23
Clay, blue	2	14	Sand, fine, red	7	30
Sand, coarse	21	35	Sand, coarse; gravel	4	34
Bedrock	..	..	Bedrock	..	..
<u>9N-22W-20ccb1.</u> 660 feet north and 264 feet east of SW cor. sec. 20. Shell Oil Co. test-hole 51. Altitudes: land surface, 1,740; bedrock, 1,708.			<u>9N-22W-30bac1.</u> Center of NW $\frac{1}{2}$ sec. 30. Shell Oil Co. test-hole 44. Altitudes: land surface, 1,788; bedrock, 1,747		
Clay, sandy, brown	2	2	Clay, sandy, brown	15	15
Sand; gravel; clay	18	20	Sand, fine	3	18
Sand, coarse	12	32	Sand, coarse; gravel	23	41
Bedrock	..	..	Bedrock	..	..
<u>9N-22W-29bbb1.</u> 660 feet south and 640 feet east of NW cor. sec. 20. Shell Oil Co. test-hole 52. Altitudes: land surface, 1,737; bedrock, 1,704.			<u>9N-22W-30acc1.</u> 660 feet north of center of sec. 30. Shell Oil Co. test-hole 35. Altitudes: land surface, 1,761; bedrock, 1,717.		
Clay, sandy, brown	2	2	Sand, brown	8	8
Sand, coarse; clay	12	14	Sand, fine	10	18
Sand, coarse	19	33	Clay, red	2	20
Bedrock	..	..	Sand, coarse; gravel	18	38
<u>9N-22W-29bbc1.</u> 1,320 feet south and 264 feet east of NW cor. sec. 29. Altitudes: land surface, 1,735; bedrock, 1,704.			Clay, sandy, red	6	44
Clay, sandy, brown	2	2	Bedrock	..	..
Sand, fine	12	14	<u>9N-22W-30bcd1.</u> 1,320 feet east and 660 feet north of W $\frac{1}{2}$ cor. sec. 30. Shell Oil Co. test-hole 43. Altitudes: land surface, 1,776; bedrock, 1,714.		
Sand; gravel; clay	6	20	Clay, sandy, red	20	20
Sand, coarse	11	31	Clay, blue	13	33
Bedrock	..	..	Sand, medium	22	55
<u>9N-22W-30aaa1.</u> NE cor. sec. 30. Shell Oil Co. test-hole 24. Altitudes: land surface, 1,739; bedrock, 1,705.			Sand, coarse; gravel	7	62
Clay, red	5	5	Bedrock	5	67
Sand, coarse	20	25	<u>9N-22W-30bcd1.</u> 1,320 feet east of W $\frac{1}{2}$ cor. sec. 30. Shell Oil Co. test-hole 37. Altitudes: land surface, 1,785; bedrock, 1,707.		
Sand, coarse; gravel, clay balls	5	30	Clay, chalky, gray	12	12
Sand, coarse	4	34	Sand, fine; clay streaks	8	20
Bedrock	..	..	Sand, medium	20	40
<u>9N-22W-30abb1.</u> N $\frac{1}{2}$ cor. sec. 30. Shell Oil Co. test-hole 9. Altitudes: land surface, 1,775; bedrock, 1,720.			Clay, sandy, red	3	43
Sand, fine, brown	18	18	Sand, medium; gravel	29	72
Sand, medium	5	23	Sand; gravel, large; clay	6	78
Sand, coarse; gravel	5	28	Bedrock	12	90
Sand, fine	10	38	<u>9N-22W-30dbb1.</u> 660 feet south of center of sec. 30. Shell Oil Co. test-hole 36. Altitudes: land surface, 1,757; bedrock, 1,712.		
Sand, medium; gravel	3	41	Clay, blue	20	20
Sand, fine, hard, red	14	55	Sand, medium	22	42
Bedrock	..	..	Sand, coarse; gravel	3	45
			Bedrock	..	..

Description	Thick- ness	Depth	Description	Thick- ness	Depth
<u>9N-22W-30dcb1.</u> 1,320 feet north of S $\frac{1}{4}$ cor. sec. 30. Shell Oil Co. test-hole 38. Altitudes: land surface, 1,763; bedrock, 1,710.			<u>9N-23W-24add1.</u> 495 feet north of E $\frac{1}{4}$ cor. sec. 24. Shell Oil Co. test-hole 13. Altitudes: land surface, 1,792; bedrock, 1,774.		
Sand, brown	9	9	Sand, fine, brown	2	2
Sand, coarse; gravel	11	20	Clay, chalky	4	6
Sand, medium; gravel	15	35	Clay, gray and brown	8	14
Sand, fine	13	48	Sand, coarse	4	18
Sand, coarse; gravel; clay	5	53	Bedrock	..	..
Bedrock	4	57	<u>9N-23W-25aaal.</u> NE cor. sec. 25. Shell Oil Co. test-hole 7. Altitudes: land surface, 1,801; bedrock, 1,763.		
<u>9N-22W-30cca1.</u> Center of SW $\frac{1}{4}$ sec. 30. Shell Oil Co. test-hole 41. Altitudes: land surface, 1,780; bedrock, 1,740.			Soil, black	4	4
Clay, chalky, red	15	15	Clay, blue	5	9
Sand, medium	4	19	Clay, sandy, brown	13	22
Clay, red	2	21	Sand, fine	8	30
Sand, coarse; gravel	17	38	Sand, coarse; gravel	8	38
Sand, fine, red	2	40	Bedrock	..	..
Bedrock	..	..	<u>9N-23W-25aad1.</u> 660 feet south of NE cor. sec. 25. Shell Oil Co. test-hole 54. Altitudes: land surface, 1,796; bedrock, 1,757.		
<u>9N-22W-30dcd1.</u> 660 feet north of S $\frac{1}{4}$ cor. sec. 30. Shell Oil Co. test-hole 39. Altitudes: land surface, 1,773; bedrock, 1,708.			Clay, brown	6	6
Clay, chalky, gray	8	8	Clay, sandy, red	14	20
Clay, blue	5	13	Sand, fine	5	25
Sand, medium	10	23	Sand, coarse; gravel	14	39
Sand, coarse; gravel	2	25	Bedrock	..	..
Sand, fine	10	35	<u>9N-23W-25aad2.</u> 1,320 feet south of NE cor. sec. 25. Shell Oil Co. test-hole 55. Altitudes: land surface, 1,787; bedrock, 1,719.		
Sand, coarse; gravel	16	51	Soil, sandy, brown	5	5
Sand, fine, hard	4	55	Clay, sandy, brown	14	19
Clay, sandy, red	3	58	Clay, blue	5	24
Sand, coarse; gravel, large	7	65	Sand, coarse; gravel, large; clay	4	28
Bedrock	..	..	Sand, coarse; gravel	12	40
<u>9N-22W-30ccd1.</u> 660 feet north and 1,320 feet east of SW cor. sec. 30. Shell Oil Co. test-hole 42. Altitudes: land surface, 1,779; bedrock, 1,749.			Sand, fine	8	48
Sand, fine, brown	6	6	Sand, coarse, gravel	20	68
Clay, chalky, red	7	13	Bedrock	..	..
Sand, coarse	7	20	<u>9N-23W-25aad1.</u> 660 feet north of E $\frac{1}{4}$ cor. sec. 25. Shell Oil Co. test-hole 56. Altitudes: land surface, 1,789; bedrock, 1,727.		
Sand, coarse; gravel	6	26	Sand, fine, brown	5	5
Sand, fine	4	30	Clay, sandy, red and white	11	16
Bedrock	..	..	Sand, fine	12	28
<u>9N-22W-31abb1.</u> NE $\frac{1}{4}$ cor. sec. 31. Shell Oil Co. test-hole 5. Altitudes: land surface, 1,755; bedrock, 1,712.			Clay streak	..	..
Soil, sandy, black	4	4	Sand, medium	7	35
Clay, sandy	2	6	Sand, coarse; gravel	15	50
Clay, gray	8	14	Sand, fine	8	58
Sand, medium; gravel streaks	21	35	Bedrock	4	62
Sand, fine	5	40	<u>9N-23W-25aad2.</u> E $\frac{1}{4}$ cor. sec. 25. Shell Oil Co. test-hole 6. Altitudes: land surface, 1,788; bedrock, 1,733.		
Sand, fine; gravel, large	3	43	Clay, rocky, gray and red	15	15
Bedrock	..	..	Sand, fine	17	32
<u>9N-23W-18ddd1.</u> 240 feet north and 15 feet west of SE cor. sec. 18. Altitudes: land surface, 1,839; bedrock, 1,785.			Sand, coarse; gravel	5	37
Sand, medium, brown	15	15	Sand, fine	18	55
Sand, silty, brown; caliche	5	20	Bedrock	..	..
Clay, dark-gray; caliche; clay, sand, red; gravel, few, fine	5	25	<u>9N-23W-25daa1.</u> 660 feet south of E $\frac{1}{4}$ cor. sec. 25. Shell Oil Co. test-hole 57. Altitudes: land surface, 1,789; bedrock, 1,734.		
Sand, coarse, brown; gravel, fine	5	30	Sand, fine, brown	6	6
Gravel, fine; sand, coarse, brown; clay, red, streaks; caliche	10	40	Clay, sandy, red and white	12	18
Gravel, medium; sand, medium; caliche	14	54	Sand, fine	6	24
Bedrock	5	59	Sand, coarse; gravel	11	35
<u>9N-23W-24daa1.</u> 495 feet south of E $\frac{1}{4}$ cor. sec. 24. Shell Oil Co. test-hole 11. Altitudes: land surface, 1,797; bedrock, 1,771.			Sand, fine	13	48
Sand, fine, brown	8	8	Sand, coarse; gravel; clay	1	49
Clay, tan	11	19	Sand, fine	6	55
Sand, coarse; gravel	7	26	Bedrock	..	..
Bedrock	..	..	

Description	Thick- ness	Depth	Description	Thick- ness	Depth
<u>9N-23W-25dad1.</u> 1,320 feet north of SE cor. sec. 25. Shell Oil Co. test-hole 58. Altitudes: land surface, 1,792; bedrock, 1,750.			<u>9N-24W-16ddd1.</u> 45 feet north and 10 feet west of SE cor. sec. 16. Altitudes: land surface, 1,908; bedrock, 1,843.		
Sand, fine, brown	10	10	Sand, medium, brown, silty	10	10
Clay, sandy, red and white	12	22	Clay, reddish-brown, sandy	20	30
Sand, fine	7	29	Clay, reddish-brown and gray, sandy	9	39
Sand, coarse; gravel	5	34	Gravel, fine	1	40
Sand, fine	6	40	Sand, coarse; gravel, fine	10	50
Sand, coarse; gravel	2	42	Gravel, medium; sand, medium	15	65
Bedrock	..	..	Bedrock	2	67
<u>9N-23W-25dad1.</u> 660 feet north of SE cor. sec. 25. Shell Oil Co. test-hole 59. Altitudes: land surface, 1,796; bedrock, 1,765.			<u>9N-24W-17aaa1.</u> 215 feet west and 20 feet south of NE cor. sec. 17. Altitudes: land surface, 1,899; bedrock, 1,852.		
Sand, fine, brown	2	2	Sand, medium, brown	15	15
Clay, sandy	24	26	Sand, medium, brown; caliche	5	20
Sand, fine	5	31	Sand, medium, reddish-brown	5	25
Bedrock	..	..	Sand, medium, reddish-brown; caliche	5	30
<u>9N-23W-28ccc1.</u> 135 feet east and 15 feet north of SW cor. Altitudes: land surface, 1,901; bedrock, 1,788.			Sand, medium, brown	10	40
Sand, brown, medium; calcareous; fine gravel	15	15	Sand, coarse, brown	5	45
Sand, brown	5	20	Gravel, fine; sand, medium	2	47
Sand, medium, brown, clayey	18	38	Bedrock	3	50
Sand, medium, brown	2	40	<u>9N-24W-18bbb1.</u> 50 feet east and 20 feet south of NW cor. sec. 18. Altitudes: land surface, 1,942; bedrock, 1,857.		
No sample	5	45	Sand, medium, brown; clay, brown	5	5
Sand, medium, silty, clayey	5	50	Sand, medium, brown	10	15
Sand, coarse, brown	20	70	Sand, medium, brown; clay streaks, reddish-brown, sandy	5	20
Sand, medium, brown, silty; caliche	13	83	Sand, medium, brown	10	30
Gravel, medium	7	90	Sand, medium, brown; clay, reddish-brown	10	40
Sand, coarse, brown	5	95	Clay, reddish-brown and gray, sandy; sand, medium	10	50
Sand, coarse, brown; gravel streaks	5	100	Sand, medium, clayey, brown; caliche	10	60
Sand, medium, brown	13	113	Sand, coarse, clayey, brown; gravel, fine; caliche	15	75
Bedrock	7	120	Clay, red and gray, sandy; gravel, fine	5	80
<u>9N-23W-36aaa1.</u> NE cor. sec. 36. Shell Oil Co. test-hole 4. Altitudes: land surface, 1,802; bedrock, 1,772.			Sand, medium, brown; gravel, medium	5	85
Sand, fine, brown	12	12	Bedrock	2	87
Clay, sandy, brown	8	20	<u>9N-24W-18ddd1.</u> 45 feet east and 10 feet north of SE cor. sec. 18. Altitudes: land surface, 1,931; bedrock, 1,835.		
Clay, red and blue	7	27	Sand, medium, clayey, brown	5	5
Sand, medium; gravel	3	30	Sand, medium, brown; clay, gray and brown	12	17
Bedrock	..	..	Sand, coarse, brown	3	20
<u>9N-24W-6ddd1.</u> 45 feet north and 10 feet west of SE cor. sec. 6. Altitudes: land surface, 1,934; bedrock, 1,885.			No sample	10	30
Sand, coarse; caliche	5	5	Sand, coarse, brown	10	40
Sand, coarse, brown	5	10	No sample	10	50
Sand, coarse, yellow-brown; clay, reddish-brown	5	15	Sand, coarse, brown	9	59
Sand, medium, yellow	5	20	Gravel, fine; sand, coarse; clay, brown, streaks	11	70
Sand, medium, brown, clayey	20	40	No sample	5	75
Sand, coarse; clay, gray; gravel, fine	5	45	Sand, medium, brown	20	85
Clay, reddish-brown and gray, sandy; gravel, fine; caliche	4	49	Gravel, fine; sand, medium	11	96
Bedrock	6	55	Bedrock	2	98
<u>9N-24W-12ddd1.</u> 125 feet north and 20 feet west of SE cor. sec. 12. Altitudes: land surface, 1,847; bedrock, 1,793.			<u>9N-24W-19ccc1.</u> 15 feet north and 20 feet east of SW cor. sec. 19. Altitudes: land surface, 1,967; bedrock, 1,890.		
Sand, silty, coarse, brown; calcareous	5	5	Sand, medium, brown, clayey	10	10
Sand, silty, coarse, brown; gravel, fine; clay, reddish-brown; caliche	5	10	Sand, medium, yellow-brown	5	15
Sand, coarse, brown; gravel, fine; caliche	40	50	Sand, medium, reddish-brown, clayey	10	25
Gravel, medium; caliche	4	54	Clay, reddish-brown, sandy	10	35
Bedrock	6	60	Sand, medium; clay, reddish-brown; gravel, fine	5	40
<u>9N-24W-14bbb1.</u> 120 feet south and 20 feet east of NW cor. sec. 14. Altitudes: land surface, 1,854; bedrock, 1,795.			Sand, medium, brown	10	50
Sand, medium, brown	10	10	Sand, fine, clayey, brown	10	60
Sand, medium, brown, clayey	10	20	Clay, reddish-brown, sandy	15	75
Clay, brown, sandy; caliche	10	30	Gravel, medium	2	77
Clay, dark gray and brown, sandy; caliche	15	45	Bedrock	2	79
Clay, gray and red; gravel, fine; caliche	5	50	<u>9N-24W-22ddd1.</u> 80 feet north and 15 feet west of SE cor. sec. 22. Altitudes: land surface, 1,920; bedrock, 1,814.		
Sand, medium; gravel, fine	5	55	Sand, brown, medium	10	10
Gravel, fine; sand, coarse; caliche	4	59	Sand, coarse, reddish-brown, silty, clayey	20	30
Bedrock	2	61	Sand, medium, silty, reddish-brown	10	40
			No sample	10	50
			Sand, brown, medium, clayey	5	55
			Sand, medium, brown, clayey; caliche	15	70
			Gravel, streaks; clay, gray, reddish-brown, sandy, streaks	10	80

Appendix C

Description	Thick- ness	Depth	Description	Thick- ness	Depth
<u>9N-24W-22ddd1.--Continued</u>			<u>9N-24W-25ddd1. 20 feet west and 15 feet north of SE cor. sec. 25. Altitudes: land surface, 1,925; bedrock, 1,820.</u>		
Gravel, streaks; sand, medium; clay, brown; caliche	10	90	Sand, medium, brown	5	5
No sample	10	100	Clay, brown, sandy	5	10
Sand, coarse; gravel streaks; clay, red	6	106	Sand, medium, clayey	10	20
Bedrock	4	110	Sand, medium, iron particles	5	25
<u>9N-24W-23aaa1. 60 feet west and 15 feet south of NE cor. sec. 23. Altitudes: land surface, 1,889; bedrock, 1,763.</u>			Clay, brown, sandy	5	30
No sample	10	10	No sample	30	60
Sand, medium, brown	15	25	Sand, medium, clayey, reddish-brown	25	85
Clay, silty, brown, sandy	5	30	Sand, medium, silty; gravel, fine	5	90
Clay, gray; sand, silty, reddish-brown	5	35	Sand, medium, silty, clayey, reddish-brown	10	100
Silt, gray, reddish-brown; clay, gray, brown	10	45	Sand, coarse, brown	2	102
Gravel, medium	5	50	Gravel, medium	3	105
Gravel, medium; clay, brown, gray, sandy	10	60	Bedrock	5	110
Sand, coarse, reddish-brown; clay, reddish-brown, sandy; gravel, fine	10	70	<u>9N-24W-29aaa1. 250 feet south and 20 feet west of NE cor. sec. 29. Altitudes: land surface, 1,925; bedrock, 1,856.</u>		
Gravel, medium; sand, coarse	11	81	Sand, medium, brown	5	5
Clay, gray and brown, sandy	1	82	Sand, medium, silty, clayey, brown	5	10
Gravel, medium; sand, coarse	8	90	Clay, brown, sandy; caliche	20	30
Sand, coarse; gravel, few, fine	15	105	Sand, fine; clay, brown, streaks, sandy	10	40
Sand, silty, medium; clay, reddish-brown; gravel, fine	5	110	Sand, coarse, brown; gravel streaks	29	69
Sand, coarse; gravel, fine	16	126	Bedrock	1	70
Bedrock	9	135	<u>9N-24W-31bbb1. 15 feet south and 20 feet east of NW cor. sec. 31. Altitudes: land surface, 1,992; bedrock, 1,943.</u>		
<u>9N-24W-24ddd1. 140 feet north and 10 feet west of SE cor. sec. 24. Altitudes: land surface, 1,906; bedrock, 1,717.</u>			Sand, medium; clay, reddish-brown, silty	5	5
Sand, medium, brown	5	5	Sand, medium; clay, gray	5	10
Sand, medium, brown; clay, brown, streaks	10	15	Sand, medium, brown	3	13
Sand, medium, brown	5	20	Clay, reddish-brown, sandy	1	14
Sand, coarse, brown; calcareous	40	60	Sand, medium, brown; clay, reddish-brown, streaks, sandy	6	20
Sand, medium, brown, clayey	10	70	Clay, reddish-brown, sandy	5	25
Sand, medium, brown	5	75	Sand, medium, brown; clay, green and gray, reddish-brown; caliche	10	35
Sand, coarse; gravel, fine	10	85	Sand, medium, clayey, brown; clay, reddish-brown, sandy, streaks	5	40
Sand, medium; gravel, fine; clay, red and gray	5	90	Clay, yellow-gray, sandy	3	43
Sand, coarse	5	95	Sand, medium, brown	2	45
Sand, medium; gravel, fine; clay, reddish-brown	5	100	Sand, coarse, clayey; caliche	4	49
Sand, medium, brown, clayey	5	105	Bedrock	1	50
Sand, coarse; gravel, fine	5	110	<u>9N-24W-32ddd1. 60 feet north and 15 feet west of SE cor. sec. 32. Altitudes: land surface, 1,978; bedrock, 1,960.</u>		
Sand, coarse, brown	5	115	Sand, medium, brown, clayey	5	5
Sand, coarse; gravel, fine; clay, reddish-brown	5	120	Sand, medium, brown	10	15
Sand, coarse; calcareous	20	140	Gravel, fine; sand, coarse	3	18
Sand, medium, brown, clayey; calcareous	10	150	Bedrock	2	20
Gravel, streaks; sand, medium; calcareous, brown	5	155	<u>9N-24W-33aaa1. 30 feet west and 25 feet south of NE cor. sec. 33. Altitudes: land surface, 1,943; bedrock, 1,830.</u>		
Clay, reddish-brown, sandy	2	157	No sample	5	5
Gravel, medium; clay, reddish-brown, sandy, streaks	13	170	Sand, medium, brown, clayey	15	20
Sand, medium, brown; gravel, fine	5	175	Clay, brown and reddish-brown, sandy	30	50
Clay, reddish-brown, sandy; gravel, fine	5	180	Sand, brown, clayey, medium; gravel, fine	10	60
Sand, medium, brown; gravel, fine	9	189	Gravel, streaks; sand, coarse, brown; clay, reddish-brown	10	70
Bedrock	1	190	Sand, medium, brown	10	80
<u>9N-24W-25ccc1. 195 feet north and 10 feet east of SW cor. sec. 25. Altitudes: land surface, 1,909; bedrock, 1,819.</u>			Sand, coarse, brown; clay, brown, streaks	10	90
Sand, brown, coarse	5	5	No sample	10	100
Sand, medium, silty, clayey	5	10	Sand, medium, brown	10	110
Sand, medium, brown	5	15	Gravel, fine; sand, coarse	3	113
Sand, medium, brown, clayey; clay, sandy, red and gray; calcareous	5	20	Bedrock	2	115
Sand, medium, brown, clayey	5	25	<u>9N-24W-35ccc1. 80 feet east and 20 feet north of SW cor. sec. 35. Altitudes: land surface, 1,928; bedrock, 1,885.</u>		
Sand, medium, brown	10	35	Sand, medium; clay, gray; caliche	5	5
Sand, medium, clayey, brown; clay, reddish-brown, streaks	5	40	No sample	5	10
Clay, reddish-brown, sandy	5	45	Sand, coarse, clayey; clay, reddish-brown, sandy	5	15
Sand, medium, brown	20	65	Clay, red, sandy	5	20
Sand, medium; gravel, fine	5	70	Sand, coarse; gravel, fine; clay, gray and red; caliche	5	25
Sand, coarse, brown	10	80	Sand, fine, silty, brown	10	35
Sand, medium, brown, clayey	5	85	Sand, medium, clayey, brown	5	40
Gravel, fine; sand, coarse	5	90	Gravel, medium; sand, coarse	3	43
Bedrock	..	..	Bedrock	2	45

Appendix C

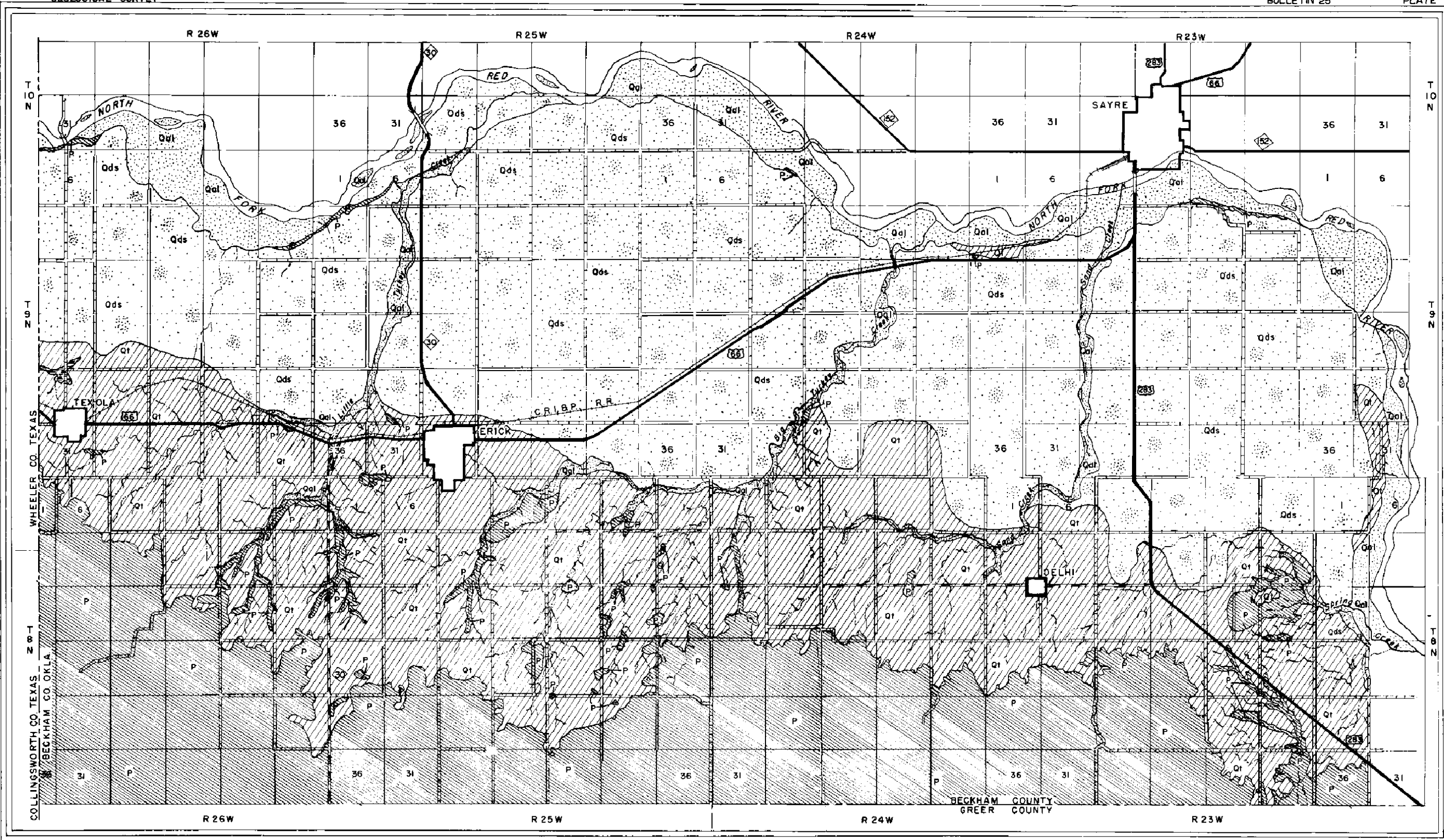
Description	Thick- ness	Depth	Description	Thick- ness	Depth
<u>9N-25W-1aaal.</u> 540 feet west and 15 feet north of NE cor. sec. 1. Altitudes: land surface, 1,943; bedrock, 1,886.			<u>9N-25W-4cabl.</u> Frick test-hole 14.		
Clay, brown, silty and sandy	5	5	Sand, fine, brown	19	19
Clay, yellow, gray, tan, sandy and silty	5	10	Clay	5	24
Sand, medium, clayey	10	20	Sand, fine	10	34
Clay, gray, sandy	5	25	Sand, fine to medium	4	38
Sand, medium, brown; clay, gray, brown	5	30	Sand, coarse; gravel	10	48
Sand, coarse, brown	10	40	Sand, fine	6	54
Sand, coarse, brown; clay, gray	10	50	<u>9N-25W-4cbb1.</u> Frick test-hole 15.		
Sand, coarse, brown; gravel, fine	7	57	Sand, fine, brown	9	9
Bedrock	5	62	Clay	3	12
<u>9N-25W-2ddd1.</u> 30 feet north and 20 feet west of SE cor. sec. 2. Altitudes: land surface, 1,987; bedrock, 1,904.			Sand, fine	14	26
Sand, medium, brown and reddish-brown	15	15	Sand, medium to coarse; gravel	8	34
Sand, medium, brown; clay, reddish-brown, sandy	5	20	Sand, fine	6	40
Sand, coarse; clay, reddish-brown; gravel, fine	5	25	Sand, medium to coarse	6	46
Sand, coarse, brown	5	30	Sand, coarse; gravel	6	52
Sand, medium, brown, silty, clayey	5	35	Sand, fine	3	55
Sand, coarse, reddish-brown	10	45	Bedrock	..	..
Sand, coarse; clay, reddish-brown	12	57	<u>9N-25W-4ccb1.</u> Frick test-hole 12.		
Gravel, fine; sand, coarse	3	60	Sand, fine, brown	33	33
Sand, coarse, brown	5	65	Sand, medium	8	41
Sand, coarse, brown; gravel, fine	5	70	Sand, coarse; gravel	5	46
Sand, coarse, brown; clay, reddish-brown, sandy streaks	8	78	<u>9N-25W-4ccc1.</u> Frick test-hole 9.		
Gravel, medium	5	83	Sand, fine, brown	11	11
Bedrock	7	90	Clay	2	13
<u>9N-25W-3aaa1.</u> 30 feet south and 25 feet west of NE cor. sec. 3. Altitudes: land surface, 1,943; bedrock, 1,905.			Sand, fine	35	48
Sand, coarse, brown	10	10	Sand, medium	3	51
Sand, coarse, brown; gravel, fine; clay, red	5	15	Sand, coarse; gravel	2	53
Clay, silty, yellow-brown, sandy; gravel, fine; sand, coarse	5	20	Clay	1	54
Sand, coarse, brown; gravel, fine	10	30	Sand, fine	4	58
Sand, coarse, brown; gravel, fine; clay, reddish-brown	5	35	Sand, medium; gravel	2	60
Gravel, fine, sand, coarse; clay, reddish-brown; caliche	3	38	Bedrock	..	..
Bedrock	2	40	<u>9N-25W-6ddd1.</u> 65 feet west and 15 feet north of SE cor. sec. 6. Altitudes: land surface, 1,974; bedrock, 1,943.		
<u>9N-25W-3ccc1.</u> 20 feet north and 15 feet east SW cor. sec. 3. Altitudes: land surface, 1,984; bedrock, 1,857.			Sand, medium, brown	10	10
Sand, medium, brown	5	5	Gravel, medium; sand, coarse, brown	13	23
Clay, dark gray, sandy	5	10	Clay, gray, sandy	3	26
Sand, medium, red and brown, clayey	5	15	Gravel, medium; sand, coarse	5	31
Clay, reddish-brown, sandy	5	20	Bedrock	4	35
Sand, coarse, brown	15	35	<u>9N-25W-7ccc1.</u> 0.1 mile east and 15 feet north of SW cor. sec. 7. Altitudes: land surface, 2,014; bedrock, 1,988.		
Sand, coarse, clayey, reddish-brown	5	40	Clay, dark gray; silt, sand	4	4
Sand, fine, brown	10	50	Sand, coarse, brown; clay, reddish-brown and gray	6	10
No sample	15	65	Sand, reddish-brown and tan, fine, clayey	5	15
Sand, coarse	1	66	Clay, variegated, sandy; sand, yellow-brown, clayey streaks	5	20
Clay, reddish-brown, sandy	4	70	Sand, medium, brown, clayey; gravel, fine	6	26
Sand, coarse; clay, gray, black and reddish-brown	5	75	Bedrock	1	27
Sand, coarse, brown	5	80	<u>9N-25W-8add1.</u> Frick test-hole 8.		
Sand, coarse, brown; clay, reddish-brown and gray	5	85	Sand, fine, brown	8	8
Clay, dark gray, sandy	5	90	Clay	8	16
Clay, dark gray and reddish-brown, sandy; gravel	5	95	Sand, fine; clay streaks	47	63
Sand, coarse; gravel, fine	10	105	Sand, medium; gravel	2	65
Sand, medium; gravel, fine; caliche	5	110	Bedrock	..	..
Clay, reddish-brown and gray, sandy; gravel; calcareous	17	127	<u>9N-25W-8ddd1.</u> Frick test-hole 7.		
Bedrock	23	150	Sand, fine, brown	8	8
<u>9N-25W-4bdd1.</u> Frick test-hole 13.			Clay	8	16
Sand, fine, brown	6	6	Sand, fine; clay streaks	54	70
Clay	4	10	Sand, medium; gravel	2	72
Sand, fine	24	34	Bedrock	..	..
Sand, fine to medium	5	40	<u>9N-25W-11ccc1.</u> 30 feet east and 20 feet north of SW cor. sec. 11. Altitudes: land surface, 1,989; bedrock, 1,869.		
Sand, medium	8	48	Sand, coarse, brown	5	5
Sand, coarse; gravel	7	55	Sand, medium, clayey, brown	19	24
Sand, fine to medium	7	62	Clay, reddish-brown, sandy	6	30
Bedrock	..	..	Sand, coarse, reddish-brown, silty and clayey	10	40
			Sand, coarse, brown	5	45
			Sand, coarse, reddish-brown, clayey	5	50
			Sand, coarse, reddish-brown	15	65
			Sand, medium, reddish-brown; clay, gray, sandy	5	70

Appendix C

Description	Thick- ness	Depth	Description	Thick- ness	Depth
<u>9N-25W-11ccc1.</u> —Continued.			<u>9N-25W-26bbb1.</u> 60 feet east and 10 feet south of NW cor. sec. 26. Altitudes: land surface, 2,009; bedrock, 1,954.		
Clay, red and gray, sandy	7	77	Sand, medium, brown	13	13
Sand, coarse, brown	8	85	Sand, medium, clayey, brown	7	20
Sand, medium, brown; clay, gray, sandy	5	90	Clay, brown, sandy	5	25
Sand, coarse, brown; clay, reddish-brown, sandy	5	95	Sand, medium, brown	5	30
Clay, reddish-brown, sandy; caliche	5	100	Sand, medium, clayey, brown	5	35
Sand, medium, brown; clay, reddish-brown; caliche	5	105	Sand, medium, brown	5	40
Gravel, medium; sand, medium	5	110	Sand, medium, brown, clayey; clay, reddish-brown, sandy streaks	10	50
Gravel, medium; clay, reddish-brown, sandy	10	120	Sand, medium, brown; clay, brown	3	53
Bedrock	8	128	Gravel	1	54
<u>9N-25W-17add2.</u> Erick test-hole 6.			Sand, medium, brown; clay, brown	1	55
Sand	19	19	Bedrock	15	70
Sand, fine; clay	56	75	<u>9N-25W-29add1.</u> Erick test-hole 2.		
<u>9N-25W-17ddd1.</u> Erick test-hole 5.			Sand, fine, brown	15	15
Sand, fine, brown	10	10	Clay, sandy, red	33	48
Sand, fine; clay streaks	65	75	Bedrock	..	..
Clay; sand, red	5	80	<u>9N-25W-29ddd1.</u> SE cor. Erick test-hole 1.		
<u>9N-25W-18ddd1.</u> 100 feet west and 15 feet north of SE cor. sec. 18. Altitudes: land surface, 1,999; bedrock, 1,947.			Sand, fine, brown	8	8
Sand, medium	2	2	Clay, sandy	8	16
Sand, medium; clay, reddish-brown and gray	3	5	Sand, fine, tan	4	20
Clay, greenish-gray, sandy; caliche	5	10	Clay, red, sandy	13	33
Clay, reddish-brown, sandy; caliche	5	15	Clay, red; "gyp" rock	6	39
Sand, medium, brown, clayey; clay, sandy, gray; caliche	5	20	Clay, red	10	49
Sand, coarse; gravel, fine	8	28	<u>9N-25W-33ada1.</u> 0.3 mile south and 12 feet west of NE cor. sec. 33, 65 feet south of U.S. Highway 66. Altitudes: land surface, 2,022; bedrock, 1,957.		
Clay, reddish-brown and gray, sandy; caliche	7	35	Clay, brown, sandy	5	5
Sand, coarse; gravel, fine; clay, reddish-brown; caliche	5	40	Sand, medium; clay, reddish-brown, sandy	5	10
Sand, gray, clayey, fine; clay, reddish-brown; caliche	5	45	Clay, reddish-brown, sandy	5	15
Sand, coarse; gravel, fine	5	50	Clay, reddish-brown and gray, sandy; caliche	20	35
Gravel, medium	2	52	Clay, reddish-brown, sandy; caliche	30	65
Bedrock	8	60	Bedrock	2	67
<u>9N-25W-20add1.</u> Erick test-hole 4.			<u>9N-26W-6abb1.</u> 0.1 mile south and 15 feet east of NW cor. NE $\frac{1}{2}$ sec. 6. Altitudes: land surface, 2,040; bedrock, 2,019.		
Sand, fine, brown	5	5	Sand, medium clayey; gravel, fine; caliche	5	5
Sand, fine; clay streaks	65	70	Sand, medium, reddish-brown, clayey; gravel, fine	5	10
<u>9N-25W-20ddd1.</u> Erick test-hole 3.			Sand, coarse, reddish-brown; gravel, fine; clay, reddish-brown and gray	11	21
Sand, fine, brown	5	6	Bedrock	4	25
Sand, fine; clay streaks	64	70	<u>9N-26W-7abb1.</u> 280 feet south and 10 feet east of NW cor. NE $\frac{1}{2}$ sec. 7. Altitudes: land surface, 2,070; bedrock, 1,918.		
Bedrock	..	..	Sand, medium; gravel, fine; caliche	5	5
<u>9N-25W-21aaa1.</u> 50 feet south and 20 feet west of NE cor. sec. 21. Altitude: land surface, 2036.			Sand, fine, brown, clayey	15	20
Sand, medium, brown, silty	15	15	Sand, medium, brown; gravel, fine	5	25
Sand, coarse, brown; clay, reddish-brown, sandy	20	35	Sand, medium, brown; clay, brown and gray; gravel, fine	5	30
Sand, coarse, brown	10	45	Sand, medium; clay, gray	5	35
Clay, reddish-brown, sandy	5	50	Sand, coarse, brown	5	40
Sand, medium, brown and gray	10	60	Sand, coarse, brown; gravel, fine	10	50
Sand, medium, brown; clay, reddish-brown, sandy	10	70	Sand, coarse, brown	5	55
Sand, medium, brown	35	105	Gravel, medium; sand, coarse, brown	15	70
Sand, medium, brown; gravel streaks; clay, gray	5	110	Gravel, medium; sand, coarse; clay, reddish-brown	5	75
Sand, coarse, brown; gravel streaks	10	120	Gravel, coarse; sand, coarse	7	82
Sand, coarse, brown; gravel streaks	30	150	Clay, reddish-brown, sandy	8	90
Sand, coarse, brown; clay streaks, sandy, reddish-brown	5	155	Sand, medium; gravel, fine; clay, reddish-brown	5	95
Clay, red, sandy; gravel; caliche	5	160	Sand, coarse; gravel	5	100
Sand, coarse; gravel; clay, red, sandy; caliche	10	170	Sand, coarse	8	108
Sand, coarse, brown; gravel, fine	25	195	Clay, reddish-brown, sandy; caliche	2	110
<u>9N-25W-24bbb1.</u> 60 feet east and 15 feet south of NW cor. sec. 24. Altitudes: land surface, 1,974; bedrock, 1,926.			Sand, coarse; clay, reddish-brown	8	118
Sand, medium, reddish-brown, silty and clayey	10	10	Sand, coarse; gravel streaks	19	137
Sand, medium, brown	5	15	Sand, coarse; clay, reddish-brown, sandy; caliche	3	140
Sand, medium, brown, clayey	5	20	Sand, coarse; gravel, fine	12	152
Sand, medium, brown	5	25	Bedrock	8	160
Sand, coarse, clayey, brown; gravel, fine	15	40			
Sand, coarse, brown	8	48			
Bedrock	6	54			

Appendix C

Description	Thick- ness	Depth	Description	Thick- ness	Depth
<u>9N-26W-8aaa1.</u> 130 feet north and 10 feet south of NE cor. sec. 8. Altitudes: land surface, 2,009; bedrock, 1,922.			<u>9N-26W-18aaa1.</u> 0.1 mile south and 10 feet west of NE cor. sec. 18. Altitudes: land surface, 2,083; bedrock, 2,001.		
Sand, medium, dark brown	10	10	Sand, medium silty and clayey, brown	5	5
Sand, medium; clay, reddish-brown, sandy	5	15	Clay, brown; sand, medium, brown	5	10
Clay, reddish-brown; sand, coarse	15	30	Sand, coarse, brown	2	12
Clay, reddish-brown, sandy; gravel, fine	10	40	Clay, brown, sandy	5	17
Sand, coarse; gravel, fine	5	45	Sand, coarse, brown	3	20
Clay, reddish-brown, sandy; gravel, fine	5	50	Sand, medium, clay, gray	5	25
Sand, medium	10	60	Sand, coarse, brown	5	30
Gravel, medium; sand, coarse	8	68	Sand, medium clayey, brown	5	35
Clay, reddish-brown, sandy; calcareous	2	70	Sand, medium, brown	5	40
Clay, light-gray, sandy; calcareous	5	75	Sand, medium, silty, clayey, brown	5	45
Clay, reddish-brown and light-gray; sand, coarse; calcareous; gravel, fine	10	85	Sand, medium, brown	5	50
Gravel, medium; sand, coarse	2	87	Sand, medium, clayey, brown	5	55
Bedrock	1	88	Sand, medium, brown	10	65
			Clay, red, sandy; caliche	2	67
			Bedrock	..	..
<u>9N-26W-9ccc1.</u> 95 feet north and 15 feet east of SW cor. sec. 9. Altitudes: land surface, 2,042; bedrock, 1,907.			<u>9N-26W-21add1.</u> 525 feet north and 15 feet west of SE cor. NE $\frac{1}{4}$ sec. 21. Altitudes: land surface, 2,054; bedrock, 2 037.		
Sand, medium	15	15	Sand, medium, brown	3	3
Clay, reddish-brown, sandy	15	30	Clay, red, sandy	2	5
Sand, reddish-brown, medium, clayey	10	40	Clay, red, sandy; caliche	5	10
Sand, medium, reddish-brown	17	57	Sand, coarse, brown; caliche	7	17
Clay, reddish-brown, sandy; gravel streak	1	58	Bedrock	3	20
Sand, coarse, reddish-brown	2	60			
Sand, coarse, reddish-brown; clay, greenish-gray, sandy; gravel	5	65	<u>9N-26W-24bbb1.</u> 30 feet east and 20 feet south of NW cor. sec. 24. Altitudes: land surface, 2,033; bedrock, 1,928.		
Sand, coarse; gravel	5	70	Clay, reddish-brown, sandy	5	5
Sand, coarse, brown	20	90	Sand, medium, brown, clayey; caliche	5	10
Sand, coarse; clay, brown, sandy	5	95	Sand, coarse, brown	3	13
Sand, coarse; gravel, fine	5	100	Clay, reddish-brown, sandy; caliche	2	15
Sand, medium	8	108	Clay, reddish-brown, sandy	10	25
Sand, coarse; gravel streaks	2	110	Sand, coarse, brown	7	32
Sand, coarse; clay, reddish-brown	5	115	Clay, gray, sandy	1	33
Sand, coarse	5	120	Sand, coarse, brown	2	35
Sand, coarse, gravel, fine; clay, reddish-brown	5	125	Sand, coarse, brown; gravel, fine	5	40
Sand, coarse; gravel, fine	10	135	Sand, coarse, brown; gravel, fine; clay, sandy, reddish-brown	10	50
Bedrock	5	140	Sand, coarse, brown; gravel, fine	10	60
			Sand, coarse, brown; clay, reddish-brown	5	65
<u>9N-26W-10ddd1.</u> 50 feet west and 20 feet north of SE cor. sec. 10. Altitudes: land surface, 2,014; bedrock, 1,996.			Gravel, medium	30	95
Sand, medium, brown, silty, clayey	5	5	Clay, red, sandy; caliche	10	105
Sand, fine, gray; gravel, fine	5	10	Bedrock	5	110
Sand, coarse; clay, reddish-brown; gravel	5	15			
Sand, medium	3	18	<u>9N-26W-26ddd1.</u> 60 feet north and 12 feet west of SE cor. sec. 26. Altitudes: land surface, 2,001; bedrock, 1,970.		
Bedrock	2	20	Sand, medium, brown	4	4
			Clay, reddish-brown; sand, medium	6	10
<u>9N-26W-15bbb1.</u> 40 feet east and 15 feet south of NW cor. sec. 15. Altitudes: land surface, 2,040; bedrock, 1,955.			Sand, medium, brown	4	14
Sand, medium, brown	13	13	Clay, gray, sandy	1	15
Clay, reddish-brown and light-gray, sandy	2	15	Clay, brown and gray, sandy	5	20
Clay, tan and gray, sandy	5	20	Clay, red, sandy; gravel, fine; caliche	5	25
Clay, reddish-brown, sandy; sand, fine	5	25	Gravel, medium; clay, red; caliche	5	30
Sand, medium, brown	5	30	Clay, reddish-brown and gray, sandy; caliche	1	31
Sand, medium, brown; gravel, fine; calcareous	5	35	Bedrock	1	32
Sand, fine; gravel, fine	5	40			
Sand, medium; gravel, fine; caliche	5	45	<u>9N-26W-26bbb1.</u> 125 feet south and 10 feet east of NW cor. sec. 26. Altitudes: land surface, 2,073; bedrock, 2,024.		
Sand, coarse, brown	20	65	Sand, coarse, dark brown	5	5
Sand, coarse; gravel, fine; clay, reddish-brown, sandy; calcareous	5	70	Sand, coarse, reddish-brown, clayey	15	20
Sand, coarse, brown and gray; gravel streak; clay, reddish-brown	5	75	Sand, coarse, brown	10	30
Gravel, fine; sand, coarse	5	80	Clay, reddish-brown, sandy	16	46
Sand, coarse; gravel	5	85	Clay, reddish-brown, sandy; caliche	3	49
Bedrock	6	91	Bedrock	1	50
<u>9N-26W-16ccc1.</u> 60 feet north and 15 feet east of SW cor. sec. 16. Altitudes: land surface, 2,090; bedrock, 2,054.			<u>9N-26W-28bbb1.</u> 65 feet east and 18 feet south of NW cor. sec. 28. Altitudes: land surface, 2,111; bedrock, 2,076.		
Sand, reddish-brown, medium, clayey	5	5	Sand, fine, reddish-brown, clayey	5	5
Sand, reddish-brown, medium	5	10	Clay, dark gray and reddish-brown, sandy, calcareous	6	11
Sand, reddish-brown, coarse, clayey	5	15	Clay, reddish-brown, sandy	4	15
Sand, brown, coarse	17	32	Clay, tan, sandy; caliche	15	30
Clay, reddish-brown, sandy; caliche	4	36	Clay, red, sandy, caliche	5	35
Bedrock	4	40	Bedrock	..	..



EXPLANATION

- Alluvium
 - Dune sand
 - Terrace deposits
 - Permian bedrock
- QUATERNARY
- PERMIAN

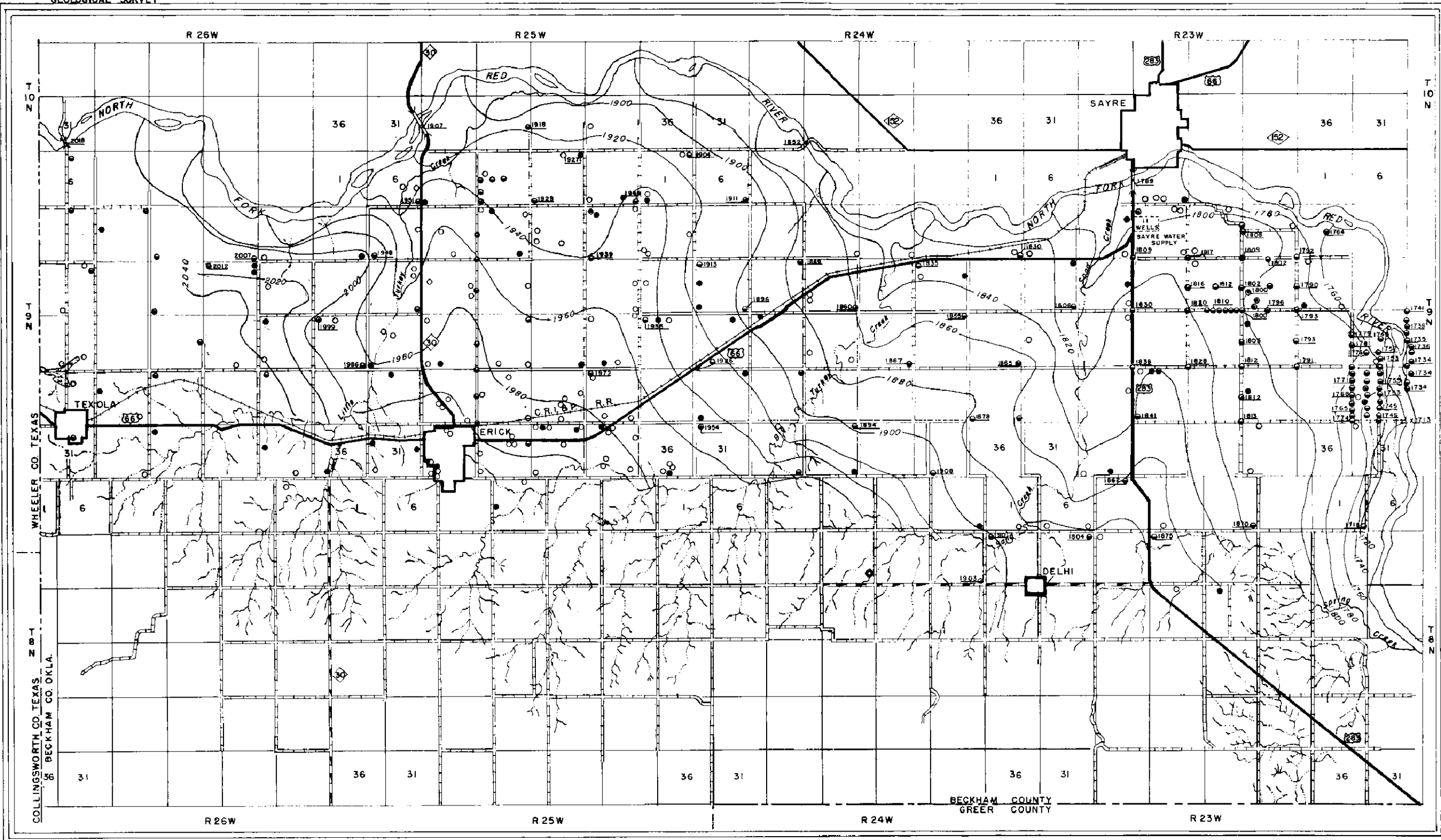
- Paved road
- Gravel road
- Graded and drained road
- Unimproved road
- Federal highway
- Oklahoma state highway
- Railroad
- State line
- County line
- Marsh or swamp
- Intermittent stream
- Perennial stream

Base map from aerial photographs

Geology by L. C. Burton
1951-2

GEOLOGIC MAP OF CENTRAL BECKHAM COUNTY, OKLAHOMA



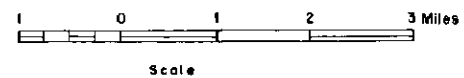


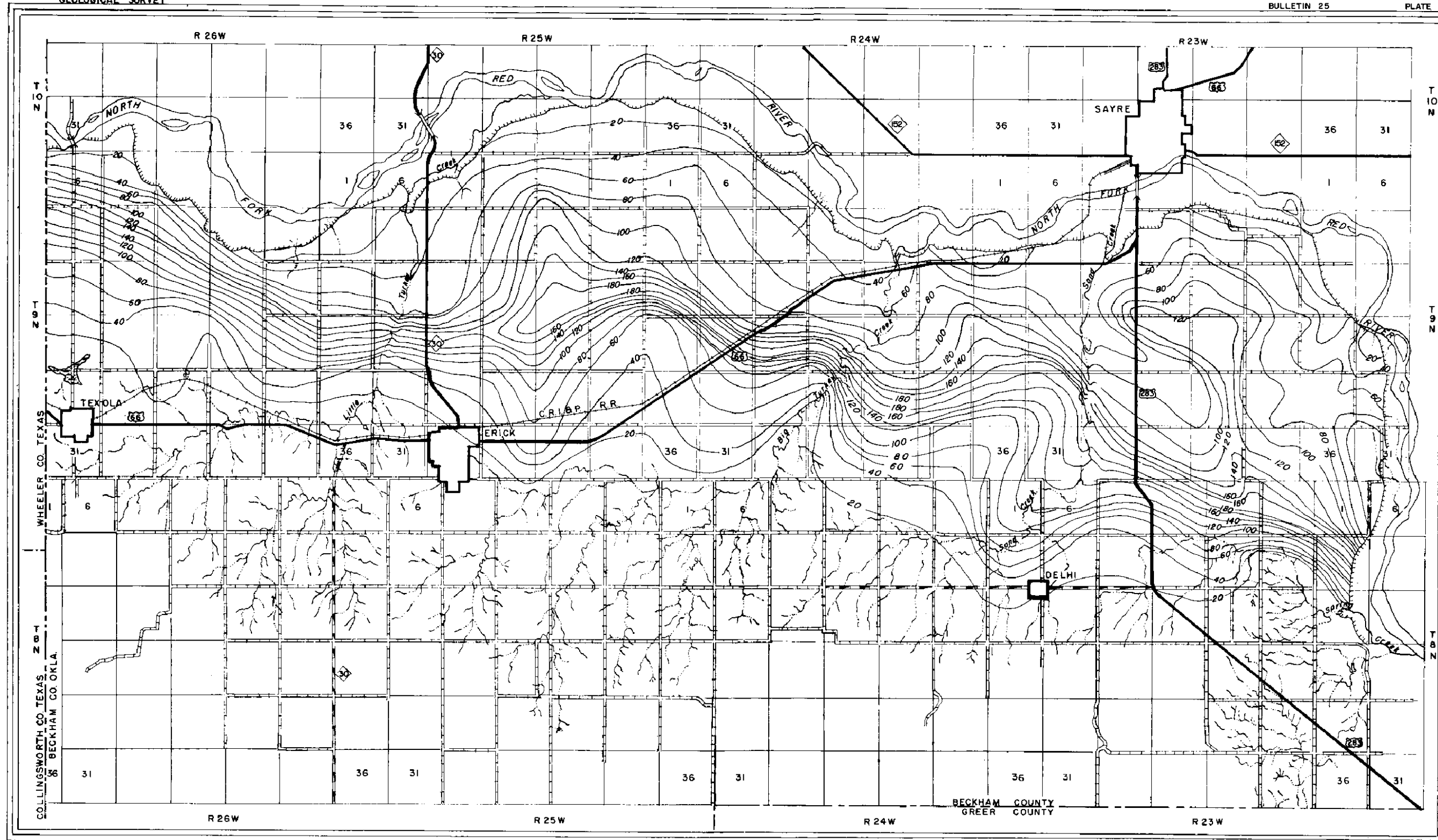
- EXPLANATION**
- Observation well
 - ⊗ Unused well
 - ⊙ Irrigation well
 - ⊕ Industrial or public water supply
 - Stock or domestic well
 - ⊖ Test hole
- 1862
Altitude of water table in well or test hole, or altitude of water surface of river.
- 1840
Line showing approximate altitude of water table.
- Contour interval 20 feet
- Paved road
 - Gravel road
 - Graded and drained road
 - Unimproved road
 - Federal highway
 - Oklahoma state highway
 - Railroad
 - State line
 - County line
 - Marsh or swamp
 - Intermittent stream
 - Perennial stream

Base map from aerial photographs

Contoured by L. C. Burton
1952

**MAP OF CENTRAL BECKHAM COUNTY, OKLAHOMA
SHOWING SLOPE AND SHAPE OF THE WATER TABLE**





EXPLANATION

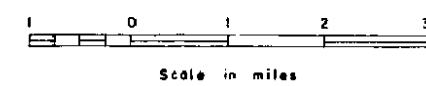
Line showing
approximately equal
thickness of terrace
deposits
Interval 20 feet

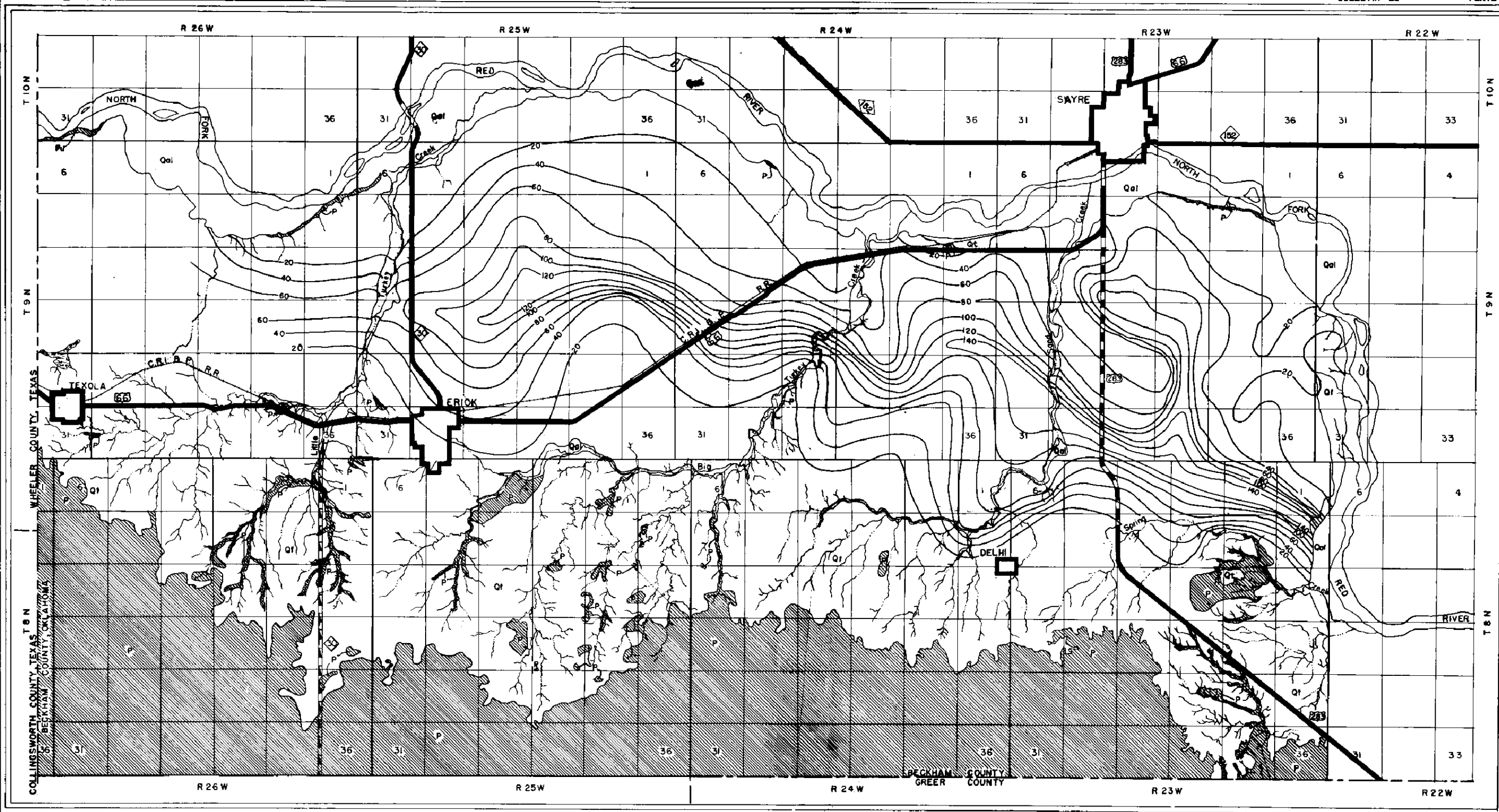
- Paved road
- Gravel road
- Graded and drained road
- Unimproved road
- Federal highway
- Oklahoma state highway
- Railroad
- State line
- County line
- Marsh or swamp
- Intermittent stream
- Perennial stream

Base map from aerial photographs

Contoured by L.C. Burton, 1952

MAP OF CENTRAL BECKHAM COUNTY, OKLAHOMA
SHOWING TOTAL THICKNESS OF TERRACE DEPOSITS





EXPLANATION

- Qal Alluvium
- Qt Terrace deposits
- P Permian bedrock

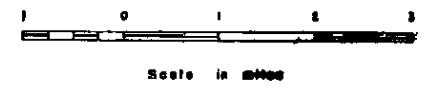
Line showing approximately equal thickness of saturated terrace deposits
Interval 20 feet

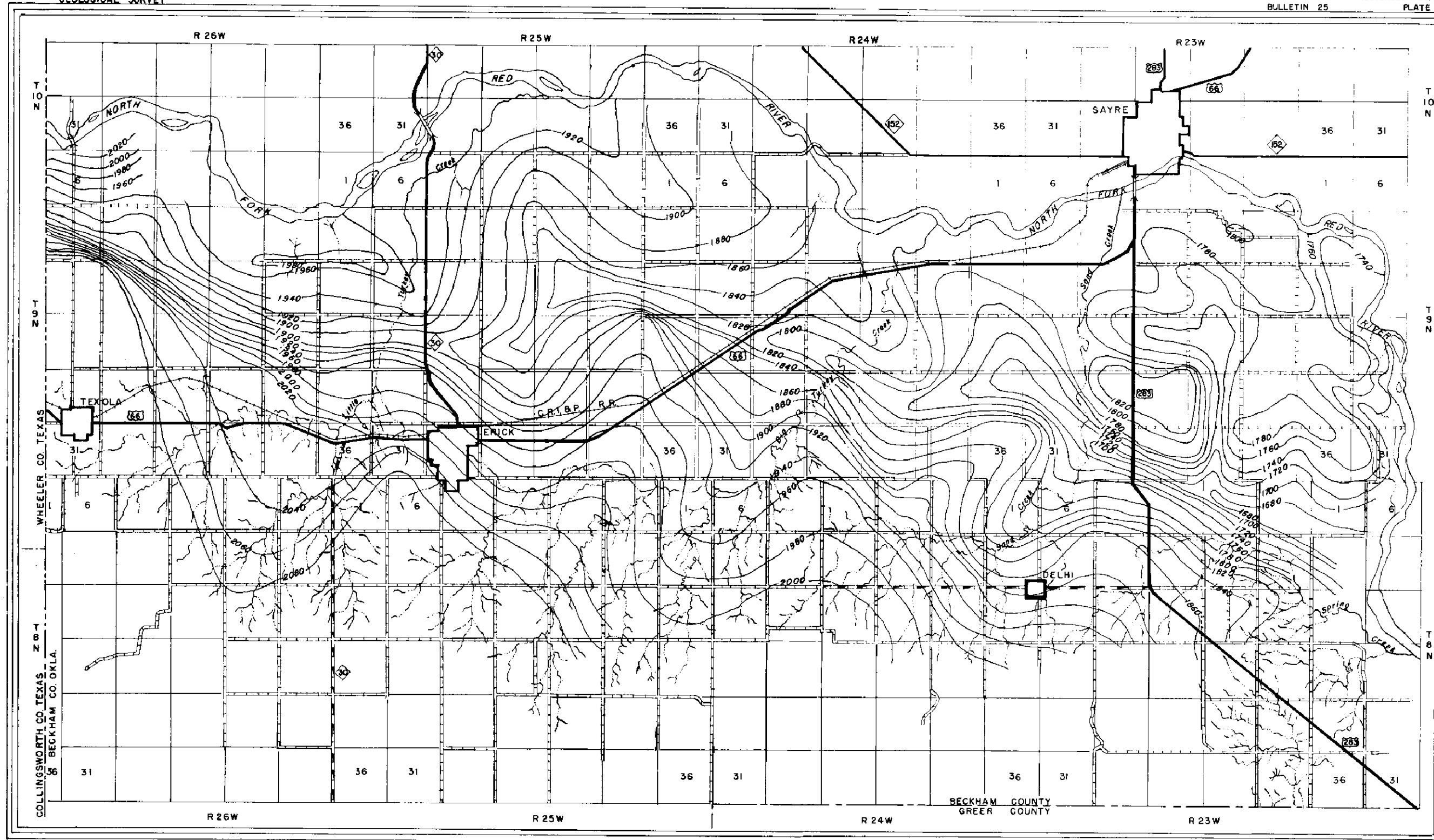
- Federal highway
- Oklahoma state highway
- Railroad
- State line
- County line
- Marsh or swamp
- Intermittent stream
- Perennial stream

Base from aerial photographs

Contoured by: L.G. Bertee, 1952

MAP OF CENTRAL BECKHAM COUNTY, OKLAHOMA
SHOWING SATURATED THICKNESS OF TERRACE DEPOSITS





EXPLANATION

1820
Contour line showing approximate altitude of the bedrock surface.

Contour interval 20ft.

- Paved road
- Gravel road
- Graded and drained road
- Unimproved road
- Federal highway
- Oklahoma state highway
- Railroad
- State line
- County line
- Marsh or swamp
- Intermittent stream
- Perennial stream

Base map from aerial photographs

Contoured by L.C. Burton, 1952

MAP OF CENTRAL BECKHAM COUNTY, OKLAHOMA
SHOWING CONTOURS ON THE BEDROCK SURFACE

