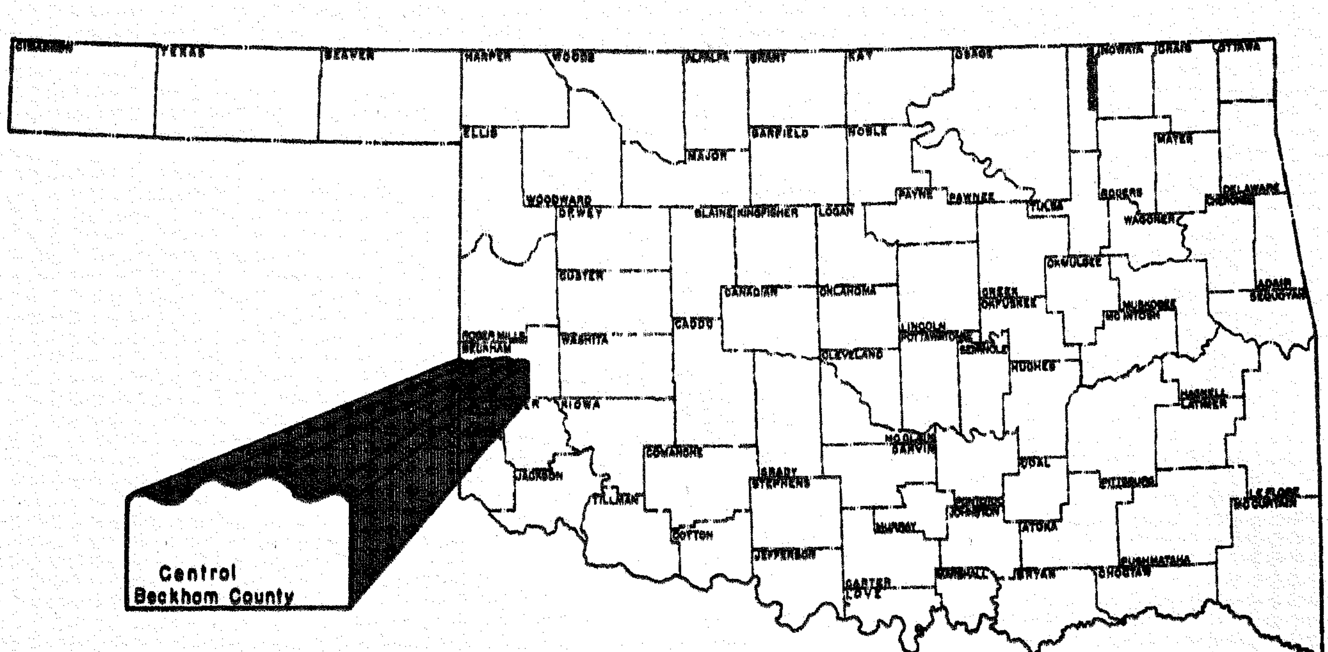
Ground Water In Terrace Deposits Of Central Beckham County



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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

Not reviewed for conformance with stratigraphic
nomenclature and editorial standards of
the U.S. Geological Survey

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Contents

Illustrations

/All plates in pocket/

GROUND WATER IN TERRACE DEPOSITS OF CENTRAL BECKHAM COUNTY, OKLAHOMA

By Lee C. Burton

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-1dddl, 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).

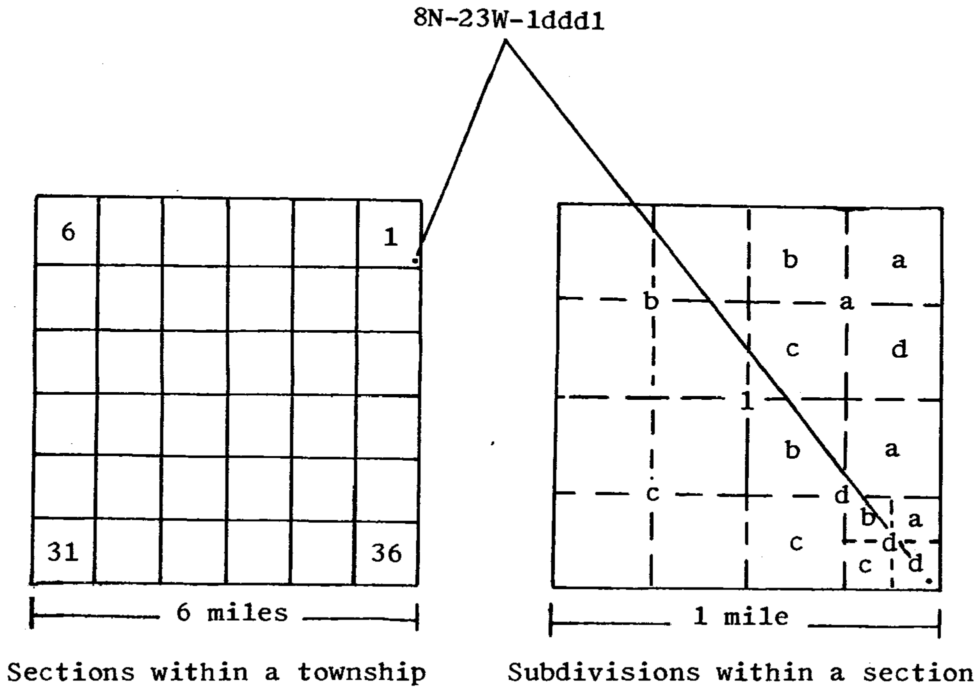

Figure 2.--Diagram showing well-numbering system

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-9dda1 (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 poreclain 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 magnesion. 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 magnesion. 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 3 8; 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 (SO_4), 250 ppm; chloride (Cl), 250 ppm; nitrate (NO_3), 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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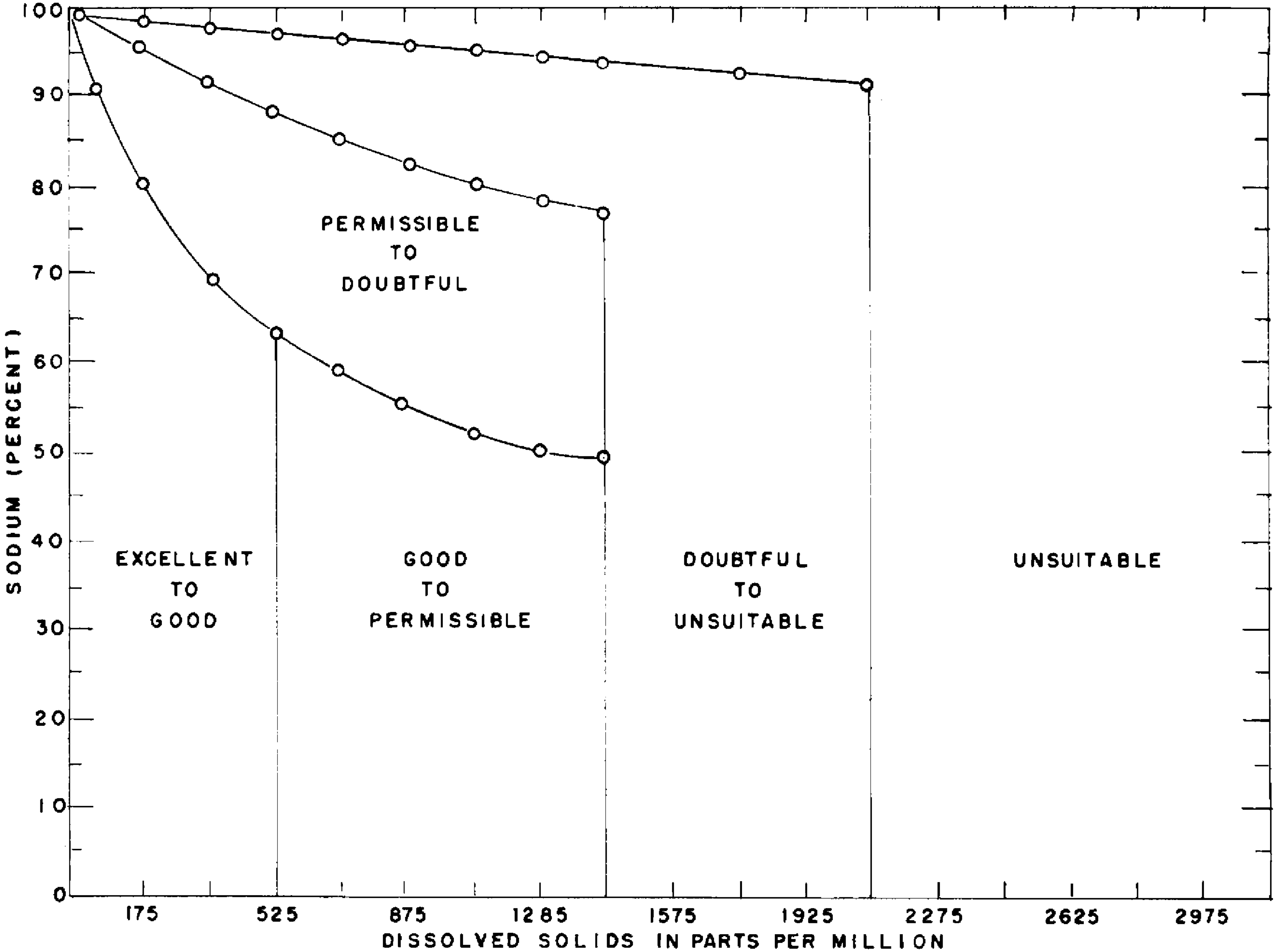

Figure 3.--Diagram for interpreting analysis of irrigation water. (From Chemical and Engineering News, 1951. Modified by T. B. Dover.)

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: Depth below land surface (feet)	Water level: Date of measurement	Altitude above mean sea level (feet): Land surface	Altitude above mean sea level (feet): Water-level surface	Altitude above mean sea level (feet): Permian surface	Other data
8N-23W-1ddd1	SE¼SE¼SE¼	U.S. Geol. Survey	D	N	T	Qt	54	4.00	7- 5-51	1,722	1,718	1,679	L
3ddd1	SE¼SE¼SE¼	do	D	N	T	Qt	98	3.30	7- 5-51	1,813	1,810	1,718	L
4ccd1	SE¼SW¼SW¼	A. F. Wells	D	B,h	D	Qt	57	39.32	2-28-52	.....	.....	.....	
5aab1	NE¼NW¼NE¼	U.S. Geol. Survey	D	N	T	Qt	135	47.80	7- 5-51	1,910	1,862	1,775	L
6dd1	SE¼SE¼	Clarence Cherry	Dg	J,e	D,S	Qt	36	25.37	3- 1-52	.....	.....	.....	
6cc1	SW¼SW¼	W. O. Hood	D	J,e	D	Qt	26	.....	....	.....	.....	.....	
7aaa1	NE¼NE¼NE¼	U.S. Geol. Survey	D	N	T	Qt	40	25.00	7- 5-51	1,909	1,884	1,874	L
8bbb1	NW¼NW¼NW¼	Dr. Bonnifield	Dg	J,e	S	...	50	.....	....	.....	.....	.....	
9bbb1	NW¼NW¼NW¼	U.S. Geol. Survey	D	N	T	Qt	52	27.40	7- 5-51	1,902	1,875	1,853	L
15bbb1	NW¼NW¼NW¼	Jack Bonnifield	D	C,w	O	...	52	30.28	2- 9-52	.....	.....	.....	
16baa1	NE¼NW¼NW¼	Garland Gurley	D	C,w	S	Qt	...	.....	....	.....	.....	.....	
8N-24W-1dcc1	SW¼SW¼SE¼	Ralph Moore	D	J,e	D	Qt	...	.....	....	.....	.....	.....	
2ddd1	SE¼SE¼SE¼	Mrs. C. E. Waters	D	N	O	Qt	29	16.70	3- 3-52	.....	.....	.....	
9dda1	NE¼SE¼SE¼	G. O. McDonald	D	T,g	I	P	107	46.60	5-10-51	.....	.....	.....	
11ddd1	SE¼SE¼SE¼	U.S. Geol. Survey	D	N	T	Qt	32	25.00	7- 5-51	1,928	1,903	1,897	L
12bbb1	NW¼NW¼NW¼	do	D	N	T	Qt	98	13.50	7- 5-51	1,914	1,901	1,819	L
8N-25W-4abb1	NW¼NW¼NE¼	Guy Brock	Dg	C,w	S	Qt	14	9.60	3- 4-52	.....	.....	.....	
4bcc1	SW¼SW¼NW¼	....	Dg	N	O	Qt	...	15.43	3- 4-52	.....	.....	.....	
8N-26W-2bb1	NW¼NW¼	J. P. Johnson	Dg	C,w	S	Qt	45	.....	....	.....	.....	.....	
9N-22W-19aaa1	NE¼NE¼NE¼	Shell Oil Co.	D	N	T	Qal	34	6.00	1950	1,747	1,741	1,713	L
19aad1	SE¼NE¼NE¼	do	D	N	T	Qal	33	7.00	1950	1,745	1,738	1,712	L
19aad2	SE¼NE¼NE¼	do	D	N	T	Qal	32	6.00	1950	1,744	1,738	1,712	L
19add1	SE¼SE¼NE¼	do	D	N	T	Qal	44	5.00	1950	1,742	1,737	1,710	L
19add2	SE¼SE¼NE¼	do	D	N	T	Qal	33	6.00	1950	1,741	1,735	1,708	L
19acc1	SW¼SW¼NE¼	do	D	N	T	Qal	23	2.00	1950	1,745	1,743	1,722	L
19cac1	SW¼NE¼SW¼	do	D	N	T	Qt	32	26.00	1950	1,802	1,776	1,770	L
19cad1	SE¼NE¼SW¼	do	D	N	T	Qt	18	12.00	1950	1,769	1,757	1,751	L
19cda1	NE¼SE¼SW¼	do	D	N	T	Qt	23	12.00	1950	1,762	1,750	1,739	L
19cdd1	SE¼SE¼SW¼	John Edwards	D	B,h	D	Qt	22	14.00	2-27-51	.....	.....	.....	
20cbb1	NW¼NW¼SW¼	Shell Oil co.	D	N	T	Qal	33	5.00	1950	1,741	1,736	1,708	L
20cbc1	SW¼NW¼SW¼	do	D	N	T	Qal	35	6.00	1950	1,741	1,735	1,706	L
20ccb1	NW¼SW¼SW¼	do	D	N	T	Qal	32	6.00	1950	1,740	1,734	1,708	L
29bbb1	NW¼NW¼NW¼	do	D	N	T	Qal	33	3.00	1950	1,737	1,734	1,704	L
29bbc1	SW¼NW¼NW¼	do	D	N	T	Qal	31	3.00	1950	1,735	1,732	1,704	L
30aaa1	NE¼NE¼NE¼	do	D	N	T	Qal	34	5.00	1950	1,739	1,734	1,705	L
30abb1	NW¼NW¼NE¼	do	D	N	T	Qt	55	22.00	1950	1,775	1,753	1,720	L
30abc1	SW¼NW¼NE¼	do	D	N	T	Qt	41	18.00	1950	1,773	1,755	1,732	L
30bbd1	SE¼NW¼NW¼	do	D	N	T	Qt	33	24.00	1950	1,789	1,765	1,756	L
30abc1	SW¼NW¼NE¼	do	D	N	T	Qt	34	11.00	1950	1,767	1,755	1,733	L
30bac1	SW¼NE¼NW¼	do	D	N	T	Qt	41	25.00	1950	1,788	1,762	1,747	L
30add1	SE¼SE¼NE¼	do	D	N	T	Qal	32	2.00	1950	1,736	1,734	1,704	
30acc1	SW¼SW¼NE¼	do	D	N	T	Qt	44	6.00	1950	1,761	1,755	1,717	L
30bcd1	SE¼SW¼NW¼	do	D	T,e	In,D	Qt	67	17.00	11- 1-51	1,776	1,761	1,714	C,L
30acc2	SW¼SW¼NE¼	do	D	N	T	Qt	29	24.00	1950	1,777	1,753	1,748	
30bcd1	SE¼SW¼NW¼	do	D	N	T	Qt	90	.....	....	1,785	.....	1,707	L
30dbb1	NW¼NW¼SE¼	do	D	N	T	Qt	45	14.00	1950	1,757	1,743	1,712	L
30cba1	NE¼NW¼SW¼	do	D	T,e	In,D	Qt	58	24.50	8-23-51	1,782	1,758	1,724	C
30dcb1	NW¼SW¼SE¼	do	D	N	T	Qt	57	17.00	1950	1,763	1,745	1,710	L
30cca1	NE¼SW¼SW¼	do	D	N	T	Qt	40	24.00	1950	1,780	1,756	1,740	L
30dcc1	SW¼SW¼SE¼	do	D	N	T	Qt	65	27.00	1950	1,773	1,746	1,708	L
30ccd1	SE¼SW¼SW¼	do	D	N	T	Qt	30	24.00	1950	1,779	1,755	1,749	L
30cbb1	NW¼NW¼SW¼	Morrison	D	B,h	D	Qt	36	29.50	2-28-52	.....	.....	.....	
31abb1	NW¼NW¼NE¼	Shell Oil Co.	D	N	T	Qt	43	.....	....	1,755	.....	1,712	L
31bbb1	NW¼NW¼NW¼	Nellie Brown	D	B,h	D	Qt	53	34.66	2-28-52	.....	.....	.....	
9N-23W-4ddd1	SE¼SE¼SE¼	....	D	N	O	Qt	33	12.10	2-27-52	.....	.....	.....	
4-dcc1	SW¼SW¼SE¼	Duggard	D	C,w	S	Qal	15	6.40	8-31-51	.....	.....	.....	
4cdd1	SE¼SE¼SW¼	Nellie Stinnett	D	C,w	D	Qal	9	4.28	8-31-51	.....	.....	.....	
4ccd1	SE¼SW¼SW¼	Therman Howard	D	C,w	D	Qal	21	8.52	8-31-51	.....	.....	.....	
8dd1	SE¼SE¼	L. C. Woolsey	Dg	B,h	D	Qt	57	51.57	2-13-52	.....	.....	.....	
8ada1	NE¼SE¼NE¼	Yandell	D	N	O	Qal	14	12.74	2-28-52	.....	.....	.....	
9ddd1	SE¼SE¼SE¼	J.W. Williams	D	C,w	D,S	Qt	...	.....	....	.....	.....	.....	
9aab1	NW¼NE¼NE¼	O. H. Thomspon	D	B,h	S	Qal	20	11.05	9- 1-51	.....	.....	.....	
9aab2	NW¼NE¼NE¼	do	D	B,h	D	Qt	36	16.47	9- 1-51	.....	.....	.....	
9bcc3	SW¼SW¼NW¼	Sayre, Okla.	D	T,e	P	Qt	33	.....	....	....	.....	.....	
9bcc2	SW¼SW¼NW¼	do	D	T,e	P	Qt	68	.....	....	.....	.....	.....	C
9bdc1	SW¼SE¼NW¼	do	D	T,e	P	Qt	80	.....	....	.....	.....	.....	C
9bcc1	SW¼SW¼NW¼	do	D	T,e	P	Qt	57	.....	....	.....	.....	.....	C
9bcd1	SE¼SW¼NW¼	do	D	T,e	P	Qal	35	.....	....	.....	.....	.....	C
9bdd1	SE¼SE¼NW¼	do	D	T,e	P	Qt	96	.....	....	.....	.....	.....	
9bcc4	SW¼SW¼NW¼	do	D	T,e	P	Qt	45	.....	....	.....	.....	.....	
9bbc1	SW¼NW¼NW¼	do	D	T,e	P	Qal	35	.....	....	.....	.....	.....	
9bcb2	NW¼SW¼NW¼	do	D	T,e	P	Qal	...	.....	....	.....	.....	.....	
9bcd3	SE¼SW¼NW¼	do	D	T,e	P	Qt	78	.....	....	.....	.....	.....	C
9bcd2	SE¼SW¼NW¼	do	D	T,e	P	Qt	60	.....	....	.....	.....	.....	C
9bdd1	SE¼SE¼NW¼	do	D	T,e	P	Qt	55	.....	....	.....	.....	.....	C
10abd1	SE¼NW¼NE¼	R. E. Bohannan	D	B,h	D	Qt	30	24.67	2-27-52	.....	.....	.....	
10ada1	NE¼SE¼NE¼	Elk City, Okla.	D	N	T	Qt	24	.....	....	1,828	.....	1,804	
10add1	SE¼SE¼NE¼	do	D	N	T	Qt	44	28.00	1950	1,836	1,808	1,792	
10ccc1	SW¼SW¼SW¼	Topping	Dg	C,g	S	Qt	40	.....	....	.....	.....	.....	
11add1	SE¼SE¼NE¼	C. O. Preskitt	D	B,h	D,S	Qt	32	27.26	2-27-52	.....	.....	.....	

Well number	Location in section	Owner or tenant	Type of well	Pump and power	Use	Geologic source	Depth of well (feet)	Water level: Depth below land surface (feet)	Water level: Date of measurement	Altitude above mean sea level (feet): Land surface	Altitude above mean sea level (feet): Water-level surface	Altitude above mean sea level (feet): Permian surface	Other data
[illegible]	SW¼SW¼NE¼	Elk City, Okla.	D	N	T	Qt	26	2.00	1950	1,766	1,764	1,740	
13bba1	NE¼NW¼NW¼	....	D	C,w	S	Qt	32	23.50	2-27-52	.....	.....	.....	
13ccc1	SW¼SW¼SW¼	....	D	B,h	D,O	Qt	47	39.75	2-27-52	.....	.....	.....	
13ddc1	SW¼SE¼SE¼	Morrison	D	B,h	D	Qt	49	45.58	2-26-52	.....	.....	.....	
14aaa1	NE¼NE¼NE¼	Elk City, Okla	D	N	T	Qt	28	17.00	1950	1,809	1,792	1,781	
14add1	SE¼SE¼NE¼	do	D	N	T	Qt	43	39.00	1950	1,829	1,790	1,786	
14baa1	NE¼NE¼NW¼	do	D	N	T	Qt	51	35.00	1950	1,837	1,802	1,786	
14cbb1	NW¼NW¼SW¼	do	D	T,e	P	Qt	110	53.00	1950	1,853	1,800	1,743	C
14ccd1	SE¼SW¼SW¼	do	D	T,e	P	Qt	126	.....	....	.....	.....	.....	C
14cca1	NE¼SW¼SW¼	do	D	T,e	P	Qt	115	.....	....	.....	.....	.....	C
14caa1	NE¼NE¼SW¼	do	D	N	T	Qt	48	.....	....	1,841	.....	1,792	
15aaa1	NE¼NE¼NE¼	do	D	N	T	Qt	55	41.00	1950	1,850	1,809	1,795	
15add1	SE¼SE¼NE¼	do	D	N	T	Qt	77	42.00	1950	1,844	1,802	1,767	
15bbb1	NW¼NW¼NW¼	Ben Green	D	J,e	D,S	Qt	50	.....	....	.....	.....	.....	
15caa1	NE¼NE¼SW¼	Elk City, Okla.	D	N	N	Qt	95	39.00	1950	1,851	1,812	1,756	
16aaa1	NE¼NE¼NE¼	do	D	N	T	Qt	95	39.00	1950	1,856	1,817	1,761	
16add1	SE¼SE¼NE¼	do	D	N	T	Qt	104	51.00	1950	1,867	1,816	1,763	
17aaa1	NE¼NE¼NE¼	do	D	N	T	Qt	53	37.00	1950	1,849	1,809	1,795	
17add1	SE¼SE¼NE¼	....	D	B,h	O	Qt	49	41.20	2-28-52	.....	.....	.....	
17dda1	NE¼SE¼SE¼	W. G. Blevins	D	B,h	D	Qt	54	48.79	2-13-52	.....	.....	.....	
18ddd1	SE¼SE¼SE¼	U.S. Geol. Survey	D	N	O	Qt	59	32.52	7- 5-51	1,839	1,806	1,785	L
18aaa1	NE¼NE¼NE¼	....	D	C,w	S,O	Qt	28	16.50	11-14-51	.....	.....	.....	
19bcc1	SW¼SW¼NW¼	....	D	N	O	Qt	62	52.10	2-14-52	.....	.....	.....	
20aaa1	NE¼NE¼NE¼	Elk City, Okla.	D	N	T	Qt	129	47.00	1950	1,877	1,830	1,747	
20aaa2	NE¼NE¼	Paul Watson	D	J,e	D,S	Qt	100	.....	....	.....	.....	.....	
21aaa1	NE¼NE¼NE¼	Elk City, Okla.	D	N	T	Qt	120	46.00	1950	1,866	1,820	1,746	
22aaa1	NE¼NE¼NE¼	do	D	N	T	Qt	110	53.00	1950	1,853	1,800	1,743	
22aaa2	NE¼NE¼NE¼	do	D	N	T	Qt	113	49.00	1950	1,852	1,803	1,739	
22aab1	NW¼NE¼NE¼	do	D	N	T	Qt	120	48.00	1950	1,852	1,804	1,732	
22aba1	NE¼NW¼NE¼	do	D	N	T	Qt	95	48.00	1950	1,853	1,805	1,758	
22abb1	NW¼NW¼NE¼	do	D	N	T	Qt	113	49.00	1950	1,857	1,808	1,744	
22add1	SE¼SE¼NE¼	do	D	N	T	Qt	98	42.00	1950	1,847	1,805	1,749	
22baa1	NE¼NE¼NW¼	do	D	N	T	Qt	130	53.00	1950	1,863	1,810	1,733	
22baa2	NE¼NE¼NW¼	do	D	N	T	Qt	102	50.00	1950	1,866	1,816	1,764	
23aaa1	NE¼NE¼NE¼	do	D	N	T	Qt	70	39.00	1950	1,832	1,793	1,762	
23add1	SE¼SE¼NE¼	do	D	N	T	Qt	48	33.00	1950	1,826	1,793	1,778	
23baa1	NE¼NE¼NW¼	do	D	N	T	Qt	77	45.00	1950	1,841	1,796	1,764	
23bbc1	SW¼NW¼NW¼	do	D	T,e	P	Qt	95	.....	....	.....	.....	.....	C
24daa1	NE¼NE¼SE¼	Shell Oil Co.	D	N	T	Qt	26	16.00	1950	1,797	1,781	1,771	L
24add1	SE¼SE¼NE¼	do	D	N	T	Qt	18	13.00	1950	1,792	1,779	1,774	L
25aaa1	NE¼NE¼NE¼	do	D	N	T	Qt	38	22.00	1950	1,801	1,778	1,763	L
25aad1	SE¼NE¼NE¼	do	D	N	T	Qt	39	21.00	1950	1,796	1,775	[illegible]	L
25aad2	SE¼NE¼NE¼	do	D	N	T	Qt	68	16.00	1950	1,787	1,771	1,719	L
25add1	SE¼SE¼NE¼	do	D	N	T	Qt	62	20.00	1950	1,789	1,769	1,727	L
25add2	SE¼SE¼NE¼	do	D	N	T	Qt	55	20.00	1950	1,788	1,768	1,733	L
25daa1	NE¼NE¼SE¼	do	D	N	T	Qt	55	22.00	1950	1,789	1,767	1,734	L
25dad1	SE¼NE¼SE¼	do	D	N	T	Qt	42	27.00	1950	1,792	1,765	1,750	L
25dda1	NE¼SE¼SE¼	do	D	N	T	Qt	31	29.00	1950	1,796	1,767	1,765	L
26aaa1	NE¼NE¼NE¼	Elk City, Okla.	D	N	T	Qt	70	50.00	1950	1,841	1,791	1,771	
26bcc1	SW¼SW¼NW¼	Williams Estate	D	N	O	Qt	75	64.00	2-28-52	.....	.....	.....	
27aaa1	NE¼NE¼NE¼	Elk City, Okla.	D	N	T	Qt	90	48.00	1950	1,860	1,812	1,770	
27add1	SE¼SE¼NE¼	do	D	N	T	Qt	88	54.00	1950	1,866	1,812	1,778	
28aaa1	NE¼NE¼NE¼	do	D	N	T	Qt	75	63.00	1950	1,891	1,828	1,816	
28bbb1	NW¼NW¼NW¼	do	D	C,w	D,S	Qt	86	71.00	2-13-52	.....	.....	.....	
28baa1	NE¼NE¼NW¼	Okla. Nat. Gas Co.	D	J,e	In	Qt	80	47.96	2-28-52	.....	.....	.....	
28baa2	NE¼NE¼NW¼	do	D	J,e	In	Qt	80	63.59	2-28-52	.....	.....	.....	
28ccc1	SW¼SW¼SW¼	U.S. Geol. Survey	D	N	T	Qt	120	59.50	7- 5-51	1,901	1,841	1,788	L
29aaa1	NE¼NE¼NE¼	Elk City, Okla.	D	N	T	Qt	70	53.00	1950	1,891	1,838	1,821	
29add1	SE¼SE¼NE¼	E. W. Barker	D	C,w	D,S	Qt	78	61.95	2-13-52	.....	.....	.....	
32ccc1	SW¼SW¼SW¼	Ralph Moore	D	C,w	S	Qt	63	35.76	2-12-52	.....	.....	.....	C
32cdd1	SE¼SE¼SW¼	do	D	N	O	Qt	49	45.11	2-13-52	.....	.....	.....	
34aaa1	NE¼NE¼NE¼	Elk City, Okla.	D	N	T	Qt	112	69.00	1950	1,882	1,813	1,770	
35bab1	NW¼NE¼NW¼	....	D	C,w	S	Qt	100	69.44	2-28-52	.....	.....	.....	
35ccd1	SE¼SW¼SW¼	....	D	C,w	S	Qt	89	83.47	2-28-52	.....	.....	.....	
36aaa1	NE¼NE¼NE¼	Shell Oil Co.	D	...	...	Qt	30	28.00	1950	1,802	1,774	1,772	L
9N-24W-6ddd1	SE¼SE¼SE¼	U.S. Geol. Survey	D	N	T	Qt	55	23.50	7- 5-51	1,934	1,911	1,885	L
7cc1	SW¼SW¼	....	D	C,h	D	Qt	21	17.53	4- 8-52	.....	.....	.....	
9ddd1	SE¼SE¼SE¼	W. L. Dowdell	D	C,w	S	Qt	27	13.85	2-26-52	.....	.....	.....	
10ddd1	SE¼SE¼SE¼	M. A. Berry	D	C,[illegible],[illegible]	D,S	Qt	27	.....	....	.....	.....	.....	C
12ddd1	SE¼SE¼SE¼	U.S. Geol. Survey	D	N	T	Qt	60	16.50	7- 5-51	1,847	1,830	1,793	L
12ddd2	SE¼SE¼SE¼	Fred Stagg	D	J,e	D	Qt	33	16.64	9- 6-51	.....	.....	.....	
14bbb1	NW¼NW¼NW¼	U.S. Geol. Survey	D	N	T	Qt	61	19.00	7- 5-51	1,854	1,835	1,795	L
14cda1	NE¼SE¼NE¼	....	D	N	O	Qt	26	25.66	2-14-52	.....	.....	.....	
14bcb1	NW¼SW¼NW¼	....	D	C,w	T	Qt	31	.....	....	.....	.....	.....	
16ddd1	SE¼SE¼SE¼	U.S. Geol. Survey	D	N	O	Qt	67	39.46	7- 5-51	1,908	1,860	1,843	L
16ccb1	NW¼SW¼SW¼	R. W. Sanders	D	B,h	D	Qt	39	34.47	8-29-51	.....	.....	.....	
16ccb2	NW¼SW¼SW¼	do	D	J,e	D	Qt	83	33.40	6- 7-51	.....	.....	.....	
17aaa1	NE¼NE¼NE¼	U.S. Geol. Survey	D	N	T	Qt	50	20.00	7- 5-51	1,899	1,869	1,852	L
18ddd1	SE¼SE¼SE¼	do	D	N	T	Qt	98	35.00	7- 5-51	1,931	1,896	1,835	L
18bbb1	NW¼NW¼NW¼	do	D	N	T	Qt	87	29.00	7- 5-51	1,942	1,913	1,857	L
18bcc1	SW¼SW¼NW¼	....	D	N	O	Qt	40	28.93	12-12-51	.....	.....	.....	
18ccb1	NW¼SW¼SW¼	....	D	N	O	Qt	46	36.48	12-12-51	.....	.....	.....	
19ccc1	SW¼SW¼SW¼	U.S. Geol. Survey	D	N	T	Qt	79	41.50	7- 5-51	1,967	1,926	1,890	L
19aba1	NE¼NW¼NE¼	....	D	N	O	Qt	57	47.37	2-26-52	.....	.....	.....	
20bab1	NW¼NE¼NW¼	....	D	C,w	S,O	Qt	50	36.34	12-30-51	.....	.....	.....	
21cbc1	SW¼NW¼SW¼	....	Dg	N	N	Qt	50	38.41	2-26-52	.....	.....	.....	
21dda1	NE¼SE¼SE¼	Mrs. Strouds	D	B,h	D	Qt	27	21.89	2-16-52	.....	.....	.....	
22ddd1	SE¼SE¼SE¼	U.S. Geol. Survey	D	N	T	Qt	110	53.00	7- 5-51	1,920	1,867	1,814	L
23aaa1	NE¼NE¼NE¼	do	D	N	T	Qt	135	34.00	7- 5-51	1,889	1,855	1,763	L
24ddd1	SE¼SE¼SE¼	do	D	N	T	Qt	190	41.20	7- 5-51	1,906	1,865	1,717	L
25ccc1	SW¼SW¼SW¼	do	D	N	T	Qt	90	31.00	7- 5-51	1,909	1,878	1,819	L
25ddd1	SE¼SE¼SE¼	do	D	N	T	Qt	110	.....	....	1,925	.....	1,820	L
29aaa1	NE¼NE¼NE¼	do	D	N	T	Qt	70	.....	....	1,925	.....	1,856	L
30aaa1	NE¼NE¼NE¼	D. H. Crosby	D	N	O	Qt	66	59.92	2-26-52	.....	.....	.....	

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	SW¼SW¼SW¼	....	D	N	O	Qt	73	65.00	2-26-62	.....	.....	.....	
31bbb1	NW¼NW¼NW¼	U.S. Geol. Survey	D	N	T	Qt	50	37.20	7- 5-51	1,992	1,954	1,943	L
32ddd1	SE¼SE¼SE¼	do	D	N	T	Qt	20	.....	....	1,978	.....	1,960	L
32baa1	NE¼NE¼NW¼	Henry Flanagan	D	S,e	S	Qt	53	.....	....	.....	.....	.....	
33aaa1	NE¼NE¼NE¼	U.S. Geol. Survey	D	N	T	Qt	115	49.00	7- 5-51	1,943	1,894	1,830	L
33ddd1	SE¼SE¼SE¼	....	Dg	B,h	S,O	Qt	12	7.70	2-26-62	.....	.....	.....	
35cdc1	SW¼SE¼SW¼	U.S. Geol. Survey	D	N	T	Qt	45	20.20	7- 5-51	1,928	1,908	1,885	L
9N-25W-1aaa1	NE¼NE¼NE¼	do	D	N	T	Qt	62	31.00	7- 5-51	1,943	1,904	1,886	L
1aab1	NW¼NE¼NE¼	John Catlott	D	C,w,h	D,S	Qt	...	.....	....	.....	.....	.....	
1ccd1	SE¼SW¼SW¼	John Bronbreak	B	C,w,h	D,S	Qt	48	38.37	12- 4-51	.....	.....	.....	
1ccd2	SE¼SW¼SW¼	do	D	N	O	Qt	46	38.63	12- 4-51	.....	.....	.....	
2ddd1	SE¼SE¼SE¼	U.S. Geol. Survey	D	N	T	Qt	90	39.00	7- 5-51	1,987	1,948	1,904	L
2ccc1	SW¼SW¼SW¼	....	D	C,w	N	Qt	43	.....	....	.....	.....	.....	
2dcd1	SE¼SW¼SE¼	....	D	C,h	O	Qt	56	38.50	12- 4-51	.....	.....	.....	
3ccc1	SW¼SW¼SW¼	U.S. Geol. Survey	D	N	T	Qt	150	54.00	7- 5-51	1,984	1,929	1,857	L
3aaa1	NE¼NE¼NE¼	do	D	N	O	Qt	40	14.91	12- 3-51	1,943	1,927	1,905	L
3abb1	NW¼NW¼NE¼	T. H. Pirtle	Dg	B,h	S	Qt	51	30.02	12-11-51	.....	.....	.....	
4bc1	SW¼NW¼	Erick, Okla.	D	N	O	Qt	53	40.38	11-26-51	.....	.....	.....	
4bdd1	SE¼SE¼NW¼	do	D	N	T	Qt	62	37.50	1946	.....	.....	.....	L
4cab1	NW¼NE¼SW¼	do	D	N	T	Qt	54	33.00	1946	.....	.....	.....	L
4cbb1	NW¼NW¼SW¼	do	D	N	T	Qt	55	26.00	1946	.....	.....	.....	L
4ccb1	NW¼SW¼SW¼	do	D	N	T	Qt	46	.....	....	.....	.....	.....	L
4ccc1	SW¼SW¼SW¼	do	D	N	T	Qt	60	41.00	1946	.....	.....	.....	L
5ccc1	SW¼SW¼SW¼	H. E. Russel, Sr.	D	B,h	O	Qt	45	34.41	11-15-51	.....	.....	.....	
6ddd1	SE¼SE¼SE¼	U.S. Geol. Survey	D	N	T	Qt	35	22.70	7- 5-51	1,974	1,951	1,943	L
6da1	NE¼SE¼	W. A. Amend	D	B,h	D	Qt	24	13.39	11-28-51	.....	.....	.....	
6db1	NW¼SE¼	do	D	C,w	S	Qal	20	9.98	11-28-51	.....	.....	.....	
7ccc1	SW¼SW¼SW¼	U.S. Geol. Survey	D	N	T	Qt	27	16.50	7- 5-51	2,014	1,948	1,988	L
7add1	SE¼SE¼NE¼	Sally Pigg	D	J,e	D	Qt	40	.....	....	.....	.....	.....	
8bd1	SE¼NW¼	G. R. Pigg	D	J,e	D,S	Qt	56	.....	....	.....	.....	.....	
8dcc1	SW¼SW¼SE¼	G. R. Crosby	D	C,w	S	Qt	60	.....	....	.....	.....	.....	
8add1	SE¼SE¼NE¼	Erick, Okla.	D	N	T	Qt	65	46.00	1946	.....	.....	.....	L
8ddd1	SE¼SE¼SE¼	do	D	N	T	Qt	72	54.00	1946	.....	.....	.....	L
9aa1	NE¼NE¼	H. L. Wolfe	D	C,w	D,S	Qt	64	.....	....	.....	.....	.....	
9bab1	NW¼NE¼NW¼	....	D	N	O	Qt	61	48.81	11-26-51	.....	.....	.....	
9bbb1	NW¼NW¼NW¼	L. D. Ramsey	D	B,h	D,S	Qt	57	41.03	11-26-51	.....	.....	.....	
9ddc1	SW¼SE¼SE¼	Roy Spencer	D	C,h	O	Qt	64	56.39	11-29-51	.....	.....	.....	
10cb1	NW¼SW¼	F. L. Reed	B	C,w	S	Qt	56	.....	....	.....	.....	.....	
10cb2	NW¼SW¼	do	B	C,h	D	Qt	70	.....	....	.....	.....	.....	
10dbc1	SW¼NW¼SE¼	G. G. Murray	D	C,w	D,S	Qt	...	.....	....	.....	.....	.....	
11ccc1	SW¼SW¼SW¼	U.S. Geol. Survey	D	N	T	Qt	128	50.20	7- 5-51	1,989	1,939	1,869	L
11aaa1	NE¼NE¼NE¼	Clancy	D	C,w	D,S	Qt	...	.....	....	.....	.....	.....	
11bbd1	SE¼NW¼NW¼	Clarence Murray	D	N	O	Qt	109	37.64	12-12-51	.....	.....	.....	
11bbb1	NW¼NW¼NW¼	do	Dg	Gas	I	Qt	...	.....	....	.....	.....	.....	
12ccc1	SW¼SW¼SW¼	....	D	C,w	D,S	Qt	...	.....	....	.....	.....	.....	
12ccc2	SW¼SW¼SW¼	....	D	C,w	S	Qt	46	44.13	12- 4-51	.....	.....	.....	
12daa1	NE¼NE¼SE¼	....	D	C,w	D,S	Qt	...	.....	....	.....	.....	.....	
13add1	SE¼SE¼NE¼	Hugh House	D	C,h	D,S	Qt	...	.....	....	.....	.....	.....	
14add1	SE¼SE¼NE¼	....	D	C,w	D,S	Qt	...	.....	....	.....	.....	.....	
14dd1	SE¼SE¼	A. J. Jones	B	C,h	D,S	Qt	75	.....	....	.....	.....	.....	
16add1	SE¼SE¼NE¼	Mrs. Bingham	D	C,w	D,S	Qt	...	.....	....	.....	.....	.....	
17add1	SE¼SE¼NE¼	S. F. Sarkey	D	C,w	D	Qt	77	59.91	11-26-51	.....	.....	.....	
17add2	SE¼SE¼NE¼	Erick, Okla.	D	N	T	Qt	75	62.00	1946	.....	.....	.....	L
17bc1	SW¼NW¼	J. W. Van	D	J,e	D,S	Qt	...	.....	....	.....	.....	.....	
17da1	NE¼SE¼	....	D	N	N	Qt	74	.....	....	.....	.....	.....	
17ddd1	SE¼SE¼SE¼	Erick, Okla.	D	N	T	Qt	80	70.00	1946	.....	.....	.....	L
18ddd1	SE¼SE¼SE¼	U.S. Geol. Survey	D	N	T	Qt	60	.....	....	1,999	.....	1,947	L
18aa1	NE¼NE¼	George Davis	D	C,w	S	Qt	49	29.57	11-28-51	.....	.....	.....	
18aa2	NE¼NE¼	do	D	C,w	S	Qt	42	17.82	11-28-51	.....	.....	.....	
19bac1	SW¼NE¼NW¼	E. T. Davis	Dg	C,w	S	Qal	21	.....	....	.....	.....	.....	
19bda1	NE¼SE¼NW¼	do	Dg	C,w	S	Qal	33	.....	....	.....	.....	.....	
19ccc1	SW¼SW¼SW¼	....	D	N	O	Qt	36	18.25	11-15-51	.....	.....	.....	
20bbb1	NW¼NW¼NW¼	....	D	B,h	D	Qt	63	54.68	11-15-51	.....	.....	.....	
20ccc1	SW¼SW¼SW¼	H. E. Russel, Jr.	D	C,w	D,S	Qt	68	56.47	11-27-51	.....	.....	.....	
20cdc1	SW¼SE¼SW¼	....	D	N	O	Qt	80	70.68	11-23-51	.....	.....	.....	
20add1	SE¼SE¼NE¼	Erick, Okla.	D	N	T	Qt	70	55.70	1946	.....	.....	.....	L
20ddd1	SE¼SE¼SE¼	do	D	N	T	Qt	70	64.00	1946	.....	.....	.....	L
21aaa1	NE¼NE¼NE¼	U.S. Geol. Survey	D	N	T	Qt	195	.....	....	.....	2,036	.....	L
21cd1	SE¼SW¼	R. C. Bloodworth	D	C,w	D,S	Qt	...	.....	....	.....	.....	.....	
21ddd1	SE¼SE¼SE¼	C. L. Strong	D	C,w	T	Qt	98	.....	....	.....	.....	.....	
22ddd1	SE¼SE¼SE¼	Barnell	D	C,h	S,O	Qt	65	47.00	12-11-51	.....	.....	.....	
23aaa1	NE¼NE¼NE¼	....	D	C,w	S	Qt	35	30.70	12-12-51	.....	.....	.....	
23bbb1	NW¼NW¼NW¼	W. E. Brown	D	C,w	D,S	Qt	60	.....	....	.....	.....	.....	
23cdc1	SW¼SE¼SW¼	....	D	C,h	O	Qt	51	26.20	12-12-51	.....	.....	.....	
23dcc1	SW¼SW¼SE¼	....	D	C,h	D,S	Qt	48	27.52	12-12-51	.....	.....	.....	
24bbb1	NW¼NW¼NW¼	U.S. Geol. Survey	D	N	T	Qt	54	19.00	7- 5-51	1,995	1,974	1,926	L
24ab1	NW¼NE¼	....	D	C,e	D,S	Qt	...	.....	....	.....	.....	.....	
24bab1	NW¼NE¼NW¼	....	D	N	O	Qt	66	52.35	12-12-51	.....	.....	.....	
26bbb1	NW¼NW¼NW¼	U.S. Geol. Survey	D	N	T	Qt	70	37.70	7- 5-51	1,972	2,009	1,954	L
26bb1	NW¼NW¼	....	D	C,w	D,S	Qt	...	.....	....	.....	.....	.....	
26cdc1	SW¼SE¼SW¼	Caudill	D	C,h	D,S	Qt	20	9.30	12-13-51	.....	.....	.....	
26ddc1	SW¼SE¼SE¼	Charley Simons	D	C,w	D,S	Qt	34	17.97	12-13-51	.....	.....	.....	
27add1	SE¼SE¼NE¼	....	D	C,w	S	Qt	47	40.06	12-12-51	.....	.....	.....	
27db1	NW¼SE¼	Arron C. Jones	D	B,h	D	Qt	60	.....	....	.....	.....	.....	
27db2	NW¼SE¼	do	D	C,h	S	Qt	70	.....	....	.....	.....	.....	
27dcc1	SW¼SW¼SE¼	John Jones	D	C,h	D,S	Qt	55	.....	....	.....	.....	.....	
28ab1	NW¼NE¼	Jeff Roberts	D	J,e	D,S	Qt	...	.....	....	.....	.....	.....	
28bcc1	SW¼SW¼NW¼	George Crosley	D	N	N	Qt	52	.....	....	.....	.....	.....	
28ddd1	SE¼SE¼SE¼	Calvin E. Rogers	D	C,w	D	Qt	...	.....	....	.....	.....	.....	
29caa1	NE¼NE¼SW¼	G. H. Harral	D	C,w	S	Qt	54	36.63	11-27-51	.....	.....	.....	
29ca1	NE¼SW¼	S. D. Martin	D	C,g	D,S	Qt	60	.....	....	.....	.....	.....	
29cad1	SE¼NE¼SW¼	H. Green	D	B,h	D,S	Qt	33	23.94	11-27-51	.....	.....	.....	
29ddc1	SW¼SE¼SE¼	Hubert Holland	D	B,h	D,S	Qt	27	13.00	11-27-51	.....	.....	.....	
29add1	SE¼SE¼NE¼	Erick, Okla.	D	N	T	Qt	48	43.50	1946	.....	.....	.....	L

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	SE¼SE¼SE¼	Erick, Okla	D	N	T	Qt	49	23.50	1946	.....	.....	.....	L
30ba1	NE¼NW¼	....	D	N	O	Qt	47	37.26	11-15-51	.....	.....	.....	
31da1	SE¼NE¼	....	D	N	O	Qt	42	32.25	11-15-51	.....	.....	.....	
31bcb1	NW¼SW¼NW¼	....	D	C,w	S,D	Qt	35	15.57	11-15-51	.....	.....	.....	
31cc1	SW¼SW¼	....	D	C,w	S	P	63	30.40	11-27-51	.....	.....	.....	
32baa1	NE¼NE¼NW¼	G. B. Foshee	D	B,h	D	Qt	36	20.02	11-23-51	.....	.....	.....	
32ba1	NE¼NW¼	Jones	D	B,h	D	Qt	33	20.63	11-23-51	.....	.....	.....	
32cb1	NW¼SW¼	L. W. Lakey	D	C,w	S	Qt	48	.....	....	.....	.....	.....	
32cca1	NE¼SW¼SW¼	Walter Harrison	D	N	O	Qt	31	21.12	11-27-51	.....	.....	.....	
32cc1	SW¼SW¼	H. P. Bullard	D	B,h	D	Qt	32	21.83	11-27-51	.....	.....	.....	
32ccd1	SE¼SW¼SW¼	G. C. Harkins	D	C,h	D	Qt	28	.....	....	.....	.....	.....	
32cc2	SW¼SW¼	C. O. Howard	D	B,h	D,S	Qt	31	24.38	11-27-51	.....	.....	.....	
33ada1	NE¼SE¼NE¼	U.S. Geol. Survey	D	N	T	Qt	67	.....	....	2,022	.....	1,957	L
33ab1	NW¼NE¼	George Stephen	Dg	J,e	D	Qt	35	16.16	12-18-51	.....	.....	.....	
33ac1	SW¼NE¼	Ernie Ivesters	D	J,e	D,S	Qt	30	10.06	12-18-51	.....	.....	.....	
33acb1	NW¼SW¼NE¼	J. T. Flowers	B	B,h	D	Qt	22	12.03	12-18-51	.....	.....	.....	
33cb1	NW¼SW¼	Hall Meese	D	C,h	D	Qt	23	8.85	11-26-51	.....	.....	.....	
33cc1	SW¼SW¼	Erick, Okla.	D	C,h	S	Qt	42	12.42	11-26-51	.....	.....	.....	
34bbb2	NW¼NW¼NW¼	J. H. Hester	D	C,w	D	Qt	60	.....	....	.....	.....	.....	
34bbb1	NW¼NW¼NW¼	do	Dg	C,h	S,O	Qt	79	43.43	8-29-51	.....	.....	.....	
34bab1	NW¼NE¼NW¼	J. H. Van Horn	Dg	B,h	D,S	Qt	64	54.25	12-11-51	.....	.....	.....	
34acb1	NW¼SW¼NE¼	....	D	B,h	S	Qt	24	18.11	12-18-51	.....	.....	.....	
34ccc1	SW¼SW¼SW¼	James Turner	Dg	J,e	D,S	Qt	11	7.50	12-13-51	.....	.....	.....	
34aaa1	NE¼NE¼NE¼	L. T. Kelley	D	N	O	Qt	19	6.64	12-12-51	.....	.....	.....	
34bb1	NW¼NW¼	do	D	B,h	S	Qt	22	6.86	12-12-51	.....	.....	.....	
35baa1	NE¼NE¼NW¼	A. P. Burkhalder	Dg	J,e	D	Qt	22	18.03	12-13-51	.....	.....	.....	C
35ba1	NE¼NW¼	do	Dg	N	O	Qt	9	7.31	12-13-51	.....	.....	.....	
35baa2	NE¼NE¼NW¼	do	D	C,h	D	Qt	27	.....	....	.....	.....	.....	
35ada1	NE¼SE¼NE¼	Sam Holmberg	D	C,w	S	Qt	31	24.29	12-13-51	.....	.....	.....	
35dd1	SE¼SE¼	Henry Gibson	D	S,e	S	Qt	...	.....	....	.....	.....	.....	
35cdb1	NW¼SE¼SW¼	S. H. Wester	D	C,w	S	Qt	35	12.32	12-13-51	.....	.....	.....	
35ca1	NE¼SW¼	do	D	C,w	S	Qt	40	.....	....	.....	.....	.....	
36dcc1	SW¼SW¼SE¼	D. M. Elms	D	N	O	Qt	...	28.16	12-13-51	.....	.....	.....	
36dcb1	NW¼SW¼SE¼	do	D	C,w	S	Qt	50	.....	....	.....	.....	.....	
36dc1	SW¼SE¼	do	D	J,e	D,S	Qt	75	.....	....	.....	.....	.....	
36dc2	SW¼SE¼	J. S. Holmberg	D	J,e	D,S	Qt	108	36.54	12-13-51	.....	.....	.....	
9N-26W-6abb1	NW¼NW¼NE¼	U.S. Geol. Survey	D	N	T	Qt	25	.....	....	2,040	.....	2,019	L
7abb1	NW¼NW¼NE¼	do	D	N	T	Qt	160	.....	....	2,070	.....	1,918	L
8aaa1	NE¼NE¼NE¼	do	D	N	T	Qt	88	.....	....	2,009	.....	1,922	L
8bc1	SW¼NW¼	....	D	C,w	O	Qt	63	56.32	11- 6-51	.....	.....	.....	
9ccc1	SW¼SW¼SW¼	U.S. Geol. Survey	D	N	T	Qt	140	.....	....	2,042	.....	1,907	L
10ddd1	SE¼SE¼SE¼	do	D	N	T	Qt	20	7.00	7-10-51	2,014	2,007	1,996	L
11cc1	SW¼SW¼	Ross Simmons	D	B,h	D	Qt	18	.....	....	.....	.....	.....	
12dd1	SE¼SE¼	....	Dg	N	O	Qt	14	12.69	11- 8-51	.....	.....	.....	
14bc1	SW¼NW¼	....	D	N	N	Qt	58	46.28	11- 8-51	.....	.....	.....	
15bbb1	NW¼NW¼NW¼	U.S. Geol. Survey	D	N	T	Qt	91	28.00	7-10-51	2,040	2,012	1,955	L
15aaa1	NE¼NE¼NE¼	L. D. McDermett	D	N	O	Qt	44	15.42	11- 7-51	.....	.....	.....	
15aa1	NE¼NE¼	....	D	N	O	Qt	25	15.07	11- 7-51	.....	.....	.....	
16ccc1	SW¼SW¼SW¼	U.S. Geol. Survey	D	N	T	Qt	40	.....	....	2,090	.....	2,054	L
18aaa1	NE¼NE¼NE¼	do	D	N	T	Qt	67	.....	....	2,083	.....	2,001	L
18aa1	NE¼NE¼	....	D	C,w	S	Qt	78	47.82	11- 6-61	.....	.....	.....	
18cdd1	SE¼SE¼SW¼	H. B. Doss	D	C,g	S	...	85	.....	....	.....	.....	.....	
19cd1	SE¼SW¼	A. E. Lusby	D	C,g	S	Qt	20	12.75	11- 6-51	.....	.....	.....	
19dac1	SW¼NE¼SE¼	Tommy Brooks	D	C,w	D,S	...	100	.....	....	.....	.....	.....	
21add1	SE¼SE¼NE¼	U.S. Geol. Survey	D	N	T	Qt	20	.....	....	2,054	.....	2,037	L
22dcc1	SW¼SW¼SE¼	Nanny Ward	D	C,w	D,S	Qt	48	18.86	3-30-51	.....	.....	.....	
23bb1	NW¼NW¼	Della Vann James	D	C,h	O	Qt	58	44.51	11- 8-51	.....	.....	.....	
23cc1	SW¼SW¼	G. C. Hobart	B	N	D	Qt	48	34.94	3-30-51	.....	.....	.....	
24ddd1	SE¼SE¼SE¼	U.S. Geol. Survey	D	N	T	Qt	32	14.75	7- 5-51	2,001	1,986	1,970	L
24bbb1	NW¼NW¼NW¼	do	D	N	T	Qt	110	34.00	7- 5-51	2,033	1,999	1,928	L
24bab1	NW¼NE¼NW¼	R. A. Rodgers	B	C,w	D,S	Qt	63	.....	....	.....	.....	.....	C
26bbb1	NW¼NW¼NW¼	U.S. Geol. Survey	D	N	T	Qt	50	.....	....	2,073	.....	2,024	L
28bbb1	NW¼NW¼NW¼	do	D	N	T	Qt	35	.....	....	2,111	.....	2,076	L
29bc1	SW¼NW¼	C. M. Ballew	D	N	O	Qt	33	18.94	11- 6-51	.....	.....	.....	
29dd1	SE¼SE¼	C. T. Nickels	D	C,w	S	P	85	35.00	3-30-51	.....	.....	.....	
30abc1	SW¼NW¼NE¼	Texola, Okla.	Dg	T,e	S	Qt	18	10.00	11- 2-51	.....	.....	.....	C
31abc1	SW¼NW¼NE¼	do	D	T,e	S	P	112	.....	....	.....	.....	.....	C
32dd1	SE¼SE¼	....	Dg	C,w	S	Qt	...	13.97	11- 7-51	.....	.....	.....	
33bbb1	NW¼NW¼NW¼	....	D	N	O	Qt	33	13.73	11- 7-51	.....	.....	.....	
35bc1	SW¼NW¼	....	Dg	N	O	Qt	25	14.07	11- 8-51	.....	.....	.....	
35dcd1	SE¼SW¼SE¼	....	Dg	C,w	S	...	38	27.06	11- 8-51	.....	.....	.....	
36cdc1	SW¼SE¼SW¼	....	D	N	O	...	27	9.09	11- 8-51	.....	.....	.....	
10N-25W-33daa1	NE¼NE¼SE¼	U.S. Geol. Survey	D	N	T	Qt	25	12.00	7-5-51	1,928	1,918	1,910	
35cbb1	NW¼NW¼SW¼	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	[illegible]		262	1,600	56	...	16	2,730	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
9bdc1	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	126	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	Thickness	Depth
8N-23W-1dd1. 140 feet north and 20 feet west of SE cor. sec. 1. Altitudes: land surface, 1,722; bedrock, 1,670.		
Sand, medium	10	10
Clay, gray, yellow stains, sandy	5	15
Clay, gray, sandy, calcareous, sand lenses	5	20
No sample	5	25
Gravel, fine, caliche, coarse sand	18	43
Bedrock	11	54
8N-23W-3ddd1. 50 feet north and 15 feet west of SE cor. sec 3. Altitudes: land surface, 1,813; bedrock, 1,718.		
Sand, medium, brown, caliche	5	5
Sand, medium, brown; caliche; gray clay	5	10
Sand, medium, brown; caliche, gravel, fine	5	15
Sand, coarse; silt; caliche	15	30
Sand, coarse; reddish-brown	3	33
Sand, coarse; reddish-brown; caliche	4	37
Sand, coarse, reddish-brown	3	40
Sand, coarse, reddish-brown; caliche; clay, reddish-brown	20	60
No sample	5	65
Sand, medium, reddish-brown; caliche; clay, reddish-brown and gray	5	70
Sand, medium, reddish-brown; caliche	5	75
Clay, dark-gray, sandy	5	80
Gravel, fine; sand, coarse; clay, gray streaks	10	90
Clay, reddish-brown, sandy	5	95
Bedrock	3	98
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, reddish-brown, medium, silty, clayey, calcareous	5	5
No sample	5	10
Sand, fine, reddish-brown, calcareous	5	15
Sand, medium, clayey, reddish-brown, calcareous	10	25
No sample	10	35
Sand, medium, reddish-brown, clayey, calcareous	15	50
No sample	10	60
Sand, medium, clayey, reddish-brown	20	80
Sand, medium, reddish-brown, calcareous	5	85
Gravel, medium	5	90
No sample	10	100
Sand, coarse, brown, calcareous	25	125
Gravel, fine; sand, coarse	10	135
Bedrock	..	...
8N-23W-7aaa1. 160 feet west and 15 feet south of NE cor. sec. 7. Altitudes: land surface, 1,909; bedrock, 1,874.		
Sand, reddish-brown, medium	5	5
Sand, reddish-brown, medium, clayey	10	15
Sand, coarse	5	20
Gravel, fine; clay, reddish-brown; sand coarse	5	25
Sand, medium; gravel, fine	10	35
Bedrock	5	40
8N-23W-9bbb1. 160 feet east and 15 feet south of NW cor. sec. 9. Altitudes: land surface, 1,902; bedrock, 1,853.		
Sand, medium, reddish-brown; clay, gray and reddish-brown, sandy streaks	15	15
Clay, brown, sandy	5	20
Sand, coarse, reddish-brown; clay, reddish-brown, streaks; silt	5	25
Gravel, medium; sand, coarse	15	40
Sand, medium, reddish-brown	5	45
Gravel, medium	4	49
Bedrock	3	52
8N-24W-11ddd1. 85 feet north and 15 feet west of SE cor. sec. 11. Altitudes: land surface, 1,928; bedrock, 1,879.		
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
8N-24W-12bbb1. 50 feet east and 15 feet south of NW cor. sec. 12. Altitudes: land surface, 1,914; bedrock, 1,819.		
Sand, brown, silty, clayey	5	5
Sand, fine, reddish-brown, calcareous	5	10
No sample	10	20
Sand, fine; caliche	10	30
Clay, reddish-brown, sandy; caliche	29	59
Sand, reddish-brown, medium; caliche	8	67
Gravel, medium	3	70
No sample	10	80
Gravel, medium; sand, coarse	10	90
Gravel, medium; sand, coarse,; caliche	5	95
Bedrock	3	98
9N-22W-19aaa1. NE cor. sec. 19. Shell Oil Co. test-hole 28. Altitudes: land surface; 1,747; bedrock, 1,713.		
Sand, fine	20	20
Sand, coarse; clay balls	14	34
Bedrock	..	..
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.		
Clay, brown	5	5
Sand, fine	10	15
Sand, coarse	18	33
Bedrock	..	..
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
Sand, fine	13	15
Sand; gravel; clay	3	18
Sand, coarse	14	32
Bedrock	..	..
9N-22W-19add1. 660 feet north of E½ sec. 19. Shell Oil Co. test-hole 48. Altitudes: land surface, 1,742; bedrock, 1,710.		
Clay, red	6	6
Sand, fine	7	13
Sand, coarse	11	24
Sand; gravel; clay	4	28
Sand, coarse	4	32
Sand, fine, red (bedrock)	12	44
9N-22W-19add2. E¼ cor. sec. 19. Shell Oil Co. test-hole 26. Altitudes: land surface, 1,741; bedrock, 1,708.		
Sand, fine	8	8
Clay, blue	2	10
Sand, coarse; gravel; clay balls	23	33
Bedrock	..	..
9N-22W-19acc1. Center of sec. 19. Shell Oil Co. test-hole 12. Altitudes: land surface, 1,745; bedrock, 1,722.		
Sand, medium; gravel	23	23
Bedrock	..	..
9N-22W-19cac1. Center of SW¼ sec. 19. Shell Oil Co. test-hole 30. Altitudes: land surface, 1,802; bedrock, 1,770.		
Sand, fine, brown	9	9
Clay, sandy	11	20
Sand, medium	2	22
Sand, fine; clay, streaks	8	30
No sample	2	32
Bedrock	..	..
9N-22W-19cad1. 1,320 feet north of S¼ cor. sec. 19. Shell Oil Co. test-hole 31. Altitudes: land surface, 1,769; bedrock, 1,751.		
Sand, fine, brown	11	11
Sand, coarse; gravel	1	12

Description	Thick-ness	Depth
9N-22W-19cad1.--Continued		
Clay, red	1	13
Clay, sandy, red	5	18
Bedrock	..	..
9N-22W-19cda1. 660 feet north of S¼ cor. sec. 19. Shell Oil Co. test-hole 32. Altitudes: land surface, 1,762; bedrock, 1,739.		
Sand, fine, brown	5	5
Sand, medium	7	12
Clay, sandy, red	2	14
Sand, medium; gravel	9	23
Bedrock	..	..
9N-22W-20cbb1. 660 feet south and 264 feet east of W¼ cor. sec. 20. Shell Oil Co. test-hole 49. Altitudes: land surface, 1,741; bedrock, 1,708.		
Clay, brown	5	5
Sand, coarse	9	14
Clay, blue	2	16
Sand, coarse	17	33
Bedrock	..	..
9N-22W-20cbc1. 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.		
Clay, brown	5	5
Sand, coarse	7	12
Clay, blue	2	14
Sand, coarse	21	35
Bedrock	..	..
9N-22W-20ccb1. 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.		
Clay, sandy, brown	2	2
Sand; gravel; clay	18	20
Sand, coarse	12	32
Bedrock	..	..
9N-22W-29bbb1. 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.		
Clay, sandy, brown	2	2
Sand, coarse; clay	12	14
Sand, coarse	19	33
Bedrock	..	..
9N-22W-29bbc1. 1,320 feet south and 264 feet east of NW cor. sec. 29. Altitudes: land surface, 1,735; bedrock, 1,704.		
Clay, sandy, brown	2	2
Sand, fine	12	14
Sand; gravel; clay	6	20
Sand, coarse	11	31
Bedrock	..	..
9N-22W-30aaa1. NE cor. sec. 30. Shell Oil Co. test-hole 24. Altitudes: land surface, 1,739, bedrock, 1,705.		
Clay, red	5	5
Sand, coarse	20	25
Sand, coarse; gravel, clay balls	5	30
Sand, coarse	4	34
Bedrock	..	..
9N-22W-30abb1. N¼ cor. sec. 30. Shell Oil Co. test-hole 9. Altitudes: land surface, 1,775; bedrock, 1,720.		
Sand, fine, brown	18	18
Sand, medium	5	23
Sand, coarse; gravel	5	28
Sand, fine	10	38
Sand, medium; gravel	3	41
Sand, fine, hard, red	14	55
Bedrock	..	..
9N-22W-30abc1. 660 feet south of N¼ cor. sec. 30. Shell Oil Co. test-hole 33. Altitudes: land surface, 1,773; bedrock, 1,732.		
Sand, fine	14	14
Sand, coarse	2	16
Sand, fine	9	25
Sand, coarse; gravel; clay	5	30
Sand, fine	5	35
Sand, coarse; gravel, large	6	41
Bedrock	..	..
9N-22W-30bbd1. 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.		
Sand, fine, brown	20	20
Clay, sandy	5	25
Sand, fine	3	28
Sand, coarse; gravel	5	33
Bedrock	..	..
9N-22W-30abc1. 1,320 feet south of N¼ cor. sec. 30. Shell Oil Co. test-hole 34. Altitudes: land surface, 1,767; bedrock, 1,733.		
Sand, fine, brown	10	10
Sand, fine	5	15
Clay, blue	2	17
Sand, coarse; gravel; clay streaks	6	23
Sand, fine, red	7	30
Sand, coarse; gravel	4	34
Bedrock	..	..
9N-22W-30bac1. Center of NW¼ sec. 30. Shell Oil Co. test-hole 44. Altitudes: land surface, 1,788; bedrock, 1,747		
Clay, sandy, brown	15	15
Sand, fine	3	18
Sand, coarse; gravel	23	41
Bedrock	..	..
9N-22W-30acc1. 660 feet north of center of sec. 30. Shell Oil Co. test-hole 35. Altitudes: land surface, 1,761; bedrock, 1,717.		
Sand, brown	8	8
Sand, fine	10	18
Clay, red	2	20
Sand, coarse; gravel	18	38
Clay, sandy, red	6	44
Bedrock	..	..
9N-22W-30bcd1. 1,320 feet east and 660 feet north of W¼ cor. sec. 30. Shell Oil Co. test-hole 43. Altitudes: land surface, 1,776; bedrock, 1,714.		
Clay, sandy, red	20	20
Clay, blue	13	33
Sand, medium	22	55
Sand, coarse; gravel	7	62
Bedrock	5	67
9N-22W-30bcd1. 1,320 feet east of W¼ cor. sec. 30. Shell Oil Co. test-hole 37. Altitudes; land surface, 1,785; bedrock, 1,707.		
Clay, chalky, gray	12	12
Sand, fine; clay streaks	8	20
Sand, medium	20	40
Clay, sandy, red	3	43
Sand, medium; gravel	29	72
Sand; gravel, large; clay	6	78
Bedrock	12	90
9N-22W-30dbb1. 660 feet south of center of sec. 30. Shell Oil Co. test-hole 36. Altitudes: land surface, 1,757; bedrock, 1,712.		
Clay, blue	20	20
Sand, medium	22	42
Sand, coarse; gravel	3	45
Bedrock	..	..

Description	Thick-ness	Depth
9N-22W-30dcb1. 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.		
Sand, brown	9	9
Sand, coarse; gravel	11	20
Sand, medium; gravel	15	35
Sand, fine	13	48
Sand, coarse; gravel; clay	5	53
Bedrock	4	57
9N-22W-30cca1. Center of $SW\frac{1}{4}$ sec. 30. Shell Oil Co. test-hole 41. Altitudes: land surface, 1,780; bedrock, 1,740.		
Clay, chalky, red	15	15
Sand, medium	4	19
Clay, red	2	21
Sand, coarse; gravel	17	38
Sand, fine, red	2	40
Bedrock	..	..
9N-22W-30dcc1. 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, chalky, gray	8	8
Clay, blue	5	13
Sand, medium	10	23
Sand, coarse; gravel	2	25
Sand, fine	10	35
Sand, coarse; gravel	16	51
Sand, fine, hard	4	55
Clay, sandy, red	3	58
Sand, coarse; gravel, large	7	65
Bedrock	..	..
9N-22W-30ccd1. 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, brown	6	6
Clay, chalky, red	7	13
Sand, coarse	7	20
Sand, coarse; gravel	6	26
Sand, fine	4	30
Bedrock	..	..
9N-22W-31abb1. $N\frac{1}{4}$ cor. sec. 31. Shell Oil Co. test-hole 5. Altitudes: land surface, 1,755; bedrock, 1,712.		
Soil, sandy, black	4	4
Clay, sandy	2	6
Clay, gray	8	14
Sand, medium; gravel streaks	21	35
Sand, fine	5	40
Sand, fine; gravel, large	3	43
Bedrock	..	..
9N-23W-18ddd1. 240 feet north and 15 feet west of SE cor. sec. 18. Altitudes: land surface, 1,839; bedrock, 1,785.		
Sand, medium, brown	15	15
Sand, silty, brown; caliche	5	20
Clay, dark-gray; caliche; clay, sand, red; gravel, few, fine	5	25
Sand, coarse, brown; gravel, fine	5	30
Gravel, fine; sand, coarse, brown; clay, red, streaks; caliche	10	40
Gravel, medium; sand, medium; caliche	14	54
Bedrock	5	59
9N-23W-24daa1. 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, brown	8	8
Clay, tan	11	19
Sand, coarse; gravel	7	26
Bedrock	..	..

Description	Thick-ness	Depth
9N-23W-24add1. 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, fine, brown	2	2
Clay, chalky	4	6
Clay, gray and brown	8	14
Sand, coarse	4	18
Bedrock	..	..
9N-23W-25aaa1. NE cor. sec. 25. Shell Oil Co. test-hole 7. Altitudes: land surface, 1,801; bedrock, 1,763.		
Soil, black	4	4
Clay, blue	5	9
Clay, sandy, brown	13	22
Sand, fine	8	30
Sand, coarse; gravel	8	38
Bedrock	..	..
9N-23W-25aad1. 660 feet south of NE cor. sec. 25. Shell Oil Co. test-hole 54. Altitudes: land surface, 1,796; bedrock, 1,757.		
Clay, brown	6	6
Clay, sandy, red	14	20
Sand, fine	5	25
Sand, coarse; gravel	14	39
Bedrock	..	..
9N-23W-25aad2. 1,320 feet south of NE cor. sec. 25. Shell Oil Co. test-hole 55. Altitudes: land surface, 1,787; bedrock, 1,719.		
Soil, sandy, brown	5	5
Clay, sandy, brown	14	19
Clay, blue	5	24
Sand, coarse; gravel, large; clay	4	28
Sand, coarse; gravel	12	40
Sand, fine	8	48
Sand, coarse, gravel	20	68
Bedrock	..	..
9N-23W-25add1. 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, fine, brown	5	5
Clay, sandy, red and white	11	16
Sand, fine	12	28
Clay streak	..	..
Sand, medium	7	35
Sand, coarse; gravel	15	50
Sand, fine	8	58
Bedrock	4	62
9N-23W-25add2. $E\frac{1}{4}$ cor. sec. 25. Shell Oil Co. test-hole 6. Altitudes: land surface, 1,788; bedrock, 1,733.		
Clay, rocky, gray and red	15	15
Sand, fine	17	32
Sand, coarse; gravel	5	37
Sand, fine	18	55
Bedrock	..	..
9N-23W-25daa1. 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, fine, brown	6	6
Clay, sandy, red and white	12	18
Sand, fine	6	24
Sand, coarse; gravel	11	35
Sand, fine	13	48
Sand, coarse; gravel; clay	1	49
Sand, fine	6	55
Bedrock	..	..

9N-23W-25dad1. 1,320 feet north of SE cor. sec. 25. Shell Oil Co. test-hole 58. Altitudes: land surface, 1,792; bedrock, 1,750.

Description	Thick-ness	Depth
Sand, fine, brown	10	10
Clay, sandy, red and white	12	22
Sand, fine	7	29
Sand, coarse; gravel	5	34
Sand, fine	6	40
Sand, coarse; gravel	2	42
Bedrock	..	..

9N-23W-25dda1. 660 feet north of SE cor. sec. 25. Shell Oil Co. test-hole 59. Altitudes: land surface, 1,796; bedrock, 1,765.

Description	Thick-ness	Depth
Sand, fine, brown	2	2
Clay, sandy	24	26
Sand, fine	5	31
Bedrock	..	..

9N-23W-28ccc1. 135 feet east and 15 feet north of SW cor. Altitudes: land surface, 1,901; bedrock, 1,788.

Description	Thick-ness	Depth
Sand, brown, medium; calcareous; fine gravel	15	15
Sand, brown	5	20
Sand, medium, brown, clayey	18	38
Sand, medium, brown	2	40
No sample	5	45
Sand, medium, silty, clayey	5	50
Sand, coarse, brown	20	70
Sand, medium, brown, silty; caliche	13	83
Gravel, medium	7	90
Sand, coarse, brown	5	95
Sand, coarse, brown; gravel streaks	5	100
Sand, medium, brown	13	113
Bedrock	7	120

9N-23W-36aaa1. NE cor. sec. 36. Shell Oil Co. test-hole 4. Altitudes: land surface, 1,802; bedrock, 1,772.

Description	Thick-ness	Depth
Sand, fine, brown	12	12
Clay, sandy, brown	8	20
Clay, red and blue	7	27
Sand, medium; gravel	3	30
Bedrock	..	..

9N-24W-6ddd1. 45 feet north and 10 feet west of SE cor. sec. 6. Altitudes: land surface, 1,934; bedrock, 1,885.

Description	Thick-ness	Depth
Sand, coarse; caliche	5	5
Sand, coarse, brown	5	10
Sand, coarse, yellow-brown; clay, reddish-brown	5	15
Sand, medium, yellow	5	20
Sand, medium, brown, clayey	20	40
Sand, coarse; clay, gray; gravel, fine	5	45
Clay, reddish-brown and gray, sandy; gravel, fine; caliche	4	49
Bedrock	6	55

9N-24W-12ddd1. 125 feet north and 20 feet west of SE cor. sec. 12. Altitudes: land surface, 1,847; bedrock, 1,793.

Description	Thick-ness	Depth
Sand, silty, coarse, brown; calcareous	5	5
Sand, silty, coarse, brown; gravel, fine; clay, reddish-brown; caliche	5	10
Sand, coarse, brown; gravel, fine; caliche	40	50
Gravel, medium; caliche	4	54
Bedrock	6	60

9N-24W-14bbb1. 120 feet south and 20 feet east of NW cor. sec. 14. Altitudes: land surface, 1,854; bedrock, 1,795.

Description	Thick-ness	Depth
Sand, medium, brown	10	10
Sand, medium, brown, clayey	10	20
Clay, brown, sandy; caliche	10	30
Clay, dark gray and brown, sandy; caliche	15	45
Clay, gray and red; gravel, fine; caliche	5	50
Sand, medium; gravel, fine	5	55
Gravel, fine; sand, coarse; caliche	4	59
Bedrock	2	61

9N-24W-16ddd1. 45 feet north and 10 feet west of SE cor. sec. 16. Altitudes: land surface, 1,908; bedrock, 1,843.

Description	Thick-ness	Depth
Sand, medium, brown, silty	10	10
Clay, reddish-brown, sandy	20	30
Clay, reddish-brown and gray, sandy	9	39
Gravel, fine	1	40
Sand, coarse; gravel, fine	10	50
Gravel, medium; sand, medium	15	65
Bedrock	2	67

9N-24W-17aaa1. 215 feet west and 20 feet south of NE cor. sec. 17. Altitudes: land surface, 1,899; bedrock, 1,852.

Description	Thick-ness	Depth
Sand, medium, brown	15	15
Sand, medium, brown; caliche	5	20
Sand, medium, reddish-brown	5	25
Sand, medium, reddish-brown; caliche	5	30
Sand, medium, brown	10	40
Sand, coarse, brown	5	45
Gravel, fine; sand, medium	2	47
Bedrock	3	50

9N-24W-18bbb1. 50 feet east and 20 feet south of NW cor. sec. 18. Altitudes: land surface, 1,942; bedrock, 1,857.

Description	Thick-ness	Depth
Sand, medium, brown; clay, brown	5	5
Sand, medium, brown	10	15
Sand, medium, brown; clay streaks, reddish-brown, sandy	5	20
Sand, medium, brown	10	30
Sand, medium, brown; clay, reddish-brown	10	40
Clay, reddish-brown and gray, sandy; sand, medium	10	50
Sand, medium, clayey, brown; caliche	10	60
Sand, coarse, clayey, brown; gravel, fine; caliche	15	75
Clay, red and gray, sandy; gravel, fine	5	80
Sand, medium, brown; gravel, medium	5	85
Bedrock	2	87

9N-24W-18ddd1. 45 feet east and 10 feet north of SE cor. sec. 18. Altitudes, land surface, 1,931; bedrock, 1,835.

Description	Thick-ness	Depth
Sand, medium, clayey, brown	5	5
Sand, medium, brown; clay, gray and brown	12	17
Sand, coarse, brown	3	20
No sample	10	30
Sand, coarse, brown	10	40
No sample	10	50
Sand, coarse, brown	9	59
Gravel, fine; sand, coarse; clay, brown, streaks	11	70
No sample	5	75
Sand, medium, brown	10	85
Gravel, fine; sand, medium	11	96
Bedrock	2	98

9N-24W-19ccc1. 15 feet north and 20 feet east of SW cor. sec. 19. Altitudes: land surface, 1,967; bedrock, 1,890.

Description	Thick-ness	Depth
Sand, medium, brown, clayey	10	10
Sand, medium, yellow-brown	5	15
Sand, medium, reddish-brown, clayey	10	25
Clay, reddish-brown, sandy	10	35
Sand, medium; clay, reddish-brown; gravel, fine	5	40
Sand, medium, brown	10	50
Sand, fine, clayey, brown	10	60
Clay, reddish-brown, sandy	15	75
Gravel, medium	2	77
Bedrock	2	79

9N-24W-22ddd1. 80 feet north and 15 feet west of SE cor. sec. 22. Altitudes: land surface, 1,920; bedrock, 1,814.

Description	Thick-ness	Depth
Sand, brown, medium	10	10
Sand, coarse, reddish-brown, silty, clayey	20	30
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

Description	Thick-ness	Depth
9N-24W-22ddd1.--Continued		
Gravel, streaks; sand, medium; clay, brown; caliche	10	90
No sample	10	100
Sand, coarse; gravel streaks; clay, red	6	106
Bedrock	4	110
9N-24W-23aaa1. 60 feet west and 15 feet south of NE cor. sec. 23. Altitudes: land surface, 1,889; bedrock, 1,763.		
No sample	10	10
Sand, medium, brown	15	25
Clay, silty, brown, sandy	5	30
Clay, gray; sand, silty, reddish-brown	5	35
Silt, gray, reddish-brown; clay, gray, brown	10	45
Gravel, medium	5	50
Gravel, medium; clay, brown, gray, sandy	10	60
Sand, coarse, reddish-brown; clay, reddish-brown, sandy; gravel, fine	10	70
Gravel, medium; sand, coarse	11	81
Clay, gray and brown, sandy	1	82
Gravel, medium; sand, coarse	8	90
Sand, coarse; gravel, few, fine	15	105
Sand, silty, medium; clay, reddish-brown; gravel, fine	5	110
Sand, coarse; gravel, fine	16	126
Bedrock	9	135
9N-24W-24ddd1. 140 feet north and 10 feet west of SE cor. sec. 24. Altitudes: land surface, 1,906; bedrock, 1,717.		
Sand, medium, brown	5	5
Sand, medium, brown; clay, brown, streaks	10	15
Sand, medium, brown	5	20
Sand, coarse, brown; calcareous	40	60
Sand, medium, brown, clayey	10	70
Sand, medium, brown	5	75
Sand, coarse; gravel, fine	10	85
Sand, medium; gravel, fine; clay, red and gray	5	90
Sand, coarse	5	95
Sand, medium; gravel, fine; clay, reddish-brown	5	100
Sand, medium, brown, clayey	5	105
Sand, coarse; gravel, fine	5	110
Sand, coarse, brown	5	115
Sand, coarse; gravel, fine; clay, reddish-brown	5	120
Sand, coarse; calcareous	20	140
Sand, medium, brown, clayey; calcareous	10	150
Gravel, streaks; sand, medium; calcareous, brown	5	155
Clay, reddish-brown, sandy	2	157
Gravel, medium; clay, reddish-brown, sandy, streaks	13	170
Sand, medium, brown; gravel, fine	5	175
Clay, reddish-brown, sandy; gravel, fine	5	180
Sand, medium, brown; gravel, fine	9	189
Bedrock	1	190
9N-24W-25ccc1. 195 feet north and 10 feet east of SW cor. sec. 25. Altitudes: land surface, 1,909; bedrock, 1,819.		
Sand, brown, coarse	5	5
Sand, medium, silty, clayey	5	10
Sand, medium, brown	5	15
Sand, medium, brown, clayey; clay, sandy, red and gray; calcareous	5	20
Sand, medium, brown, clayey	5	25
Sand, medium, brown	10	35
Sand, medium, clayey, brown; clay, reddish-brown, streaks	5	40
Clay, reddish-brown, sandy	5	45
Sand, medium, brown	20	65
Sand, medium; gravel, fine	5	70
Sand, coarse, brown	10	80
Sand, medium, brown, clayey	5	85
Gravel, fine; sand, coarse	5	90
Bedrock	..	..
9N-24W-25ddd1. 20 feet west and 15 feet north of SE cor. sec. 25. Altitudes: land surface, 1,925; bedrock, 1,820.		
Sand, medium, brown	5	5
Clay, brown, sandy	5	10
Sand, medium, clayey	10	20
Sand, medium, iron particles	5	25
Clay, brown, sandy	5	30
No sample	30	60
Sand, medium, clayey, reddish-brown	25	85
Sand, medium, silty; gravel, fine	5	90
Sand, medium, silty, clayey, reddish-brown	10	100
Sand, coarse, brown	2	102
Gravel, medium	3	105
Bedrock	5	110
9N-24W-29aaa1. 250 feet south and 20 feet west of NE cor. sec. 29. Altitudes: land surface, 1,925; bedrock, 1,856.		
Sand, medium, brown	5	5
Sand, medium, silty, clayey, brown	5	10
Clay, brown, sandy; caliche	20	30
Sand, fine; clay, brown, streaks, sandy	10	40
Sand, coarse, brown; gravel streaks	29	69
Bedrock	1	70
9N-24W-31bbb1. 15 feet south and 20 feet east of NW cor. sec. 31. Altitudes: land surface, 1,992; bedrock, 1,943.		
Sand, medium; clay, reddish-brown, silty	5	5
Sand, medium; clay, gray	5	10
Sand, medium, brown	3	13
Clay, reddish-brown, sandy	1	14
Sand, medium, brown; clay, reddish-brown, streaks, sandy	6	20
Clay, reddish-brown, sandy	5	25
Sand, medium, brown; clay, green and gray, reddish-brown; caliche	10	35
Sand, medium, clayey, brown; clay, reddish-brown, sandy, streaks	5	40
Clay, yellow-gray, sandy	3	43
Sand, medium, brown	2	45
Sand, coarse, clayey; caliche	4	49
Bedrock	1	50
9N-24W-32ddd1. 60 feet north and 15 feet west of SE cor. sec. 32. Altitudes: land surface, 1,978; bedrock, 1,960.		
Sand, medium, brown, clayey	5	5
Sand, medium, brown	10	15
Gravel, fine; sand, coarse	3	18
Bedrock	2	20
9N-24W-33aaa1. 30 feet west and 25 feet south of NE cor. sec. 33. Altitudes: land surface, 1,943; bedrock, 1,830.		
No sample	5	5
Sand, medium, brown, clayey	15	20
Clay, brown and reddish-brown, sandy	30	50
Sand, brown, clayey, medium; gravel, fine	10	60
Gravel, streaks; sand, coarse, brown; clay, reddish-brown	10	70
Sand, medium, brown	10	80
Sand, coarse, brown; clay, brown, streaks	10	90
No sample	10	100
Sand, medium, brown	10	110
Gravel, fine; sand, coarse	3	113
Bedrock	2	115
9N-24W-35cdc1. 80 feet east and 20 feet north of SW cor. sec. 35. Altitudes: land surface, 1,928; bedrock, 1,885.		
Sand, medium; clay, gray; caliche	5	5
No sample	5	10
Sand, coarse, clayey; clay, reddish-brown, sandy	5	15
Clay, red, sandy	5	20
Sand, coarse; gravel, fine; clay, gray and and red; caliche	5	25
Sand, fine, silty, brown	10	35
Sand, medium, clayey, brown	5	40
Gravel, medium; sand, coarse	3	43
Bedrock	2	45

Description	Thick-ness	Depth
9N-25W-1aaa1. 540 feet west and 15 feet north of NE cor. sec. 1. Altitudes: land surface, 1,943; bedrock, 1,886.		
Clay, brown, silty and sandy	5	5
Clay, yellow, gray, tan, sandy and silty	5	10
Sand, medium, clayey	10	20
Clay, gray, sandy	5	25
Sand, medium, brown; clay, gray, brown.	5	30
Sand, coarse, brown	10	40
Sand, coarse, brown; clay, gray	10	50
Sand, coarse, brown; gravel, fine	7	57
Bedrock	5	62
9N-25W-2ddd1. 30 feet north and 20 feet west of SE cor. sec. 2. Altitudes: land surface, 1,987; bedrock, 1,904.		
Sand, medium, brown and reddish-brown	15	15
Sand, medium, brown; clay, reddish-brown, sandy	5	20
Sand, coarse; clay, reddish-brown; gravel, fine	5	25
Sand, coarse, brown	5	30
Sand, medium, brown, silty, clayey	5	35
Sand, coarse, reddish-brown	10	45
Sand, coarse; clay, reddish-brown	12	57
Gravel, fine; sand, coarse	3	60
Sand, coarse, brown	5	65
Sand, coarse, brown; gravel, fine	5	70
Sand, coarse, brown; clay, reddish-brown, sandy streaks	8	78
Gravel, medium	5	83
Bedrock	7	90
9N-25W-3aaa1. 30 feet south and 25 feet west of NE cor. sec. 3. Altitudes: land surface, 1,943; bedrock, 1,905.		
Sand, coarse, brown	10	10
Sand, coarse, brown; gravel, fine; clay, red	5	15
Clay, silty, yellow-brown, sandy; gravel, fine; sand, coarse	5	20
Sand, coarse, brown; gravel, fine	10	30
Sand, coarse, brown; gravel, fine; clay, reddish-brown	5	35
Gravel, fine, sand, coarse; clay, reddish-brown; caliche	3	38
Bedrock	2	40
9N-25W-3ccc1. 20 feet north and 15 feet east SW cor. sec. 3. Altitudes: land surface, 1,984; bedrock, 1,857.		
Sand, medium, brown	5	5
Clay, dark gray, sandy	5	10
Sand, medium, red and brown, clayey	5	15
Clay, reddish-brown, sandy	5	20
Sand, coarse, brown	15	35
Sand, coarse, clayey, reddish-brown	5	40
Sand, fine, brown	10	50
No sample	15	65
Sand, coarse	1	66
Clay, reddish-brown, sandy	4	70
Sand, coarse; clay, gray, black and reddish-brown	5	75
Sand, coarse, brown	5	80
Sand, coarse, brown; clay, reddish-brown and gray	5	85
Clay, dark gray, sandy	5	90
Clay, dark gray and reddish-brown, sandy; gravel	5	95
Sand, coarse; gravel, fine	10	105
Sand, medium; gravel, fine; caliche	5	110
Clay, reddish-brown and gray, sandy; gravel; calcareous	17	127
Bedrock	23	150
9N-25W-4bdd1. Erick test-hole 13.		
Sand, fine, brown	6	6
Clay	4	10
Sand, fine	24	34
Sand, fine to medium	5	40
Sand, medium	8	48
Sand, coarse; gravel	7	55
Sand, fine to medium	7	62
Bedrock	..	..

Description	Thick-ness	Depth
9N-25W-4cab1. Erick test-hole 14.		
Sand, fine, brown	19	19
Clay	5	24
Sand, fine	10	34
Sand, fine to medium	4	38
Sand, coarse; gravel	10	48
Sand, fine	6	54
9N-25W-4cbb1. Erick test-hole 15.		
Sand, fine, brown	9	9
Clay	3	12
Sand, fine	14	26
Sand, medium to coarse; gravel	8	34
Sand, fine	6	40
Sand, medium to coarse	6	46
Sand, coarse; gravel	6	52
Sand, fine	3	55
Bedrock	..	..
9N-25W-4ccb1. Erick test-hole 12.		
Sand, fine, brown	33	33
Sand, medium	8	41
Sand, coarse; gravel	5	46
9N-25W-4ccc1. Erick test-hole 9.		
Sand, fine, brown	11	11
Clay	2	13
Sand, fine	35	48
Sand, medium	3	51
Sand, coarse; gravel	2	53
Clay	1	54
Sand, fine	4	58
Sand, medium; gravel	2	60
Bedrock	..	..
9N-25W-6ddd1. 65 feet west and 15 feet north of SE cor. sec. 6. Altitudes: land surface, 1,974; bedrock, 1,943.		
Sand, medium, brown	10	10
Gravel, medium; sand, coarse, brown	13	23
Clay, gray, sandy	3	26
Gravel, medium; sand, coarse	5	31
Bedrock	4	35
9N-25W-7ccc1. 0.1 mile east and 15 feet north of SW cor. sec. 7. Altitudes: land surface, 2,014; bedrock, 1,988.		
Clay, dark gray; silt, sand	4	4
Sand, coarse, brown; clay, reddish-brown and gray	6	10
Sand, reddish-brown and tan, fine, clayey	5	15
Clay, varigated, sandy; sand, yellow-brown, clayey streaks	5	20
Sand, medium, brown, clayey; gravel, fine	6	26
Bedrock	1	27
9N-25W-8add1. Erick test-hole 8.		
Sand, fine, brown	8	8
Clay	8	16
Sand, fine; clay streaks	47	63
Sand, medium; gravel	2	65
Bedrock	..	..
9N-25W-8ddd1. Erick test-hole 7.		
Sand, fine, brown	8	8
Clay	8	16
Sand, fine; clay streaks	54	70
Sand, medium; gravel	2	72
Bedrock	..	..
9N-25W-11ccc1. 30 feet east and 20 feet north of SW cor. sec. 11. Altitudes: land surface, 1,989; bedrock, 1,869.		
Sand, coarse, brown	5	5
Sand, medium, clayey, brown	19	24
Clay, reddish-brown, sandy	6	30
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

Description	Thick-ness	Depth
9N-25W-11ccc1.--Continued.		
Clay, red and gray, sandy	7	77
Sand, coarse, brown	8	85
Sand, medium, brown; clay, gray, sandy	5	90
Sand, coarse, brown; clay, reddish-brown, sandy	5	95
Clay, reddish-brown, sandy; caliche	5	100
Sand, medium, brown; clay, reddish-brown; caliche	5	105
Gravel, medium; sand, medium	5	110
Gravel, medium; clay, reddish-brown, sandy	10	120
Bedrock	8	128
9N-25W-17add2. Erick test-hole 6.		
Sand	19	19
Sand, fine; clay	56	75
9N-25W-17ddd1. Erick test-hole 5.		
Sand, fine, brown	10	10
Sand, fine; clay streaks	65	75
Clay; sand, red	5	80
9N-25W-18ddd1. 100 feet west and 15 feet north of SE cor. sec. 18. Altitudes: land surface, 1,999; bedrock, 1,947.		
Sand, medium	2	2
Sand, medium; clay, reddish-brown and gray	3	5
Clay, greenish-gray, sandy; caliche	5	10
Clay, reddish-brown, sandy; caliche	5	15
Sand, medium, brown, clayey; clay, sandy, gray; caliche	5	20
Sand, coarse; gravel, fine	8	28
Clay, reddish-brown and gray, sandy; caliche	7	35
Sand, coarse; gravel, fine; clay, reddish-brown; caliche	5	40
Sand, gray, clayey, fine; clay, reddish-brown; caliche	5	45
Sand, coarse; gravel, fine	5	50
Gravel, medium	2	52
Bedrock	8	60
9N-25W-20add1. Erick test-hole 4.		
Sand, fine, brown	5	5
Sand, fine; clay streaks	65	70
9N-25W-20ddd1. Erick test-hole 3.		
Sand, fine, brown	6	6
Sand, fine; clay streaks	64	70
Bedrock	..	..
9N-25W-21aaa1. 50 feet south and 20 feet west of NE cor. sec. 21. Altitude : land surface, 2036.		
Sand, medium, brown, silty	15	15
Sand, coarse, brown; clay, reddish-brown, sandy	20	35
Sand, coarse, brown	10	45
Clay, reddish-brown, sandy	5	50
Sand, medium, brown and gray	10	60
Sand, medium, brown; clay, reddish-brown, sandy	10	70
Sand, medium, brown	35	105
Sand, medium, brown; gravel streaks; clay, gray	5	110
Sand, coarse, brown; gravel streaks	10	120
Sand, coarse, brown; gravel streaks	30	150
Sand, coarse, brown; clay streaks, sandy, reddish-brown	5	155
Clay, red, sandy; gravel; caliche	5	160
Sand, coarse; gravel; clay, red, sandy; caliche	10	170
Sand, coarse, brown; gravel, fine	25	195
9N-25W-24bbb1. 60 feet east and 15 feet south of NW cor. sec. 24. Altitudes: land surface, 1,974; bedrock, 1,926.		
Sand, medium, reddish-brown, silty and clayey	10	10
Sand, medium, brown	5	15
Sand, medium, brown, clayey	5	20
Sand, medium, brown	5	25
Sand, coarse, clayey, brown; gravel, fine	15	40
Sand, coarse, brown	8	48
Bedrock	6	54

Description	Thick-ness	Depth
9N-25W-26bbb1. 60 feet east and 10 feet south of NW cor. sec. 26. Altitudes: land surface, 2,009; bedrock, 1,954.		
Sand, medium, brown	13	13
Sand, medium, clayey, brown	7	20
Clay, brown, sandy	5	25
Sand, medium, brown	5	30
Sand, medium, clayey, brown	5	35
Sand, medium, brown	5	40
Sand, medium, brown, clayey; clay, reddish-brown, sandy streaks	10	50
Sand, medium, brown; clay, brown	3	53
Gravel	1	54
Sand, medium, brown; clay, brown	1	55
Bedrock	15	70
9N-25W-29add1. Erick test-hole 2.		
Sand, fine, brown	15	15
Clay, sandy, red	33	48
Bedrock	..	..
9N-25W-29ddd1. SE cor. Erick test-hole 1.		
Sand, fine, brown	8	8
Clay, sandy	8	16
Sand, fine, tan	4	20
Clay, red, sandy	13	33
Clay, red; "gyp" rock	6	39
Clay, red	10	49
9N-25W-33ada1. 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, brown, sandy	5	5
Sand, medium; clay, reddish-brown, sandy	5	10
Clay, reddish-brown, sandy	5	15
Clay, reddish-brown and gray, sandy; caliche	20	35
Clay, reddish-brown, sandy; caliche	30	65
Bedrock	2	67
9N-26W-6abb1. 0.1 mile south and 15 feet east of NW cor. NE¼ sec. 6. Altitudes: land surface, 2,040; bedrock, 2,019.		
Sand, medium clayey; gravel, fine; caliche	5	5
Sand, medium, reddish-brown, clayey; gravel, fine	5	10
Sand, coarse, reddish-brown; gravel , fine; clay, reddish-brown and gray	11	21
Bedrock	4	25
9N-26W-7abb1. 280 feet south and 10 feet east of NW cor. NE¼ sec. 7. Altitudes: land surface, 2,070; bedrock, 1,918.		
Sand, medium; gravel, fine; caliche	5	5
Sand, fine, brown, clayey	15	20
Sand, medium, brown; gravel, fine	5	25
Sand, medium, brown; clay, brown and gray; gravel, fine	5	30
Sand, medium; clay, gray	5	35
Sand, coarse, brown	5	40
Sand, coarse, brown; gravel, fine	10	50
Sand, coarse, brown	5	55
Gravel, medium; sand, coarse, brown	15	70
Gravel, medium; sand, coarse; clay, reddish-brown	5	75
Gravel, coarse; sand, coarse	7	82
Clay, reddish-brown, sandy	8	90
Sand, medium; gravel, fine; clay, reddish-brown	5	95
Sand, coarse; gravel	5	100
Sand, coarse	8	108
Clay, reddish-brown, sandy; caliche	2	110
Sand, coarse; clay, reddish-brown	8	118
Sand, coarse; gravel streaks	19	137
Sand, coarse; clay, reddish-brown, sandy; caliche	3	140
Sand, coarse; gravel, fine	12	152
Bedrock	8	160

9N-26W-8aaa1. 130 feet north and 10 feet south of NE cor. sec. 8. Altitudes: land surface, 2,009; bedrock, 1,922.

Description	Thickness	Depth
Sand, medium, dark brown	10	10
Sand, medium; clay, reddish-brown, sandy	5	15
Clay, reddish-brown; sand, coarse	15	30
Clay, reddish-brown, sandy; gravel, fine	10	40
Sand, coarse; gravel, fine	5	45
Clay, reddish-brown, sandy; gravel, fine	5	50
Sand, medium	10	60
Gravel, medium; sand, coarse	8	68
Clay, reddish-brown, sandy; calcareous	2	70
Clay, light-gray, sandy; calcareous	5	75
Clay, reddish-brown and light-gray; sand, coarse; calcareous; gravel, fine	10	85
Gravel, medium; sand, coarse	2	87
Bedrock	1	88

9N-26W-9ccc1. 95 feet north and 15 feet east of SW cor. sec. 9. Altitudes: land surface, 2,042; bedrock, 1,907.

Description	Thickness	Depth
Sand, medium	15	15
Clay, reddish-brown, sandy	15	30
Sand, reddish-brown, medium, clayey	10	40
Sand, medium, reddish-brown	17	57
Clay, reddish-brown, sandy; gravel streak	1	58
Sand, coarse, reddish-brown	2	60
Sand, coarse, reddish-brown; clay, greenish-gray, sandy; gravel	5	65
Sand, coarse; gravel	5	70
Sand, coarse, brown	20	90
Sand, coarse; clay, brown, sandy	5	95
Sand, coarse; gravel, fine	5	100
Sand, medium	8	108
Sand, coarse; gravel streaks	2	110
Sand, coarse; clay, reddish-brown	5	115
Sand, coarse	5	120
Sand, coarse, gravel, fine; clay, reddish-brown	5	125
Sand, coarse; gravel, fine	10	135
Bedrock	5	140

9N-26W-10ddd1. 50 feet west and 20 feet north of SE cor. sec. 10. Altitudes: land surface, 2,014; bedrock, 1,996.

Description	Thickness	Depth
Sand, medium, brown, silty, clayey	5	5
Sand, fine, gray; gravel, fine	5	10
Sand, coarse; clay, reddish-brown; gravel	5	15
Sand, medium	3	18
Bedrock	2	20

9N-26W-15bbb1. 40 feet east and 15 feet south of NW cor. sec. 15. Altitudes: land surface, 2,040; bedrock, 1,955.

Description	Thickness	Depth
Sand, medium, brown	13	13
Clay, reddish-brown and light-gray, sandy	2	15
Clay, tan and gray, sandy	5	20
Clay, reddish-brown, sandy; sand, fine	5	25
Sand, medium, brown	5	30
Sand, medium, brown; gravel, fine; calcareous	5	35
Sand, fine; gravel, fine	5	40
Sand, medium; gravel, fine; caliche	5	45
Sand, coarse, brown	20	65
Sand, coarse; gravel, fine; clay, reddish-brown, sandy; calcareous	5	70
Sand, coarse, brown and gray; gravel streak; clay, reddish-brown	5	75
Gravel, fine; sand, coarse	5	80
Sand, coarse; gravel	5	85
Bedrock	6	91

9N-26W-16ccc1. 60 feet north and 15 feet east of SW cor. sec. 16. Altitudes: land surface, 2,090; bedrock, 2,054.

Description	Thickness	Depth
Sand, reddish-brown, medium, clayey	5	5
Sand, reddish-brown, medium	5	10
Sand, reddish-brown, coarse, clayey	5	15
Sand, brown, coarse	17	32
Clay, reddish-brown, sandy; caliche	4	36
Bedrock	4	40

9N-26W-18aaa1. 0.1 mile south and 10 feet west of NE cor. sec. 18. Altitudes: land surface, 2,083; bedrock, 2,001.

Description	Thickness	Depth
Sand, medium silty and clayey, brown	5	5
Clay, brown; sand, medium, brown	5	10
Sand, coarse, brown	2	12
Clay, brown, sandy	5	17
Sand, coarse, brown	3	20
Sand, medium, clay, gray	5	25
Sand, coarse, brown	5	30
Sand, medium clayey, brown	5	35
Sand, medium, brown	5	40
Sand, medium, silty, clayey, brown	5	45
Sand, medium, brown	5	50
Sand, medium, clayey, brown	5	55
Sand, medium, brown	10	65
Clay, red, sandy; caliche	2	67
Bedrock	..	..

9N-26W-21add1. 525 feet north and 15 feet west of SE cor. NE¼ sec. 21. Altitudes: land surface, 2,054; bedrock, 2 037.

Description	Thickness	Depth
Sand, medium, brown	3	3
Clay, red, sandy	2	5
Clay, red, sandy; caliche	5	10
Sand, coarse, brown; caliche	7	17
Bedrock	3	20

9N-26W-24bbb1. 30 feet east and 20 feet south of NW cor. sec. 24. Altitudes: land surface, 2,033; bedrock, 1,928.

Description	Thickness	Depth
Clay, reddish-brown, sandy	5	5
Sand, medium, brown, clayey; caliche	5	10
Sand, coarse, brown	3	13
Caly, reddish-brown, sandy; caliche	2	15
Clay, reddish-brown, sandy	10	25
Sand, coarse, brown	7	32
Clay, gray, sandy	1	33
Sand, coarse, brown	2	35
Sand, coarse, brown; gravel, fine	5	40
Sand, coarse, brown; gravel, fine; clay, sandy, reddish-brown	10	50
Sand, coarse, brown; gravel, fine	10	60
Sand, coarse, brown; clay, reddish-brown	5	65
Gravel, medium	30	95
Clay, red, sandy; caliche	10	105
Bedrock	5	110

9N-26W-26ddd1. 60 feet north and 12 feet west of SE cor. sec. 26. Altitudes: land surface, 2,001; bedrock, 1,970.

Description	Thickness	Depth
Sand, medium, brown	4	4
Clay, reddish-brown; sand, medium	6	10
Sand, medium, brown	4	14
Clay, gray, sandy	1	15
Clay, brown and gray, sandy	5	20
Clay, red, sandy; gravel, fine; caliche	5	25
Gravel, medium; clay, red; caliche	5	30
Clay, reddish-brown and gray, sandy; caliche	1	31
Bedrock	1	32

9N-26W-26bbb1. 125 feet south and 10 feet east of NW cor. sec. 26. Altitudes: land surface, 2,073; bedrock, 2,024.

Description	Thickness	Depth
Sand, coarse, dark brown	5	5
Sand, coarse, reddish-brown, clayey	15	20
Sand, coarse, brown	10	30
Clay, reddish-brown, sandy	16	46
Clay, reddish-brown, sandy; caliche	3	49
Bedrock	1	50

9N-26W-28bbb1. 65 feet east and 18 feet south of NW cor. sec. 28. Altitudes: land surface, 2,111; bedrock, 2,076.

Description	Thickness	Depth
Sand, fine, reddish-brown, clayey	5	5
Clay, dark gray and reddish-brown, sandy, calcareous	6	11
Clay, reddish-brown, sandy	4	15
Clay, tan, sandy; caliche	15	30
Clay, red, sandy, caliche	5	35
Bedrock	..	..

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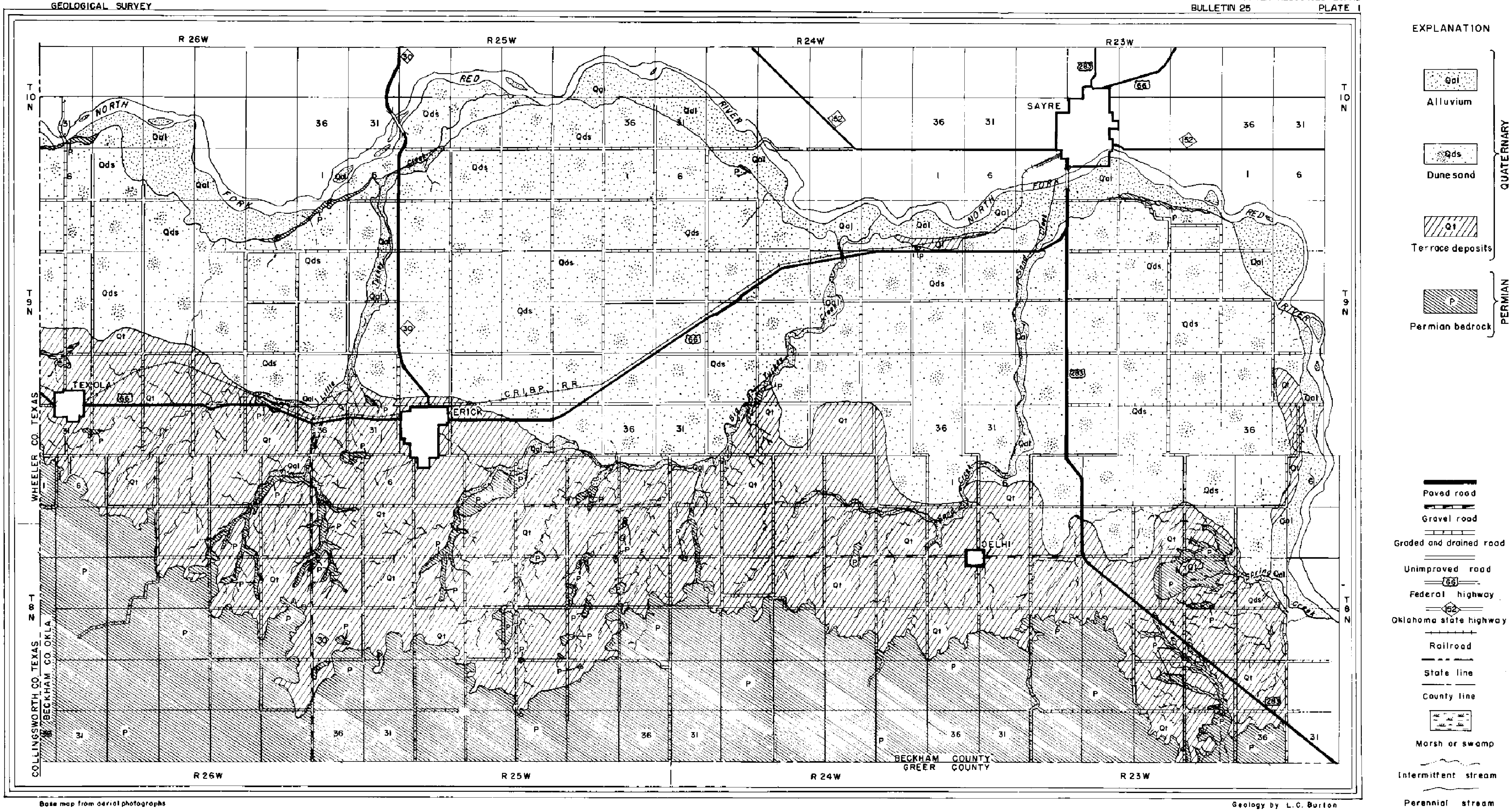
OKLAHOMA WATER RESOURCES BOARD
BULLETIN 25 PLATE I

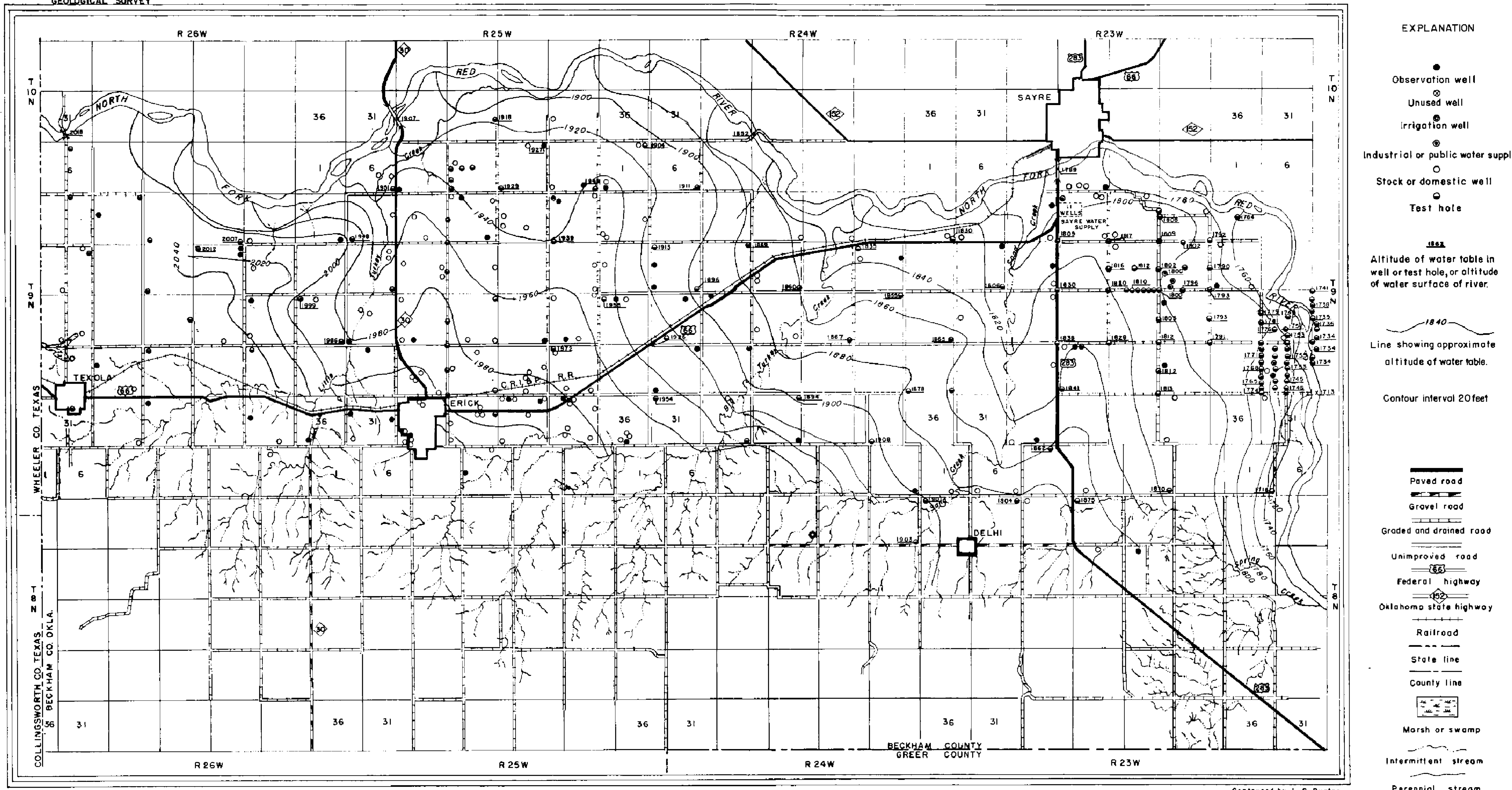


GEOLOGIC MAP OF CENTRAL BECKHAM COUNTY, OKLAHOMA

1 0 1 2 3
Scale in miles

U.S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

OKLAHOMA WATER RESOURCES BOARD
BULLETIN 25 PLATE 2



Base map from aerial photographs

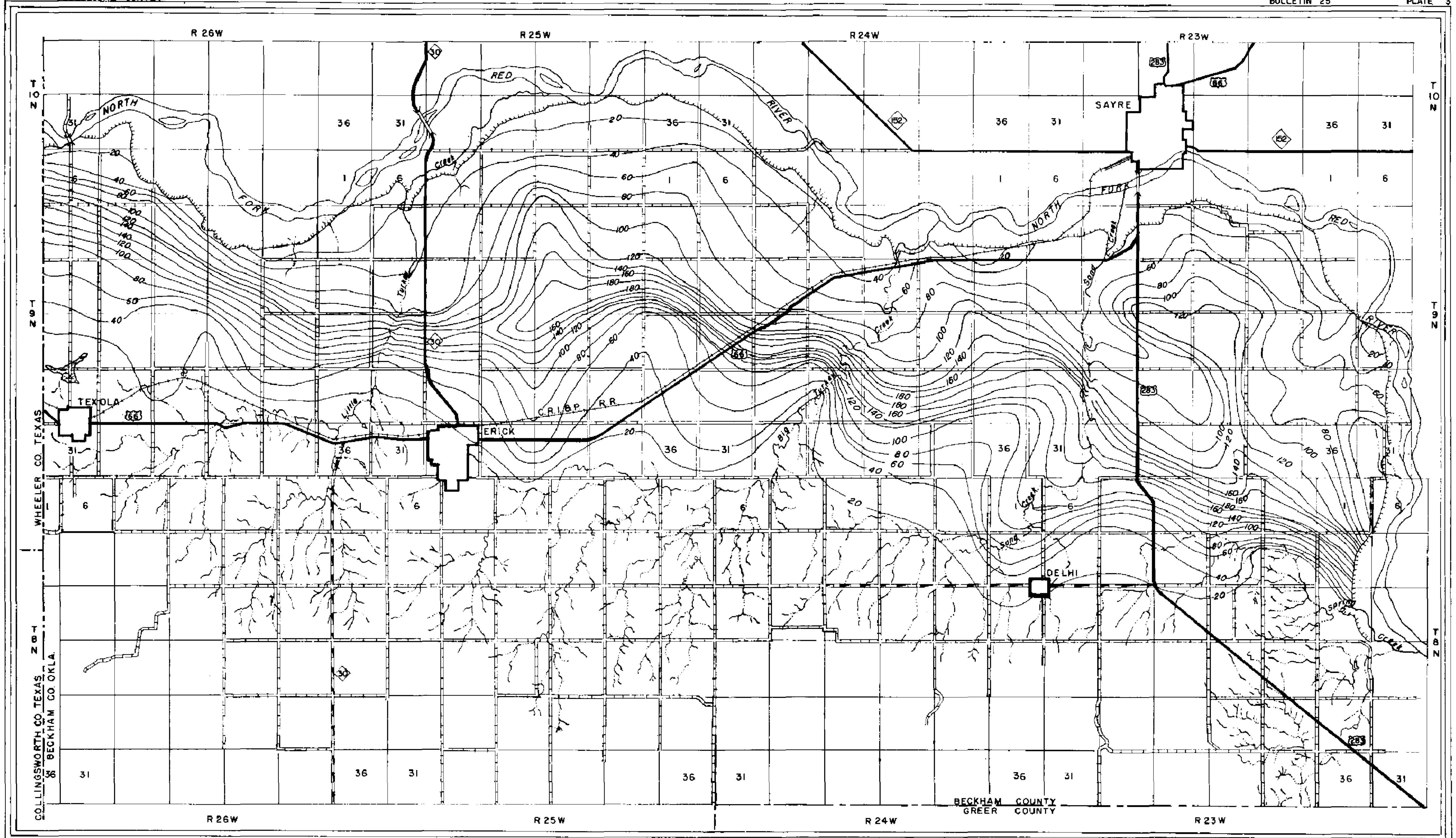
Contoured by L. C. Burton 1952

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

1 0 1 2 3 Miles
Scale

U.S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

OKLAHOMA WATER RESOURCES BOARD
BULLETIN 25 PLATE 3



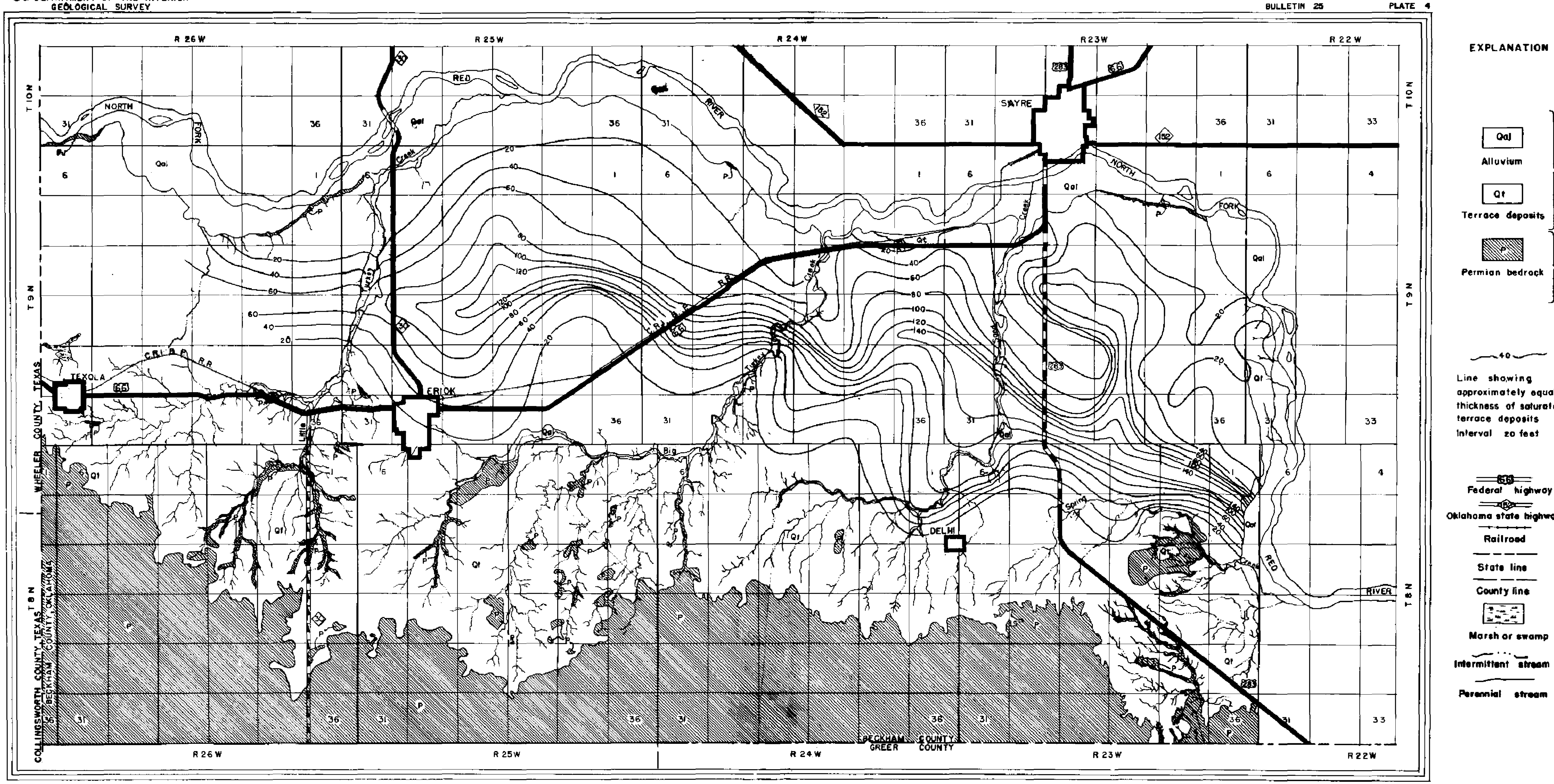
Base map from aerial photographs

Contoured by L. C. Burton, 1952

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

1 0 1 2 3

Scale in miles



Base from aerial photographs

Contoured by: L.G. Burton, 1952

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

Scale in miles

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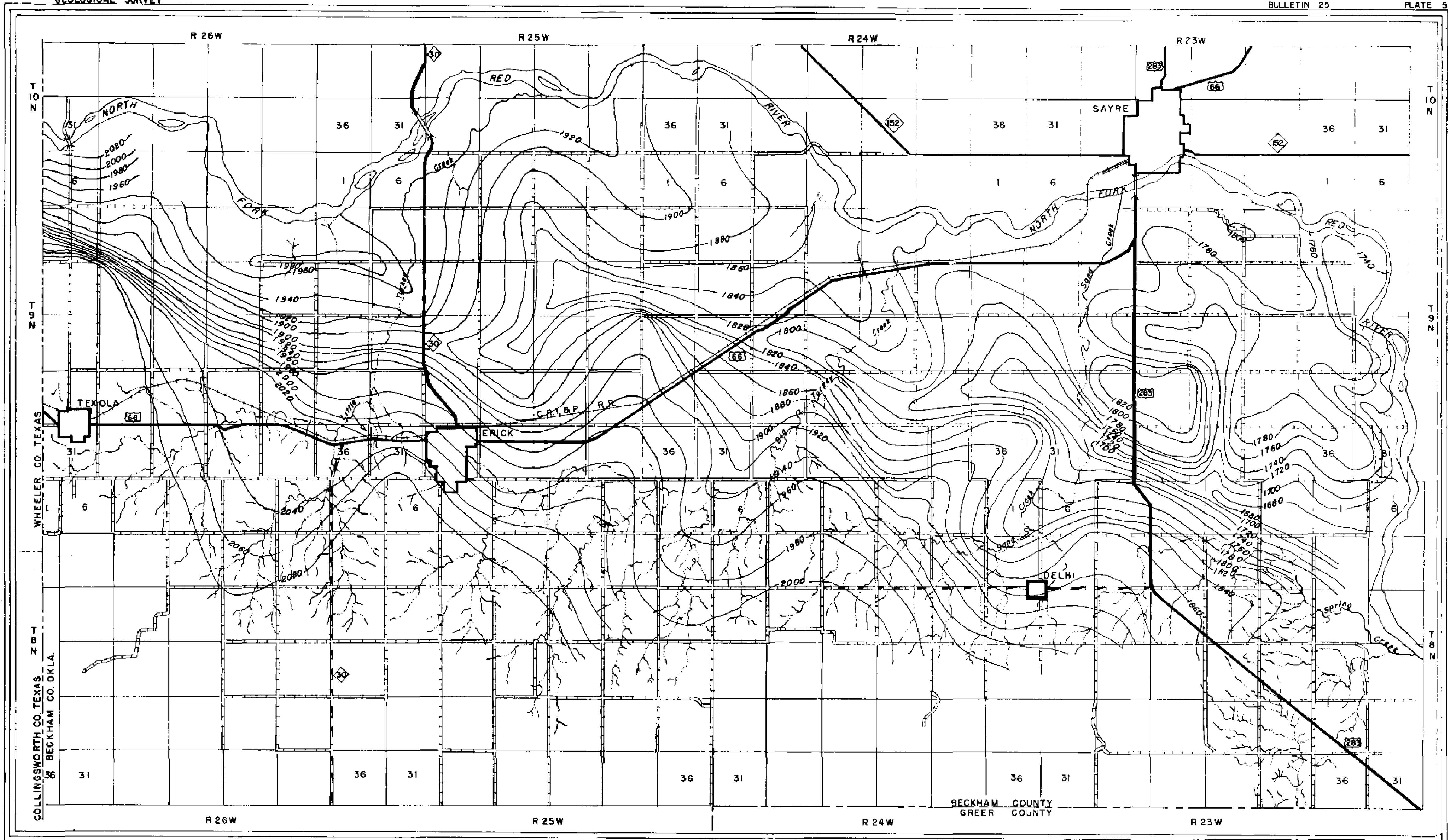
OKLAHOMA WATER RESOURCES BOARD
BULLETIN 25 PLATE 5



Base map from aerial photographs

Contoured by L.C. Burton, 1952

EXPLANATION

1820

Contour line showing approximate altitude of the bedrock surface.

Contour interval 20 ft.

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

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

1 0 1 2 3

Scale in miles