DISTRICT

Ground-Water Resources of the Prairie Creek Unit of the Lower Platte River Basin, Nebraska

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1327

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By R. T. SNIEGOCKI

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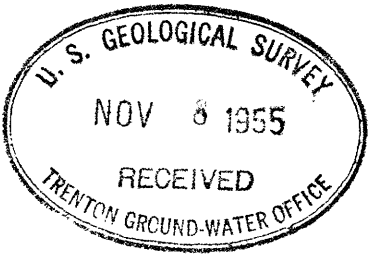
With a section on chemical quality of ground water, by F. H. Rainwater



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GROUND-WATER RESOURCES OF THE PRAIRIE CREEK UNIT OF THE LOWER PLATTE RIVER BASIN, NEBRASKA

By R. T. Sniegocki

ABSTRACT

The Prairie Creek unit is a triangular area lying between the Loup and Platte Rivers in east-central Nebraska. The unit extends westward from the confluence of the two rivers at Columbus to a north-south line through Palmer; it consists principally of cultivated farm land in the Platte River valley but includes cultivated land in the Loup River valley and the northeastward-trending sod-covered sandhill divide between the two valleys. The area of the unit is about 650 square miles. It includes almost all of Merrick County, about a fourth of Nance County, and small parts of Platte and Howard Counties.

The area is underlain by unconsolidated and semiconsolidated deposits of gravel, sand, silt, and clay of Tertiary and Quaternary age. These sediments range from about 12 to about 200 ft in thickness, and the average thickness is about 175 ft. The Quaternary sediments mantle an erosional surface that was developed on formations of Cretaceous and Tertiary age. The Ogallala formation, which is the only formation of Tertiary age present in the Prairie Creek unit, consists principally of partly consolidated fine-textured continental deposits. It ranges in thickness from a featheredge in the vicinity of Central City to about 200 ft at the western edge of the unit; it is present also in bedrock valleys (but not on bedrock ridges) in the central and eastern parts of the unit. The Ogallala formation was deposited on an erosional surface that (within the Prairie Creek unit) progressively truncates in a west to east direction the westward-dipping Pierre shale, Niobrara formation, and Carlile shale, which are of Cretaceous age. This buried erosional surface is characterized by two eastward-trending valleys wholly unrelated to the present surface topography. Underlying the Carlile shale, in order, are the Greenhorn limestone, Graneros shale, and the formations of the Dakota group, which also are of Cretaceous age.

Abundant supplies of ground water are obtained in the area from the sand and gravel deposits of Quaternary (Pleistocene) age. In parts of the area the Ogallala formation undoubtedly would yield water, but it is not known to have been tapped by wells in the unit. The water table in about 77 percent of the area is less than 10 ft below the land surface; in general, the irregularities in the depth to water correlate closely with the topography. The direction of ground-water movement in the Platte River valley is essentially parallel to the Platte River, and the gradient of the water table is about 6 ft per mile. Ground water in the Loup River valley moves toward the Loup River, and the gradient of the water table is relatively steep. Underflow from the west and infiltration of precipitation within the area are the principal sources of recharge to the ground-water reservoir; however, some recharge results also from seepage from the Platte River and its tributaries and from return infiltration of ground water pumped for irrigation. Ground water is discharged from the area by evaporation, transpiration, seepage into streams, underflow, springs, and by pumping from wells. Approximately 900 irrigation wells are in the unit; most of these

are in the valley lands of Merrick County where the approximate density of wells is about three wells per square mile. The yields of irrigation wells range from about 500 to 1,000 gallons per minute (gpm).

Ground water in the Pleistocene deposits of the Prairie Creek unit is relatively low in mineral content and is predominantly of the calcium bicarbonate type. A stoichiometric ratio exists between hardness and alkalinity throughout the range of dissolved solids. Movement of the water through the aquifer and calcareous soils results in an increase in calcium bicarbonate content. Because of its low percentage of sodium, low boron content, and relatively low mineral content, water from shallow wells in the Prairie Creek unit is of good quality for irrigation and, except for a high iron content, is suitable for domestic use also.

An increase in mineral content of the ground water and deposition of salts in the surface soil may occur if the water table is elevated by extensive irrigation. A study of the extent of the concentration and deposition and their effect on soil utility is recommended for the future.

INTRODUCTION

PURPOSE AND SCOPE OF THE INVESTIGATION

The United States Bureau of Reclamation has proposed for development in the Prairie Creek unit, Nebraska, a balanced irrigation system that would utilize both water diverted from surface sources and water pumped from the ground-water reservoir. This proposal, so far as ground water is concerned, requires prior determination of the amount of ground water available for irrigation, the delineation of areas best suited to irrigation by ground water, and an appraisal of the effect of the irrigation water on both crop growth and the soil. The amount of ground water available for irrigation depends on the amount of water in storage, the capacity of the aquifer to yield its water to wells, and the rate of recharge to the aquifer. The selection of areas best suited for irrigation by ground water depends on the availability of ground water, depth to ground water, topography, type of soil, and facilities for drainage. The effect of the irrigation water on crop growth and on the soil depends, in large part, on the chemical quality of the water. The purpose of this investigation was to collect and make available for use the ground-water information necessary for the detailed planning of additional irrigation in the Prairie Creek unit.

The extent, character, and thickness of the water-bearing materials were determined by studying the logs of previously drilled test holes and by drilling additional test holes. The cause and range of water-level fluctuations were determined by measuring the depth to water in many wells and by making periodic measurements of the depth to water in selected wells. The direction of ground-water

movement was determined by constructing a water-table contour map. Certain physical and hydrologic properties of the earth materials between the land surface and the water table and of the upper part of the water-bearing zone were determined by laboratory methods. Chemical analyses were made of samples of the ground water. This investigation is one of several being made by the U. S. Geological Survey as part of the program undertaken by the Department of the Interior for the conservation, development, and use of the water resources of the Missouri River basin. (See fig. 1.) The investigation was under the general supervision of A. N. Sayre, chief of the Ground Water Branch of the U. S. Geological Survey, and G. H. Taylor, regional engineer in charge of ground-water investigations in the Missouri River basin. H. A. Waite, district geologist, was in immediate charge of the field studies. The quality-of-water study was under the general direction of S. K. Love, chief of the Quality of Water Branch, and under the immediate supervision of P. C. Benedict, regional engineer in charge of quality-of-water investigations in the Missouri River basin.

PREVIOUS INVESTIGATIONS

Several published reports describe the geology and hydrology of areas that include part or all of the Prairie Creek unit. Lugn and Condra (Lugn, 1932) were the first to subdivide into formations the Pleistocene fluviatile and eolian sediments that underlie much of central Nebraska. Later investigations by Lugn (1934, 1935), Condra and Reed (1936, 1943), Lugn and Wenzel (1938), Condra, Reed, and Gordon (1950), and Shultz, Lueninghoener, and Frankforter (1951), and others have added greatly to the fund of detailed information about the Pleistocene and older sediments in the region. Lugn and Wenzel (1938) described also the occurrence of ground water in south-central Nebraska and discussed the relation of ground water in the Platte Valley to ground water under the upland plains to the south. A report by Waite and others (1949) contains detailed hydrologic information for a large part of the Prairie Creek unit; the water-level data appearing in that report are included also in this report. The principal papers that discuss all or part of the Prairie Creek unit are listed at the end of the report.

Much of the previously known information about subsurface geology and ground water in the Prairie Creek unit and adjacent areas was obtained by test drilling. This method of investigation has been an integral part of the joint studies that have been made since 1930 by the Conservation and Survey Division of the University of Nebraska and the U. S. Geological Survey. The logs of the

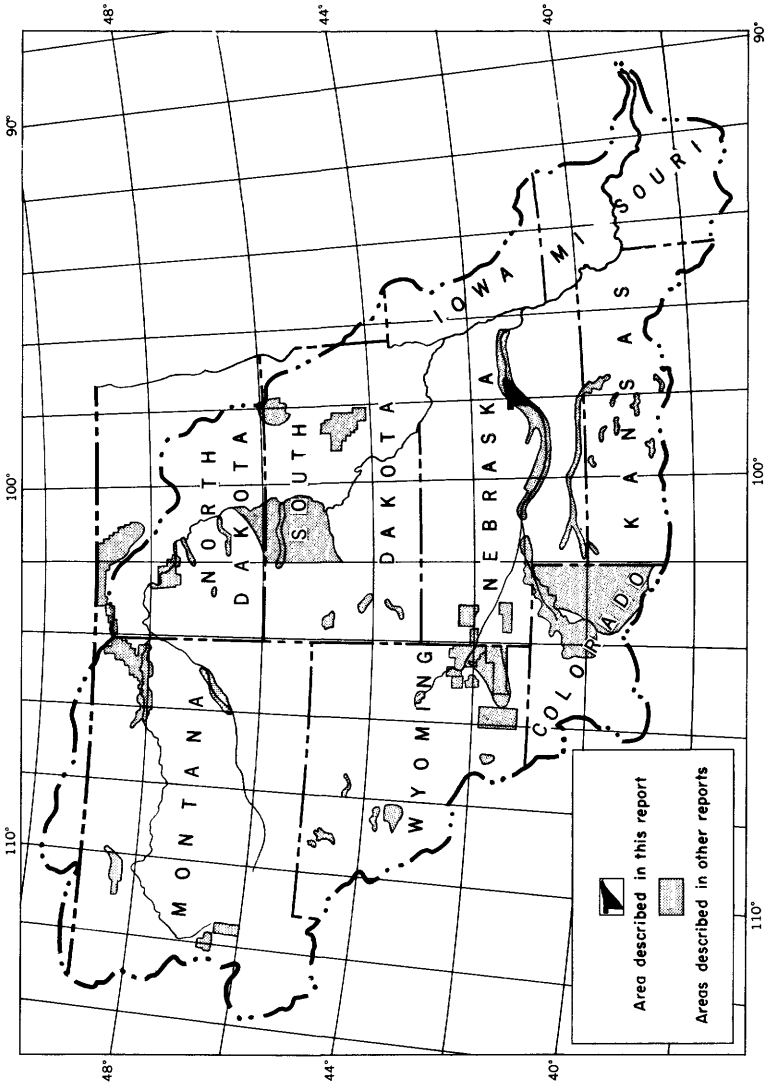

Figure 1. — Map showing areas of ground-water studies by Missouri River Development Program.

test holes drilled in the Prairie Creek unit and cross sections based on the test-hole logs are included in this report.

PRESENT INVESTIGATION

Most of the field work on which this report is based was done between April 3, 1950, and December 31, 1951. The locations of all irrigation wells in the area were determined partly from data compiled prior to the investigation, partly from records in the files of the Central City office of the Soil Conservation Service of the U. S. Department of Agriculture, and partly during a field reconnaissance in February 1952. A total of 118 water-level observation wells of small diameter were installed by jetting. Measurements of the water level in these and 166 additional wells were made periodically, and the measurements made in October 1950 were used in the construction of maps showing the depth to water and the configuration of the water table. Fourteen test holes were drilled; the logs of these test holes are included in this report and were used both in the construction of geologic sections and in the construction of maps showing the configuration of the bedrock surface and the effective saturated thickness of the water-bearing materials. Samples of the materials that lie between the ground surface and a depth approximately 3 ft below the water table were collected by means of a soil-sampling tube or a hand auger; certain physical and hydrologic properties of these samples were determined in the hydrologic laboratory of the U. S. Geological Survey in Lincoln, Nebr., and the results of the tests are included in this report. Water samples were collected from 16 representative wells and were analyzed in the chemical laboratory of the Quality of Water Branch, U. S. Geological Survey, in Lincoln, Nebr.; the results of the analyses of these and of previously collected water samples form the basis of the section on the chemical quality of the ground water in this report.

PERSONNEL AND ACKNOWLEDGMENTS

F. G. Schnittker inventoried many of the wells that were used for periodic water-level measurements. H. S. Unger, R. S. Brown, and J. T. Forsythe installed most of the jetted observation wells. A. I. Johnson was in charge of the field party that obtained soil samples, and Johnson, with the assistance of M. R. Cheuvrant and M. L. Klug, determined the physical and hydrologic properties of the samples. Personnel of the Lower Platte River area office of the U. S. Bureau of Reclamation at Grand Island, Nebr., determined the altitude of the measuring point of many wells. The State-owned drilling equipment was operated by V. H. Dreeszen,

J. W. Nelson, G. R. Svoboda, and C. A. Mueller. D. W. Brown and G. C. Chipps assisted in the making of field studies and made helpful suggestions regarding the construction of the maps in this report. E. C. Reed, Associate State Geologist, supplied unpublished data from the files of the Conservation and Survey Division of the University of Nebraska and made valuable suggestions pertaining to the construction of the geologic cross sections and the map showing the configuration of the bedrock surface. Drillers made available the logs of wells and other useful information. Many residents of the area also were helpful by readily giving permission for the measurement of the water levels in their wells and by supplying information about them.

WELL-NUMBERING SYSTEM

The well numbers in this report indicate the location of each well according to the General Land Office survey of the area. (See fig. 2.) The first numeral within the well number indicates the township, the second indicates the range, and the third indicates the section in which the well is located. The lowercase letters (a, b, c, d) following the section number designate the quarter section and the quarter-quarter section or 40-acre tract. The letters are assigned in a counterclockwise direction beginning with "a" in the northeast quadrant. If two or more wells were within a 40-acre tract, the wells were numbered serially according to the order in which they were inventoried.

GEOGRAPHY

LOCATION AND EXTENT OF THE AREA

The Prairie Creek unit lies between the lower Loup and the Platte Rivers (fig. 3); it extends westward from the confluence of the two rivers at Columbus, Nebr., to the east boundary of Howard and Hall Counties and includes also about 10 sections of land along the south side of the Loup River in Howard County. The area of the Prairie Creek unit is about 650 square miles. Nearly all of Merrick County and small parts of Platte, Nance, and Howard Counties are included in the unit. Some data for the area adjacent to the south boundary of the Prairie Creek unit are also included in this report.

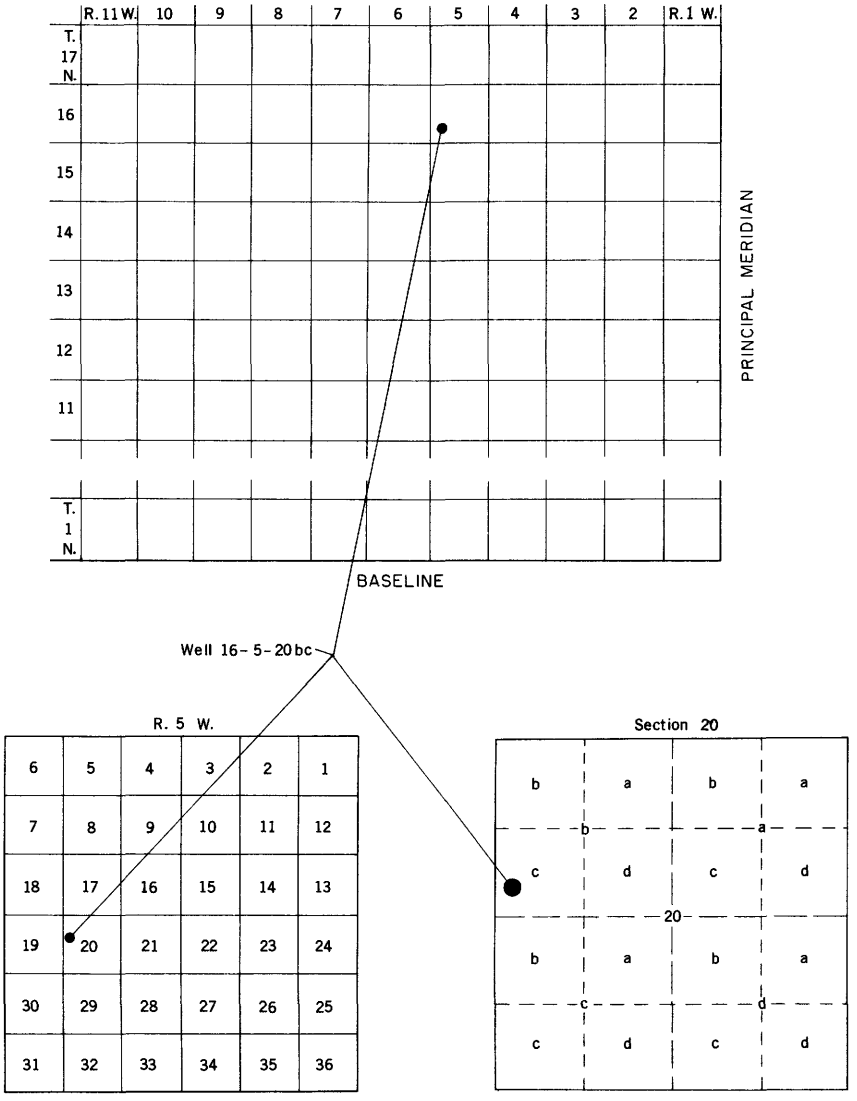

Figure 2. — Sketch illustrating well-numbering system.

TOPOGRAPHY AND DRAINAGE

The Prairie Creek unit consists largely of valley lands on the north side of the Platte River but it also includes valley lands on the south side of the Loup River and the low sandhill divide between

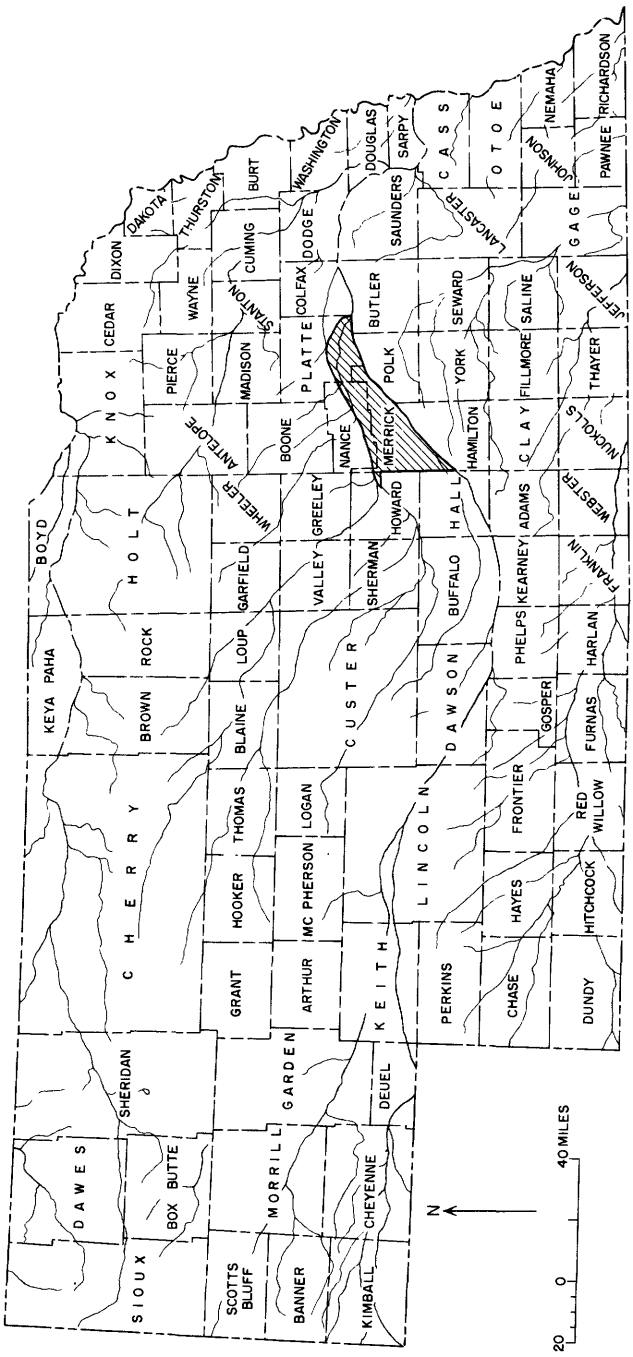

Figure 3. — Map of Nebraska showing area described by this report.

the Platte and Loup Valleys. The valley walls along the north side of the Loup River and along the south side of the Platte River are much higher and steeper than the low sandhill divide between the two rivers; if the sandhill divide were not present, the two valleys would appear as one.

The valley lands are nearly flat terraces that slope northeastward at about 8 ft to the mile. The edges of the terraces facing the streams are moderately sharp in some places, but in most places they are obscure because they are eroded or mantled by sand. In some places the highest terrace grades imperceptibly into the sandhill divide, which consists of many small hills of nearly uniform size and height, but in other places the sandhill divide rises abruptly from the nearly flat terrace and is much more conspicuous. The sandhill divide is covered with sod except for isolated cultivated fields and places where scouring of the wind has caused blowouts.

The maximum topographic relief of the area is about 400 ft; the lowest point is near Columbus and the highest is near Palmer.

All surface drainage in the Prairie Creek unit is toward the northeast. Prairie and Silver Creeks, tributaries of the Platte River, drain much of the area between the Platte and Loup Rivers; both of these creeks flow parallel to the Platte River for about 18 to 20 miles.

CLIMATE

The climate of the Prairie Creek unit is characterized by long winters, moderate rainfall, low relative humidity, and a potentially high rate of evaporation. The slight surface relief does not appreciably affect the weather within the area. The climate is favorable for the growing of hay and grain crops and for the raising of livestock.

The mean annual temperature is about 50° F. The temperature in the summer occasionally rises to about 100° F., and the temperature in the winter occasionally falls to about -30° F. The last killing frost in the spring is generally in the first part of May, and the first killing frost in the fall is generally in early October; the average growing season is about 160 days.

The prevailing winds are from the south and east during May, June, and July, and from the northwest during the remainder of the year.

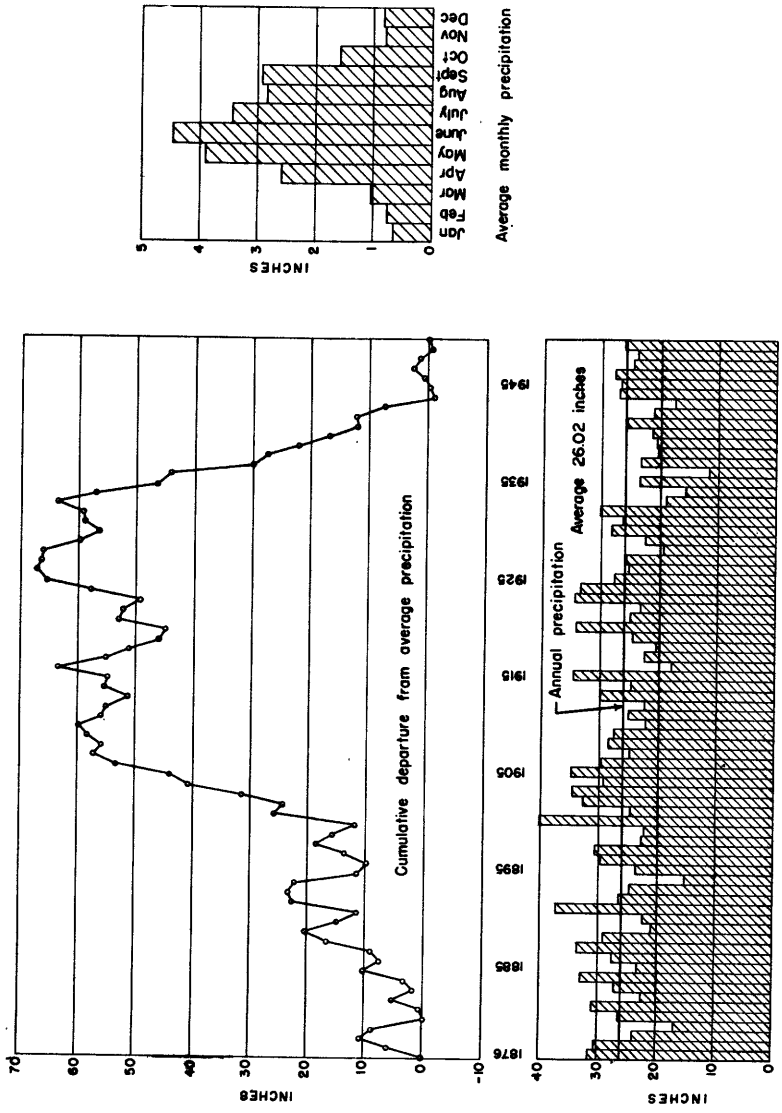

Figure 4. —Precipitation records at Genoa, Nebr., 1876–1949 (from records of the U. S. Weather Bureau).

The annual precipitation during the period 1876 to 1949 ranged from a little more than 11 in. to about 40 in. (see fig. 4). The average annual precipitation for the period of record is slightly more than 26 in.; from 1932 to 1943 the precipitation was considerably below normal; from 1943 to 1949 it was about normal. May, June, and July generally are the months of heaviest rainfall. Monthly precipitation totals at the five U. S. Weather Bureau stations within the area differ considerably, as shown by graphs for the summer of 1950. (See fig. 5.)

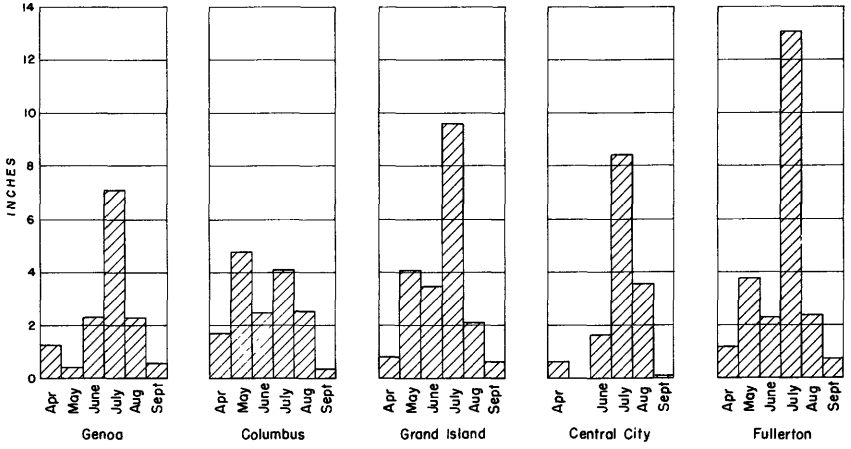

Figure 5. — Precipitation records at Genoa, Columbus, Grand Island, Central City, and Fullerton, Nebr., April to September, 1950 (from records of the U. S. Weather Bureau).

GEOLOGY

The Prairie Creek unit is underlain by unconsolidated and semiconsolidated sediments, about 12 to 315 ft thick, that rest on a bedrock surface (see pl. 1). The unconsolidated and semiconsolidated sediments are collectively termed mantle rock and consist of gravel, sand, silt, and clay; they are of Tertiary (Pliocene) and Quaternary (Pleistocene and Recent) age. The bedrock formations that directly underlie the mantle rock consist principally of shale and are of Cretaceous age. Older formations of Cretaceous age, which consist of limestone, shale, and sandstone, also underlie the Prairie Creek unit at greater depths. The geologic formations that constitute the mantle rock and the bedrock formations are described briefly in table 1. The logs of test holes drilled in the Prairie Creek unit are given in table 7.

Table 1.— *Generalized geologic section for the Prairie Creek unit and vicinity.*

System	Series	Subdivision	Characteristics and distribution	Thickness (feet)	Water supply
Quaternary	Recent	Superficial alluvium, loess, dune sand, topsoil	Flood-plain deposits of sand and gravel and isolated wind deposits of clay, silt, and sand; widespread soils.	.....	Significant only as transmitting agent in recharge to ground water.
	Pleistocene — Wisconsin	Bignell loess	Wind deposits of locally derived grayish silt on terraces and valley borders.	.....	Do.
		Unconformity			
		Peorian loess	Wind deposits of massive yellow to buff silty clay, widespread on upland surfaces north and south of Prairie Creek unit.	20- 50	Significant as transmitting agent in upland areas and around Palmer, Nebr. Saturated in places but does not yield water readily.
		Todd Valley sand	Sand and gravel deposited chiefly as valley fill; probably absent in Prairie Creek unit.	0- 50	Yields water to wells where saturated.
		Unconformity			
	Illinoian-Sangamon	Loveland formation	Chiefly silt and clay; contains laminae of fine sand in valley phase; reddish brown in upland phase; capped by old soil.	20- 50	Significant as transmitting medium in upland areas. Saturated in places but does not yield water readily.
		Crete formation	Sand and gravel deposited as channel fill. Possibly underlies part of Prairie Creek unit.	0- 30	Yields water to wells in upland areas where saturated.
		Unconformity			
	Kansan-Yarmouth	Sappa formation	Greenish silty clay; capped by old soil; probably underlies parts of Prairie Creek unit.	10- 50	Not a source of water supply.
		Grand Island formation	Stream-deposited sand and gravel; probably underlies entire Prairie Creek unit.	0-175	Yields abundant supplies of water.
		Unconformity			
	Nebraskan-Aftonian	Fullerton formation	Wind-and stream-deposited calcareous clay and silt; may grade to fine sand.	0- 85	Not a source of water supply.
		Holdrege formation	Stream-deposited sand and gravel; probably underlies much of Prairie Creek unit.	0-150	Yields abundant supplies of water.
		Unconformity			
Tertiary	Pliocene	Ogallala formation	Gravel, sand, silt, clay, and some lime-cemented beds; underlies Prairie Creek unit westward from Central City. Includes Seward facies of Condra, Reed, and Gordon.	0-200	A widespread aquifer but not known to yield water to wells in Prairie Creek unit.
		Unconformity			
Cretaceous	Upper Cretaceous	Pierre shale	Dark clay shale, shaly chalk, and limestone; some thin sandstone in upper part; underlies western part of Prairie Creek unit.	0-150	Not a source of water supply.
		Niobrara formation	Lead-gray shaly chalk; gray to yellow limestone in lower part; underlies western parts of Prairie Creek unit.	0-400	Do.
		Carlile shale	Grayish and bluish shale and thin limy layers; underlies entire Prairie Creek unit.	50-270	Do.
		Greenhorn limestone	Gray limestone interbedded with shale; underlies entire Prairie Creek unit.	30	Do.
		Graneros shale	Dark-gray plastic shale; contains some sand and calcareous layers; underlies entire Prairie Creek unit.	50- 90	Do.
		Dakota group	Sandstone interbedded with shale, sandy shale, and zones of ironstone; underlies entire Prairie Creek unit.	400-500	A widespread aquifer but not known to yield water to wells in Prairie Creek unit.

BEDROCK FORMATIONS

The bedrock surface on which the mantle rock sediments rest was produced by erosion; it consists of valleys and intervalley ridges that are in no way reflected by the present land surface. The total relief of this buried surface in the Prairie Creek unit probably is nearly twice as great as the relief of the present land surface. The regional slope of the buried bedrock surface is eastward (see pl. 2). The formations of Cretaceous age immediately underlying the bedrock surface are the Carlile shale, the Niobrara formation, and the Pierre shale, all of which dip slightly toward the west-northwest. The Carlile shale underlies the entire Prairie Creek unit but is in direct contact with the mantle rock only in the extreme eastern part of the unit; the Niobrara formation overlies the Carlile shale and is in direct contact with the mantle rock in the central part of the unit; the Pierre shale overlies the Niobrara formation and is in direct contact with the mantle rock in the northwestern third of the unit. The mantle-rock sediments yield copious supplies of ground water, therefore the underlying bedrock formations, which generally are fine grained and relatively impermeable,

are not developed as a source of ground-water supply in the Prairie Creek unit. Consequently, no further consideration is given them in this report.

MANTLE-ROCK FORMATIONS

The oldest mantle-rock sediments in the Prairie Creek unit are of Pliocene (Tertiary) age. These sediments, which are of continental origin and which in places are semiconsolidated, are referred to as the Ogallala formation, or the Seward facies of that formation as described by Condra, Reed, and Gordon (1950, p. 15). In this area the Ogallala formation consists principally of medium- to light-gray and in part brownish-gray calcareous silt and silty sandstone; it also contains some interbedded marly zones and, in places, a basal gravel member. The Ogallala formation in the subsurface is not readily distinguishable from the overlying sediments of Pleistocene age. The Ogallala formation underlies all the western part of the Prairie Creek unit; it is discontinuous in the central and eastern parts of the unit, where it is present in and along the sides of buried bedrock valleys, but it is not present on the bedrock ridges. In the Prairie Creek unit the thickness of the formation ranges from a featheredge to at least 130 ft (the thickness penetrated in test hole 14-8-6bb, near Palmer).

The Holdrege formation is the oldest recognized Pleistocene deposit in the Prairie Creek unit. It consists of sand and gravel that was deposited principally in the valleys of the pre-Pleistocene surface when the western border of the advancing Nebraskan glacier became a barrier across the east-trending valleys. The glacier caused the streams in the area between the till border and the Tertiary tablelands to aggrade their valleys and then to mantle the uplands with sand and gravel. Lugn (1935, p. 91) described the Holdrege formation as an inwash-outwash fluvioglacial deposit that was built up as an alluvial plain in Nebraskan time. Quartz and other crystalline minerals of metamorphic and granitic rocks constitute the bulk of the formation.

Because the Holdrege formation is similar to overlying younger deposits, it cannot be distinguished in many test holes. However, a sand and gravel deposit less than 20 ft thick, penetrated by test hole 13-7-24aa, had been tentatively identified as the Holdrege formation. The formation probably underlies much of the Prairie Creek unit, but its thickness is not uniform because it was deposited on an irregular surface. In areas adjacent to the Prairie Creek unit the thickness of the Holdrege formation ranges from a featheredge to about 150 ft; the maximum thickness of the formation within the Prairie Creek unit is probably about 75 ft.

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The Fullerton formation is composed of silt and calcareous clay which grade locally into fine sand. These materials, which were derived principally from exposed deposits of loess and eolian sand, were deposited during the retreat of the Nebraskan ice sheet as a widespread and more or less continuous sheet on top of the Holdrege formation. The Fullerton formation is of fluvial-eolian origin and represents deposition during the Aftonian interglacial stage (Lugn, 1935, p. 98). Silt and clayey silt penetrated in test holes 13-7-24aa and 13-7-36da have been identified as the Fullerton formation. In these two test holes the thickness of the Fullerton was about 60 and 85 ft, respectively. In general, however, the thickness of the Fullerton formation ranges from a few feet to about 50 ft and the average thickness is 20 to 30 ft. Erosion, both prior to and since the deposition of overlying formations, has completely removed the Fullerton formation in many places.

The overlying Grand Island formation is composed of sand and gravel of Kansan age. The origin of the Grand Island formation is similar to that of the Holdrege formation in that it was deposited by eastward-flowing streams that were dammed by an advancing glacial barrier. The sand and gravel were deposited to grade level and formed a plain similar to that formed by the Holdrege formation (Condra, Reed, and Gordon, 1950, p. 21). The upper part of the formation in places contains relatively large amounts of fine sand that may be of eolian origin (Lugn, 1935, p. 103). The Grand Island is more sheetlike than the Holdrege formation. It is exposed in many places along the Platte River and was penetrated by a number of the test holes drilled in the Prairie Creek unit; in test hole 13-9-1aa, sand and gravel deposits between the depths of 101 and 274 ft were tentatively identified as the Grand Island formation. The thickness of the formation ranges from a knife edge to as much as 175 ft in the deeper buried channels, but the average thickness probably is about 75 ft.

The Sappa formation formerly was named the "Upland formation" by Lugn (Condra, Reed, and Gordon, 1950, p. 22). It is believed to be of Yarmouth age and to have had about the same genesis as the Fullerton formation. Originally, the formation probably was continuous throughout the area, but erosion prior to the deposition of the overlying formations reduced the formation to patchy remnants. The Sappa formation is composed of gray to greenish-gray silty clay and fine greenish sand of aqueous-eolian origin. A volcanic ash, which is known as the Pearlette ash member, is present in the lower part of the formation and is perhaps the best horizon marker within the Pleistocene sediments (Condra, Reed and Gordon, 1950, p. 22). The Sappa formation was penetrated by a number of the test holes drilled in the Prairie Creek unit; in test

holes 13-9-24aa and 13-7-24aa it was about 50 ft thick. The thickness of the formation ranges from a knife edge to about 50 ft.

The Crete formation is a unit that was included by Lugn in the "valley phase" of the Loveland formation (Condra, Reed, and Gordon, 1950, p. 24). It is a channel-fill deposit that lies unconformably upon the Sappa formation or older sediments of Pleistocene age and is believed to be of Illinoian age. In areas bordering the Prairie Creek unit the Crete formation ranges in thickness from a knife edge to 30 ft. The composition of the formation depends upon the local material that was available for reworking; in general, it consists of sand and some gravel and resembles the Grand Island formation. The sediments composing the formation range from well-sorted material in the main parts of the channels to poorly sorted material along the channel sides. Some of the gravel is rich in pink feldspar derived from a far western source, and some of the gravel consists of pebbles and boulders of reworked Ogallala or older formations that were exposed nearby. The Crete formation is limited to channels associated with, but generally broader than, the present well-developed valleys. Possibly some of the sand and gravel deposits penetrated at a shallow depth by test holes drilled in the Prairie Creek unit represent the Crete formation, but no attempt has been made to differentiate these deposits from other sand and gravel formations of late Pleistocene age. Because the Loveland formation, which commonly overlies the Crete formation, is absent beneath the bottom and terrace lands of the Prairie Creek unit, it is not known whether part of the sand and gravel deposits lying above the Sappa in those areas represents the Crete formation.

The Loveland formation includes a valley phase and an upland phase, which in places are separated by a colluvial, or slope phase; the three phases of the formation grade into each other. The Loveland formation was deposited either at the time of the Sangamon interglacial stage or during late Illinoian time (Condra, Reed, and Gordon, 1950, p. 26). The valley phase is composed of stratified silt and clay with some laminae of very fine sand; it grades from light gray to buff in the lower part of the phase to pinkish brown in the upper part. The upland phase, which is typically thinner than the valley phase, consists of massive loess and is pinkish brown to reddish throughout. The colluvial, or slope phase, consists of poorly sorted silty to sandy, and locally pebbly, pinkish brown to reddish clay. This phase is limited to the steeper slopes of the pre-Loveland valleys. The loess of the Loveland formation is capped by a persistent soil (called the Sangamon soil in Illinois, but known as the Loveland soil in Nebraska and Iowa). The loess of the Loveland originated by the reworking of materials derived by water and wind erosion of alluvial deposits, dune sand, and

exposed older Tertiary and Pleistocene deposits. None of the deposits penetrated by the test holes drilled in the Prairie Creek unit could be correlated definitely with the Loveland formation. The Loveland formation that is present in upland areas immediately adjacent to the Prairie Creek unit ranges in thickness from a knife edge to 50 ft or more.

The Todd Valley sand is a fine grayish sand of alluvial or eolian origin and occurs chiefly as valley fill on the unevenly eroded Loveland loess. It was deposited during the Iowan glaciation in early Wisconsin time (Condra, Reed, and Gordon, 1950, p. 30). The deposit is reported to be as much as 190 ft thick in places in Nebraska (Lugn, 1935, p. 155), but no deposits that could be definitely assigned to the Todd Valley sand were recognized in the test holes drilled in the Prairie Creek unit.

The Peorian loess is of Iowan-Mankato age (Condra, Reed, and Gordon, 1950, p. 32). It was derived from exposed silty alluvium along large rivers (such as the Platte and Loup Rivers) and from other sources, and it accumulated to its greatest thickness in belts bordering the flood plains. The Peorian loess was deposited during a relatively dry cycle that followed the withdrawal of the Iowan ice sheet during middle Wisconsin time. The Peorian loess has not been definitely recognized in the valley lands of the Prairie Creek unit, but extensive deposits are known to occur in the bordering slopes and uplands adjacent to the lowland areas. In adjacent areas the thickness of the Peorian loess mantle ranges from a few feet to 100 ft.

The Bignell loess, which consists partly of reworked Peorian loess, was blown from the flood plains and valley sides and was deposited on the terraces and uplands. The thickness of this loess is variable, and its age at most places probably is Mankatoan to Recent (Condra, Reed, and Gordon, 1950, p. 33). The field data collected during this investigation do not definitely establish the presence or absence of the Bignell loess in the area described by this report.

The dune sand of the sandhill divide was derived by wind erosion of the upper part of the Grand Island formation (Lugn, 1935, p. 158). The sand was not carried into the area by the Loup River, as was once thought to be true; instead, it was derived locally and was reworked during the course of the downcutting and development of the present Platte and Loup Rivers. Lugn (1935, p. 161) pointed out that much of the reworking and formation of sand dunes has taken place since Peorian time, because remnants of the Peorian

loess are known to occur under the sand of the sandhills in the divide area between the Loup and Platte River valleys.

No sharp line of demarcation is present between the Pleistocene sediments and Recent deposits. Recent alluvium of the Platte and Loup Rivers and surficial windblown loess and topsoil constitute the Recent deposits.

PHYSICAL AND HYDROLOGIC PROPERTIES OF THE MANTLE-ROCK FORMATIONS

The quantity of ground water that a water-bearing material will yield and the rate at which ground water will move through that material depend, in part, upon the physical and hydrologic properties of the material. These properties differ greatly with changes in the size, shape, number, and degree of interconnection of the interstices between mineral particles. Sediments in nature generally are not homogeneous, and a wide range in the values of these properties is characteristic. The physical and hydrologic properties of the mantle-rock materials in the Prairie Creek unit were evaluated by three methods, the results of which are described as follows:

AQUIFER TEST

An aquifer test was made in 1945 by pumping well 17-1-34dc, which is near the eastern end of the Prairie Creek unit (Waite and others, 1949, p. 52). The thickness of the water-bearing material at the test site is 70 ft. The well was pumped at a rate of 740 gpm, and, because the maximum drawdown in the pumped well was 7.74 ft, the specific capacity of the well was 96 gpm per ft of drawdown. The field coefficient of permeability[1] was calculated to be 3,550 gallons per day per square foot (gpd/ft^2) and the coefficient of transmissibility[2] to be 249,000 gpd/ft. The coefficient of storage[3] increased from 0.101 at the end of the first hour of pumping to 0.236 at the end of the 24-hour pumping period.

[1] The coefficient of permeability, in Meinzer units, may be defined as the number of gallons of water, at 60° F., that will flow in 1 day through a cross-sectional area of 1 sq ft under a unit hydraulic gradient (1 ft per foot). The field coefficient of permeability is the same unit except that it expresses the rate of flow at the prevailing temperature of the water.

[2] Field coefficient of permeability multiplied by the saturated thickness of the aquifer, in feet.

[3] The coefficient of storage may be defined as the quantity of water, expressed as a fraction of a cubic foot, released from storage in a column of the aquifer and associated beds having a basal area of 1 sq ft and a height equal to the saturated thickness of the aquifer, when the head declines 1 ft.

EFFECTIVE SATURATED THICKNESS OF THE WATER-BEARING MATERIALS

In order to permit an approximate evaluation of the water-yielding capacity of a given aquifer, as known from the logs of test holes, E. C. Reed, Associate State Geologist of Nebraska, devised a method whereby all the materials composing an aquifer are converted into "sand-and-gravel equivalents"—that is, into units equivalent in their water-yielding capacity to a unit thickness of typical sand and gravel. For example, a thickness of 4 ft of sand or a thickness of 8 ft of sandstone is considered to be equivalent to a thickness of 1 ft of sand and gravel. For practical purposes, silt and clay are considered to be ineffective water-yielding materials; consequently, even a large thickness is not converted into "sand-and-gravel equivalents." It is estimated that a 20-ft thickness of sand and gravel generally will yield 300 to 350 gpm to a well, and that a 50-ft thickness of sand and gravel generally will yield about 1,000 gpm. The logs of 68 test holes (table 7) drilled in the area were evaluated by this method, and a map showing lines of equal effective saturated thickness, expressed in "sand-and-gravel equivalents," was prepared. (See pl. 3.) In general, the greatest effective saturated thicknesses of water-bearing materials lie in the principal buried valleys, and the least thicknesses overlie the principal bedrock ridges. (Compare pls. 2 and 3.)

LABORATORY ANALYSES OF TEST-HOLE SAMPLES

A detailed study was made of the physical and hydrologic properties of the materials between the land surface and a depth about 3 ft below the water table. These materials were sampled in 13 places in the Prairie Creek unit (see fig. 6). Most of the samples were obtained in a semidisturbed condition by using a soil-sampling tube having a diameter of 1 in.; the remaining samples were obtained by using a hand auger. The analyses included determinations of grain size, porosity, specific retention, specific yield, and coefficient of permeability. The methods of analysis are described in the following paragraphs. The results of the analyses are given in detail in table 2 and are summarized in table 3.

A mechanical analysis of granular material consists of separating the grains of different sizes into groups and determining the percentage of the total sample, by weight, that each size group constitutes. In the laboratory, samples were air dried and placed in a porcelain mortar, and adhering lumps of material were gently separated by use of a rubber-covered pestle. Care was taken not to crush the individual particles. Grain sizes larger than 0.0625 mm were determined by wet-sieve analysis and sizes smaller than 0.0625 mm were determined by the hydrometer method of

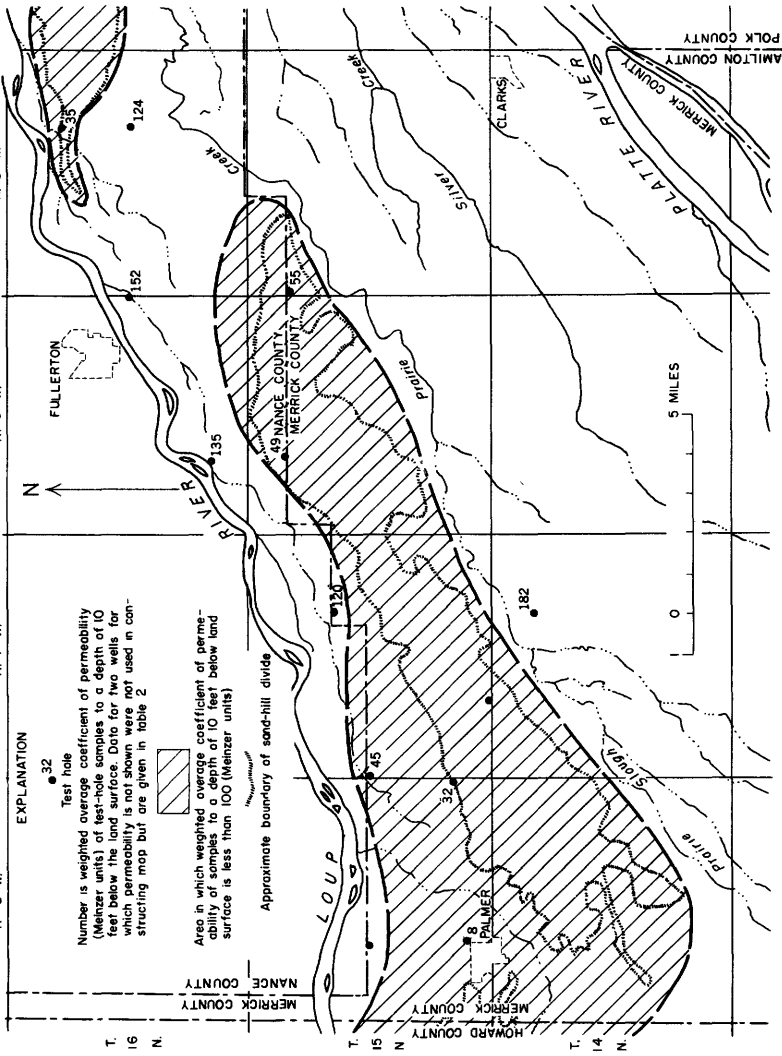

Figure 6. — Map of part of the Prairie Creek unit showing location of test holes and weighted average coefficient of permeability of test-hole samples to a depth of 10 feet below land surface.

Table 2.—*Physical and hydrological properties of mantle-rock materials*

[Method of sampling: A, hand auger; ST, soil tube. Specific retention: N, negligible value. Laboratory coefficient of permeability: N, negligible value]

Test hole no.	Depth of sample (feet)		Method of sampling	Particle size (percent by weight)											Porosity (percent by volume)	Specific retention (percent by volume)	Specific yield (percent by volume)	Laboratory coefficient of permeability (Meinzer units)
						Sand					Gravel							
	From	To		Clay (less than 0.004 mm)	Silt (0.004 - 0.0625 mm)	Very fine (0.0625 - 0.125 mm)	Fine (0.125 - 0.25 mm)	Medium (0.25 - 0.50 mm)	Coarse (0.5 - 1.0 mm)	Very coarse (1.0 - 2.0 mm)	Very fine (2 - 4 mm)	Fine (4 - 8 mm)	Medium (8 - 16 mm)	Coarse (16 - 32 mm)				
Merrick County																		
14-7-11bb	1.5	2.0	A	13.2	16.7	16.0	28.4	20.5	4.7	0.4	0.1	.....	.....	.....	.....	.....	.....	.....
	3.0	3.5	ST	40.0	52.2	1.3	2.4	2.9	1.1	.1	0	.....	.....	.....	43.1	34.2	8.9	.....
	3.5	4.0	ST	35.8	52.0	2.2	3.0	4.2	2.3	.5	0	.....	.....	.....	46.4	24.2	22.2	.....
	5.5	6.0	ST	0.9		2.2	14.6	43.6	32.7	4.6	1.3	0.1	.....	.....	34.8	N	34.8	364
	6.0	6.5	ST	1.4		7.4	29.9	37.0	21.1	1.6	.9	.7	.....	.....	34.5	2.0	32.5	132
	7.5	8.0	ST	.9		3.9	23.7	37.0	26.7	6.9	.7	.2	.....	.....	33.4	1.1	32.3	205
	8.0	8.5	ST	1.3		3.3	20.7	26.8	29.5	7.7	3.1	1.2	6.4	0	31.7	1.6	30.1	128
	9.0	9.5	ST	2.0		1.0	6.1	42.3	32.3	9.6	3.5	2.2	1.0	0	32.0	2.9	29.1	.....
	9.5	10.0	ST	.4		2.4	10.7	32.2	35.5	10.8	3.7	2.8	1.5	0	30.9	N	30.9	146
	10.0	10.5	ST	1.5		.8	5.5	35.4	34.4	14.4	5.4	2.6	0	0	32.8	14.4	18.4	.....
	1.0	1.5	ST	5.4	11.9	31.2	44.8	6.4	.3	0	.....	.....	.....	.....	48.6	6.2	42.4	745
	1.5	2.0	ST	7.3	14.9	30.9	34.8	6.6	.5	0	.....	.....	.....	.....	48.9	6.4	42.5	317
	2.0	2.5	ST	12.1	23.5	23.8	30.3	8.8	1.5	0	.....	.....	.....	.....	46.2	10.6	35.6	190
	3.0	3.5	ST	25.5	43.2	12.3	13.3	4.8	.8	.1	.....	.....	.....	.....	45.0	18.0	27.0	59
	3.5	4.0	ST	21.6	41.4	17.6	16.0	3.1	.3	0	.....	.....	.....	.....	44.6	17.2	27.4	27
	4.0	4.5	ST	26.0	51.4	12.6	9.3	.6	.1	0	.....	.....	.....	.....	44.4	23.7	20.7	14
	5.5	6.0	ST	27.0	49.1	12.7	10.4	.8	0	0	.....	.....	.....	.....	44.5	22.7	21.8	.5
	6.0	6.5	ST	26.0	54.9	8.7	9.4	.9	.1	0	.....	.....	.....	.....	43.5	21.5	22.0	.05
	7.5	8.0	ST	22.2	54.2	16.1	6.9	.5	.1	0	.....	.....	.....	.....	43.5	19.6	23.9	.05
	8.0	8.5	ST	20.2	56.6	11.0	10.8	1.3	.1	0	.....	.....	.....	.....	41.8	18.7	23.1	N

15-5-7bb	9.5	10.0	ST	28.5	66.4	3.0	1.8	.3	0	.....	.....	.....	.....	.....	49.9	27.9	22.9	N
	10.0	10.5	ST	29.7	65.2	3.0	1.6	.5	0	.....	.....	.....	.....	.....	45.2	28.9	16.3	N
	11.5	12.0	ST	31.2	66.7	1.8	.3	0	0	.....	.....	.....	.....	.....	45.9	31.5	14.4	.....
	12.0	12.5	ST	33.2	64.7	1.7	.4	0	0	.....	.....	.....	.....	.....	.....	.....	.....	.....
	13.0	13.5	ST	28.2	68.8	1.0	2.0	0	0	.....	.....	.....	.....	.....	45.0	28.2	16.8	.....
	13.5	14.0	ST	26.7	69.0	4.0	.3	0	0	.....	.....	.....	.....	.....	43.6	30.9	12.7	.....
	15.5	16.0	ST	22.4		25.1	36.6	13.9	2.0	0	.....	.....	.....	.....	.....	.....	.....	.....
	16.0	16.5	ST	7.0	15.3	30.9	38.7	7.6	.5	0	.....	.....	.....	.....	34.6	6.8	27.8	15
	17.5	18.0	ST	16.1		31.1	42.9	8.7	1.1	.1	.....	.....	.....	.....	33.1	4.7	28.4	N
	18.0	18.5	ST	26.4		32.4	32.9	7.6	.5	0	0	.2	.....	.....	35.3	5.5	29.8	N
	19.5	20.0	ST	6.5	19.7	37.0	30.8	5.5	.5	0	.....	.....	.....	.....	36.5	6.3	30.2	1
	20.0	20.5	ST	29.1		33.0	31.1	6.1	.7	0	.....	.....	.....	.....	36.8	4.7	32.1	N
	1.5	2.0	ST	15.7	37.8	5.6	16.5	19.2	4.7	.5	0	0	0	.....	51.5	11.9	39.6	.....
	2.0	2.5	ST	16.3	31.5	5.7	18.4	21.0	6.6	.4	.1	0	0	.....	51.7	12.0	39.7	155
15-7-14bb	4.0	4.5	ST	3.3		3.3	30.5	43.0	10.0	3.2	2.8	2.1	1.8	.....	30.2	1.7	28.5	98
	5.5	6.0	ST	.8		2.4	17.1	41.2	18.5	7.8	6.0	5.2	1.0	.....	30.9	.6	30.3	111
	6.0	6.5	ST	3.8		3.5	13.4	34.6	16.7	12.5	12.0	3.5	0	.....	27.4	2.7	24.7	3
	3.0	3.5	ST	12.5	.....	38.7	9.5	23.0	12.5	3.5	.3	0	0	.....	47.8	11.1	36.7	30
	4.5	5.0	ST	13.7	.....	30.3	11.4	25.5	15.5	3.2	.4	0	0	.....	48.3	11.9	36.4	25
	5.5	6.0	A	11.2	.....	10.1	18.7	31.2	21.7	6.2	.9	0	0	.....	.....	.....	.....	.....
	6.5	7.0	ST	8.8	12.6	11.0	31.9	24.1	6.5	3.0	1.8	.3	.....	.....	34.5	8.5	26.0	.....
	7.3	7.5	A	6.3		4.8	30.6	32.2	13.2	4.9	4.0	4.0	.....	.....	.....	.....	.....	.....
15-7-19bb	8.0	8.5	ST	2.0		14.8	61.5	20.7	.9	.1	0	0	.....	.....	35.8	N	35.8	66
	8.5	9.0	ST	1.6		10.3	56.6	30.3	.9	.2	.1	0	.....	.....	36.4	1.1	35.3	63
	9.0	9.5	ST	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	36.4	N	36.4	152
	9.6	9.8	A	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	1.9	2.1	A	6.5	2.0	26.5	56.0	8.8	.2	.0	.....	.....	.....	.....	.....	.....	.....	.....
	3.7	4.0	A	27.5	64.5	4.8	2.4	.7	.1	.0	.....	.....	.....	.....	.....	.....	.....	.....
	6.7	7.0	A	19.0	75.0	3.6	1.9	.5	0	.....	.....	.....	.....	.....	.....	.....	.....	.....
	8.9	9.2	A	7.2	22.2	28.4	33.0	8.8	.3	.1	0	.....	.....	.....	.....	.....	.....	.....
	9.5	9.7	A	8.4	29.8	25.6	27.6	7.5	1.0	.1	0	.....	.....	.....	.....	.....	.....	.....
	9.7	9.9	A	15.2		28.0	47.5	8.7	.6	0	0	.....	.....	.....	.....	.....	.....	.....
15-7-32dd	13.9	14.1	A	16.5		31.8	43.6	7.8	.3	0	0	.....	.....	.....	.....	.....	.....	.....
	18.2	18.4	A	8.6		23.2	52.2	15.3	.6	.1	0	.....	.....	.....	.....	.....	.....	.....
	23.6	23.8	A	12.5		24.3	44.3	13.8	4.8	.3	0	.....	.....	.....	.....	.....	.....	.....
	30.1	30.4	A	10.3	57.4	22.0	8.8	1.4	.1	0	0	.....	.....	.....	.....	.....	.....	.....
	30.8	31.0	A	9.5	12.8	26.7	38.8	11.0	1.2	0	0	.....	.....	.....	.....	.....	.....	.....
	36.6	37.0	A	10.7	80.3	8.2	.6	.1	.1	0	0	.....	.....	.....	.....	.....	.....	.....
	38.0	38.1	A	10.0	26.5	2.0	1.2	.3	0	0	0	.....	.....	.....	.....	.....	.....	.....

Table 2.— *Physical and hydrological properties of mantle-rock materials*— Continued

Test hole no.	Depth of sample (feet)		Method of sampling	Particle size (percent by weight)										Porosity (percent by volume)	Specific retention (percent by volume)	Specific yield (percent by volume)	Laboratory coefficient of permeability (Meinzer units)
						Sand					Gravel						
	From	To		Clay (less than 0.004 mm)	Silt (0.004-0.0625 mm)	Very fine (0.0625-0.125 mm)	Fine (0.125-0.25 mm)	Medium (0.25-0.50 mm)	Coarse (0.5-1.0 mm)	Very coarse (1.0-2.0 mm)	Very fine (2-4 mm)	Fine (4-8 mm)	Medium (8-16 mm)	Coarse (16-32 mm)				
Merrick County— Continued																	
	1.0	2.3	A	6.9	15.5	27.1	41.8	8.2	0.5	0	.....	.....	.....	.....	.....	.....	.....	.....
	2.3	2.6	A	19.0	64.1	8.6	6.0	2.2	.1	0	.....	.....	.....	.....	.....	.....	.....	.....
15-8-17dd	3.5	4.3	A	4.0	2.0	26.4	56.1	9.8	.9	.2	0.3	0.3	.....	.....	.....	.....	.....	.....
	4.3	4.7	A	2.0		6.5	46.1	39.8	4.1	.5	.2	.8	.....	.....	.....	.....	.....	.....
	3.0	3.5	ST	22.7	75.1	1.1	.3	.1	.1	.3	.3	.....	.....	.....	51.8	21.5	30.3	.....
	3.5	4.0	ST	21.7	76.6	1.6	.1	.0	0	0	0	.....	.....	.....	51.7	20.4	31.3	.....
	5.0	5.5	ST	19.9	78.9	1.0	.1	.1	0	0	0	.....	.....	.....	52.4	20.9	31.5	2
	5.5	6.0	ST	21.0	77.8	1.0	.1	.1	0	0	0	.....	.....	.....	50.7	19.1	31.6	5
	6.0	6.5	ST	21.0	78.1	.8	.1	0	0	0	.....	.....	.....	.....	52.5	17.7	34.8	3
15-8-33bc	7.0	7.5	ST	18.4	80.0	1.5	.1	0	0	.....	.....	.....	.....	.....	50.9	20.7	30.2	1
	9.5	10.0	ST	4.0	5.7	17.7	43.3	23.2	5.6	.5	.....	.....	.....	.....	37.3	2.3	35.0	.....
	10.0	10.5	ST	6.8	4.4	18.3	43.3	23.6	3.5	.1	.....	.....	.....	.....	34.4	1.5	32.9	36
	11.5	12.0	ST	25.8	73.1	.9	.1	.1	0	.....	.....	.....	.....	.....	47.2	22.9	24.3	N
	15.0	15.5	A	27.8	70.2	1.1	.6	.2	.1	.....	.....	.....	.....	.....	.....	.....	.....	.....
	16.5	17.0	A	11.7	26.3	16.9	33.8	10.7	.6	.....	.....	.....	.....	.....	.....	.....	.....	.....
	2.0	2.5	A	27.0		20.9	39.3	11.0	1.1	.6	.1	.....	.....	.....	.....	.....	.....	.....
	3.0	3.5	ST	7.0	4.8	25.2	49.0	10.8	1.6	1.3	.3	.....	.....	.....	40.4	2.9	37.5	89
	6.5	7.0	ST	26.1	71.0	2.3	.3	.1	.1	.1	0	.....	.....	.....	46.2	25.2	21.0	.....
	7.0	7.5	ST	24.3	72.3	3.1	.2	0	0	0	.1	.....	.....	.....	44.8	25.6	19.2	.....
15-8-36aa	8.5	9.0	ST	25.5	73.5	.9	.1	0	0	0	0	.....	.....	.....	.....	.....	.....	.....
	9.0	9.5	ST	23.3	74.7	1.5	.3	.1	.1	0	0	.....	.....	.....	48.8	24.7	24.1	24
	10.5	11.0	ST	7.6	4.7	26.0	50.2	11.2	.3	0	.....	.....	.....	.....	36.5	4.0	32.5	21

15-8-36aa	11.0	11.5	ST	7.5	12.8	27.7	46.9	5.0	.1	0	.....	.....	.....	.....	36.2	5.1	31.1	28
	12.0	12.5	ST	8.8	12.0	18.7	40.0	18.9	1.6	0	.....	.....	.....	.....	30.1	6.2	23.9	2
	12.5	13.0	ST	5.5	1.8	11.7	45.7	31.9	3.2	.1	.....	.....	.....	.....	36.1	.6	35.5	26
	13.0	13.5	ST	7.1	17.2	29.5	34.1	10.6	1.4	.1	.....	.....	.....	.....	30.9	7.7	23.2	4
	15.0	15.5	ST	6.0	11.9	17.9	39.7	19.8	4.5	.2	.....	.....	.....	.....	32.0	5.8	26.2	5
	15.5	16.0	ST	11.0	36.7	15.7	25.5	9.8	1.2	.1	.....	.....	.....	.....	38.3	10.6	27.7	1
	16.0	16.5	ST	5.6	16.8	21.9	44.8	10.5	.3	.1	.....	.....	.....	.....	36.4	4.3	32.1	19

Nance County

15-6 4cc	1.0	1.5	ST	9.7	25.0	29.3	30.3	5.2	0.4	0.1	.....	.....	.....	.....	52.0	9.1	42.9	.....
	1.5	2.0	ST	11.3	12.5	34.7	34.5	6.2	.7	.1	.....	.....	.....	.....	48.1	9.0	39.1	.....
	2.0	2.5	ST	13.0	24.1	33.4	25.7	3.4	.3	.1	.....	.....	.....	.....	42.7	8.1	34.6	5
	3.0	3.5	ST	21.6	42.8	18.5	14.8	2.1	.1	.1	.....	.....	.....	.....	48.6	17.7	30.9	224
	3.5	4.0	ST	28.2	49.6	12.3	8.0	1.5	.2	.1	0.1	.....	.....	.....	48.9	22.8	26.1	.....
	4.0	4.5	ST	37.0	56.0	4.1	2.5	.4	0	.1	0	.....	.....	.....	45.1	30.5	14.6	N
	4.5	4.8	A	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	5.0	5.5	ST	28.8	52.6	11.0	6.5	1.1	0	0	0	.....	.....	.....	42.4	28.6	13.8	29
	5.5	6.0	ST	10.1	10.6	34.0	39.6	5.4	.3	0	.....	.....	.....	.....	40.8	7.9	32.9	10
	7.0	7.5	ST	7.0	10.8	36.3	40.1	5.6	.2	0	.....	.....	.....	.....	38.8	5.8	33.0	.3
	7.5	8.0	ST	16.0		45.9	35.2	2.6	.3	0	.....	.....	.....	.....	39.7	6.0	33.7	2
	8.0	8.5	ST	7.0	13.5	40.4	35.6	3.3	.2	0	.....	.....	.....	.....	38.0	5.9	32.1	7
	9.0	9.5	ST	7.0	4.3	31.0	47.9	9.4	.4	0	.....	.....	.....	.....	39.1	3.5	35.6	136
	9.5	10.0	ST	14.1		36.0	44.8	4.8	.3	0	.....	.....	.....	.....	38.8	2.9	35.9	4
	10.0	10.5	ST	26.2		44.5	22.8	5.9	.6	0	.....	.....	.....	.....	41.0	4.5	36.5	12
	11.0	11.5	ST	5.2	6.1	33.9	45.5	9.1	.2	0	.....	.....	.....	.....	39.7	1.8	37.9	72
	11.5	12.0	ST	15.1		44.5	37.6	2.7	.1	.....	.....	.....	.....	.....	35.8	2.8	33.0	38
	12.0	12.5	ST	15.4		35.8	38.8	9.3	.7	.....	.....	.....	.....	.....	34.3	2.4	31.9	28
	13.0	13.5	ST	6.5	17.4	39.3	29.8	6.5	.5	.....	.....	.....	.....	.....	41.0	3.1	37.9	30
	13.5	14.0	ST	45.8		31.2	19.0	3.9	.1	.....	.....	.....	.....	.....	43.7	7.3	36.4	15
	14.0	14.5	ST	50.8		27.8	18.0	3.2	.2	.....	.....	.....	.....	.....	44.1	9.6	34.5	9
	15.0	15.5	ST	6.6	7.3	31.1	48.3	6.4	.3	.....	.....	.....	.....	.....	34.4	3.2	31.2	38
	15.5	16.0	ST	4.2		37.5	53.9	4.3	.1	.....	.....	.....	.....	.....	33.4	2.5	30.9	39
	16.0	16.5	ST	2.8		27.4	60.0	9.6	.2	.....	.....	.....	.....	.....	33.7	1.1	32.6	71
	17.0	17.5	ST	6.1	5.3	54.6	31.3	2.6	.1	.....	.....	.....	.....	.....	39.5	3.5	36.0	52
	17.5	18.0	ST	5.6		39.5	49.8	5.0	.1	.....	.....	.....	.....	.....	34.0	2.5	31.5	62
	18.0	18.5	ST	7.9		47.1	42.7	2.3	0	.....	.....	.....	.....	.....	34.8	2.8	32.0	39
	19.0	19.5	ST	5.5	3.7	30.8	56.6	3.3	.1	.....	.....	.....	.....	.....	40.4	2.5	37.9	87
	19.5	20.0	ST	6.9		33.3	50.5	9.1	.2	.....	.....	.....	.....	.....	36.6	2.7	33.9	71
	21.0	21.5	ST	24.3	63.3	9.8	2.4	.2	.....	.....	.....	.....	.....	.....	47.1	22.9	24.2	.3
	21.5	22.0	ST	24.3	68.8	5.3	1.5	.1	.....	.....	.....	.....	.....	.....	47.8	22.0	25.8	3
	26.0	26.5	A	6.5	.7	16.9	58.7	14.7	2.4	.1	.....	.....	.....	.....	.....	.....	.....	.....
	27.0	27.5	ST	3.7		17.0	68.2	10.3	.6	.2	.....	.....	.....	.....	35.1	.6	34.5	64
	27.5	28.0	ST	4.9		16.0	69.7	8.4	1.0	0	.....	.....	.....	.....	31.7	N	31.7	77
	28.0	28.5	ST	3.8		13.9	65.1	13.1	2.7	.7	.3	0.4	.....	.....	37.0	1.1	35.9	155

Table 2.—*Physical and hydrological properties of mantle-rock materials*—Continued

Test hole no.	Depth of sample (feet)		Method of sampling	Particle size (percent by weight)											Porosity (percent by volume)	Specific retention (percent by volume)	Specific yield (percent by volume)	Laboratory coefficient of permeability (Meinzer units)
						Sand					Gravel							
	From	To		Clay (less than 0.004 mm)	Silt (0.004-0.0625 mm)	Very fine (0.0625-0.125 mm)	Fine (0.125-0.25 mm)	Medium (0.25-0.50 mm)	Coarse (0.5-1.0 mm)	Very coarse (1.0-2.0 mm)	Very fine (2-4 mm)	Fine (4-8 mm)	Medium (8-16 mm)	Coarse (16-32 mm)				
Nance County—Continued																		
	1.5	2.0	ST	7.0	14.3	17.0	49.0	12.3	0.4	.....	.....	.....	.....	.....	41.7	4.2	37.5	84
	2.0	2.5	ST	11.4		17.1	58.9	11.9	.7	.....	.....	.....	.....	.....	36.5	1.5	35.0	85
	3.6	4.1	ST	15.3		19.8	53.8	11.0	.1	.....	.....	.....	.....	.....	36.1	1.5	34.6	23
	4.1	4.6	ST	5.9	4.2	20.1	49.8	19.0	1.0	.....	.....	.....	.....	.....	32.7	1.6	31.1	11
	5.6	6.1	ST	16.6		22.0	49.0	11.1	.8	0.4	0.1	.....	.....	.....	30.2	2.2	28.0	17
16-5-11bc	6.1	6.6	ST	.....		.....	.....	.....	.....	.....	.....	.....	.....	.....	30.7	3.0	27.7	5
	7.1	7.6	ST	11.8		29.8	46.7	9.4	2.0	.2	.1	.....	.....	.....	.....	.....	.....	.....
	7.6	8.1	ST	6.0	12.1	36.9	39.3	4.2	.7	.2	.6	.....	.....	.....	33.5	2.5	31.0	14
	8.1	8.6	ST	3.7		9.5	51.9	31.0	3.1	.4	.1	0.3	.....	.....	.....	.....	.....	.....
	8.6	8.9	A	3.1		3.4	40.5	46.8	4.4	.7	1.1	1.0	.....	.....	.....	.....	.....	.....
	.7	1.2	ST	8.0	9.5	18.4	46.0	16.0	1.8	.2	.1	.....	.....	.....	40.7	5.0	35.7	403
	1.2	1.7	ST	8.8	14.5	16.6	39.1	18.5	2.3	.2	.....	.....	.....	.....	39.0	6.5	32.5	106
	1.7	2.2	ST	8.8	13.5	13.2	38.6	22.2	3.5	.2	.....	.....	.....	.....	38.5	8.3	30.2	33
	3.2	3.7	ST	17.9	43.3	12.9	18.8	6.1	.8	.1	.1	.....	.....	.....	51.7	13.1	38.6	.....
	3.7	4.2	ST	16.6	36.5	15.7	21.0	8.8	1.3	.1	0	.....	.....	.....	51.7	11.3	40.4	136
16-5-23bb	5.2	5.7	ST	16.5	46.8	18.6	14.4	3.4	.3	0	.....	.....	.....	.....	49.7	11.8	37.9	119
	5.7	6.2	ST	14.5	23.4	14.7	30.8	13.6	2.9	.1	0	.....	.....	.....	42.4	10.9	31.5	24
	8.7	9.2	A	9.0	25.8	32.2	25.7	6.6	.5	.1	.1	.....	.....	.....	.....	.....	.....	.....
	9.2	9.8	A	6.8		16.1	54.0	20.7	1.4	.6	.4	.....	.....	.....	.....	.....	.....	.....
	10.2	10.5	A	4.4		16.7	51.4	23.6	1.2	.3	.9	1.5	.....	.....	.....	.....	.....	.....
	11.0	11.4	A	4.5		16.9	53.4	22.1	2.2	.5	0	.4	.....	.....	.....	.....	.....	.....

	1.3	1.8	ST	6.2		19.9	64.3	8.6	.4	.1	.5	.....	.....	.....	35.2	2.8	32.4	52
	1.8	2.3	ST	4.1		10.5	58.3	25.1	1.6	.2	.2	.....	.....	.....	35.9	2.4	33.5	132
16-6-24aa	3.3	3.8	ST	4.1		10.8	41.9	35.8	4.4	.6	.6	0	1.8	.....	29.9	2.6	27.3	102
	3.8	4.3	ST	.3		3.9	43.9	44.7	5.1	.5	1.0	.6	.....	.....	32.3	N	32.3	323
	1.67	2.17	ST	7.0	14.3	30.5	42.2	5.6	.2	.1	.1	0	.....	.....	.....	.....	.....	.....
	2.17	2.67	ST	7.2	20.3	24.5	41.0	6.6	.3	.1	0	.....	.....	.....	42.7	7.0	35.7	35
	3.80	4.30	ST	7.0	10.8	20.4	52.3	9.0	.4	.1	0	.....	.....	.....	37.7	6.4	31.3	.....
16-6-32aa	4.30	4.80	ST	6.0	4.3	6.5	57.5	20.7	1.9	.6	1.2	1.3	.....	.....	37.8	2.3	35.5	.....
	5.80	6.30	ST	.8		4.3	19.5	48.7	20.3	5.1	1.1	.2	0	.....	30.3	N	30.3	464
	6.30	6.80	ST	.9		3.8	30.9	46.3	13.4	2.9	.6	.3	.9	.....	31.7	N	31.7	222

Table 3.—*Summary of physical and hydrological*

[Specific retention: N, negligible value. Laboratory

Test hole no.	Topographic situation	Depth to water (feet)	Total depth of test hole (feet)	Porosity	
				Weighted average (percent)	Range (percent)
					Merrick
14-7-11bb	South of divide	9.23	10.8	38.6	30.9-46.4
15-5- 7bb	On divide	18.31	20.8	42.3	33.1-49.9
15-7-14bb	Loup River valley	4.54	6.8	41.7	27.4-51.7
19bb	do	6.66	9.8	42.4	34.5-48.3
32dd	On divide	45.60	38.8	.....	.....
15-8-17dd	Loup River valley	2.74	4.8	.....	.....
33bc	North slope of divide	10.79	18.0	47.8	34.4-52.5
36aa	do	9.98	20.8	39.1	30.1-48.8
					Nance
15-6- 4cc	On divide	27.17	28.5	41.6	31.7-52.0
16-5-11bc	Loup River valley	4.93	8.9	34.5	30.2-41.7
23bb	South of divide	8.65	12.0	45.6	38.5-51.7
16-6-24aa	Loup River valley	.90	5.0	33.3	29.9-35.9
32aa	do	4.18	7.1	36.7	30.3-42.7

Test hole no.	Topographic situation	Specific yield		
		Weighted average (percent)	Range (percent)	Depth of greatest specific yield (feet)
				Merrick County
14-7-11bb	South of divide	22.8	8.9-34.8	5.5- 6.0
15-5- 7bb	On divide	25.8	12.7-42.5	1.5- 2.0
15-7-14bb	Loup River valley	34.4	24.7-39.7	2.0- 2.5
19bb	do	34.0	26.0-36.7	3.0- 3.5
32dd	On divide	.....	.....	.....
15-8-17dd	Loup River valley	.....	.....	.....
33bc	North slope of divide	30.0	24.3-35.0	9.5-10.0
36aa	do	28.6	19.2-37.5	3.0- 3.5
				Nance County
15-6- 4cc	On divide	31.5	13.8-42.9	1.0- 1.5
16-5-11bc	Loup River valley	32.1	27.7-37.5	1.5- 2.0
23bb	South of divide	35.6	30.2-40.4	3.7- 4.2
16-6-24aa	Loup River valley	31.4	27.3-33.5	1.8- 2.3
32aa	do	33.2	30.3-35.7	2.2- 2.7

properties of mantle-rock materials

coefficient of permeability: N, negligible value]

Porosity		Specific retention			
Depth of greatest porosity (feet)	Depth of least porosity (feet)	Weighted average (percent)	Range (percent)	Depth of greatest specific retention (feet)	Depth of least specific retention (feet)
County					
3.5- 4.0	9.5-10.0	15.7	N-34.2	3.0- 3.5	5.5- 6.0 9.5-10.0
9.5-10.0	17.5-18.0	16.4	4.7-30.9	13.5-14.0	20.0-20.5
2.0- 2.5	6.0- 6.5	7.3	6-12.0	2.0- 2.5	5.5- 6.0
4.5- 5.0	6.5- 7.0	8.1	N-11.9	4.5- 5.0	8.0- 9.5
.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	.....	.....
6.0- 6.5	10.0-10.5	17.7	1.5-22.9	11.5-12.0	10.0-10.5
9.0- 9.5	12.0-12.5	10.5	.6-25.6	7.0- 7.5	12.5-13.0
County					
1.0- 1.5	27.5-28.0	10.1	N-30.5	4.0- 4.5	27.5-28.0
1.5- 2.0	5.6- 6.1	2.3	1.5- 4.2	1.5- 2.0	2.0- 2.5 3.6- 4.1
3.2- 4.2	1.7- 2.2	10.0	5.0-13.1	3.2- 3.7	.7- 1.2
1.8- 2.3	3.3- 3.8	1.9	N- 2.8	1.3- 1.8	3.8- 4.3
2.2- 2.7	5.8- 6.3	3.5	N- 7.0	2.2- 2.7	5.8- 6.3

Specific yield	Laboratory coefficient of permeability (Meinzer units)			
Depth of least specific yield (feet)	Weighted average	Maximum range	Depth of greatest coefficient of permeability (feet)	Depth of least coefficient of permeability (feet)
—Continued				
3.0- 3.5	182	128-364	5.5-6.0	8.0- 8.5
13.5-14.0	55	N-745	1.0-1.5	8.0- 8.5
6.0- 6.5	120	3-155	2.0-2.5	17.5-18.5
6.5- 7.0	45	25-152	9.0-9.5	6.0- 6.5
				4.5- 5.0
.....	.....	.....	.....	.....
.....	.....	.....	.....	.....
11.5-12.0	8	N- 36	6.0-6.5	10.0-10.5
7.0- 7.5	32	1- 89	3.0-3.5	15.5-16.0
—Continued				
5.0- 5.5	49	N-224	2.0-2.5	4.0 -4.5
6.1- 6.6	35	5- 85	2.0-2.5	6.1 -6.6
1.7- 2.2	124	24-403	.7-1.2	5.7 -6.2
3.3- 3.8	152	52-323	3.8-4.3	1.3 -1.8
5.8- 6.3	135	35-464	5.8-6.3	2.17-2.67

wet analysis. Results of these analyses were then plotted as semilogarithmic graphs. The results of the particle-size analyses are shown in plates 4 and 5.

The porosity of a rock aggregate is its property of containing interstices without regard to size, shape, or arrangement of openings. Porosity is expressed quantitatively as the percentage of the total volume of rock that is occupied by interstices. In a rock that is saturated with water the porosity is the percentage of the total volume of the rock that is occupied by water. The porosity of the analyzed samples ranged from 27.4 to 52.5 percent by volume.

The moisture equivalent of a water-bearing material is the ratio of (1) the weight of water that the material after saturation will retain against a centrifugal force 1,000 times the force of gravity to (2) the weight of the dry material. The moisture equivalent by volume is computed by multiplying the moisture equivalent by weight by the apparent specific gravity of the dry material. The specific retention—that is, the quantity of water that a material will retain against the pull of gravity if it is drained after having been saturated—is expressed as the ratio of the retained water to the total volume of the material and is determined by adjusting the moisture equivalent by volume by a correction factor that was proposed by Piper (1933, p. 481). The specific retention of the samples ranged from a negligible value to 34.2 percent.

The specific yield of a water-bearing material is defined as the ratio of (1) the volume of water that a saturated material will yield by gravity to (2) its own volume. It is numerically equal to the porosity minus the specific retention. The specific yield of the samples ranged from 8.9 to 42.9 percent.

Permeability (see definition on p. 17) is a measure of the ability of a material to transmit water under pressure. The coefficient of permeability was determined in the laboratory with a variable-head permeameter, using a method described by V. C. Fishel (Wenzel, 1942, p. 59). The coefficients of permeability of the samples collected in the Prairie Creek unit ranged from negligible values to 745 gpd/ft^2. The weighted average permeability of the top 10 ft of each test hole is shown in figure 6. In general, the lesser values of permeability characterize the sandhill divide area and the greater values characterize the valley lands.

The computed weighted averages of the laboratory determinations of porosity, specific retention, specific yield, and coefficient of permeability are given in table 3. The weighted average of a given property was computed for each test hole by (1) multiplying the

results of the laboratory analyses by the thickness represented by the sample, (2) totaling the products of these multiplications, and (3) dividing the sum by the total depth of the test hole. Also given for each test hole in table 3 are the range of values determined for each property and the depth of the greatest and the least value for each property.

GROUND WATER

The principal water-bearing materials in the Prairie Creek unit are the sand and gravel deposits of Pleistocene age. These deposits are continuous with similar deposits of the same age that adjoin the borders of the Prairie Creek unit; likewise, the ground water in these deposits is continuous with the ground water in the surrounding areas. Because it is moving laterally through the water-bearing beds, the ground water is said to be in "transient storage."

Ground water is constantly entering the area as underflow from the adjacent area to the west. When rain falls on the ground, or when snow melts within the area, water enters the interstices of the soil, and the water that is not held in the soil by molecular attraction moves downward and accumulates in the zone of saturation. In addition, part of the water that is pumped for irrigation is returned to the ground-water reservoir by seepage from the irrigated tracts and, when the streams are higher than the adjacent water table and where the stream bed is permeable, some water leaves the streams and moves downward to the zone of saturation. The water that enters the ground-water reservoir is collectively referred to as "ground-water recharge."

Essentially balancing the amount of ground-water recharge in the Prairie Creek unit is the amount of ground water that is discharged. Just as water is moving into the area by underflow, water is leaving the area by underflow. Within the area water is discharged from the zone of saturation through wells that are pumped, by vegetation having roots that extend to the capillary fringe above the water table or to the water table itself, through springs, by seepage into streams that are incised below the water table, and by evaporation in areas where the water table is within a few feet of the land surface.

DEPTH TO THE WATER TABLE

The depth to the top of the zone of saturation ranges from less than 1 ft to about 70 ft and is less than 10 ft in about three-fourths

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of the area. (See pl. 6 and tables 8 and 9.) In general, the top of the zone of saturation is a relatively smooth surface; local mounds or depressions generally are temporary under normal conditions. Consequently, the depth to water is closely related to the topography. Measurements of the depth to water in 284 wells in the Prairie Creek unit were made in October 1950, and a map (pl. 6) showing the depth to water in the area was prepared from these data. The areas having a given depth to water are irregular in outline and are oriented with their longer axis in a northeast-southwest direction.

MOVEMENT OF THE GROUND WATER

A sharply to poorly defined ground-water divide, which approximately coincides with the topographic divide, separates the part of the area in which ground-water movement is toward the Loup River from the part of the area in which ground-water movement is either toward or parallel to the Platte River (pl. 7). The gradient of the water table toward the Loup River ranges from about 10 to about 50 ft per mile and averages about 20 ft per mile in Merrick and Nance Counties; in Platte County the gradient is less steep. The movement of ground water toward the Loup River indicates that the river is an agent of ground-water discharge. In the Platte Valley the gradient of the water table averages about 6 ft per mile. The direction of ground-water movement in the vicinity of the ground-water divide is southeastward toward Prairie Creek, but it is parallel to the Platte River in the belt adjacent to the river. The movement of ground water toward Prairie Creek throughout much of its length and the local movement of ground water toward Silver Creek (pl. 7) indicate that ground water discharges into both these streams; their banks generally are wet from ground-water seepage from stream level to a height of about 12 in. The movement of ground water parallel to the flow of the Platte River indicates that in this reach the river and the adjacent ground water are essentially in equilibrium. However, this balance is not perfect; when the river stage is higher than the stage of the adjacent water table, water moves from the river into the ground-water reservoir, and when the river stage declines below that of the water table ground water moves from storage into the river.

The configuration of the water table in the Prairie Creek unit is shown by contour lines based on the altitude of the water level in 284 wells. (See pl. 7 and table 9.) Ground-water movement is at right angles to the course of the contour lines and in the direction of the downward slope of the water table.

WATER-LEVEL FLUCTUATIONS

The stage of the water table is the net effect of all the recharge to, and discharge from, the aquifer. If ground water entered and left the area only by underflow, a state of relative equilibrium would exist and water levels in wells would remain essentially constant. However, several agents of recharge and discharge are intermittently and concurrently operative within the Prairie Creek unit.

Precipitation is the most effective agent of recharge in the area. Where the water table is shallow, the water table generally rises promptly in response to rainfall; where the water table is deeper, the response may be delayed or negligible. In general, the amount of water-level rise depends on the amount and duration of precipitation, amount of frost in the ground, amount of moisture in the soil, permeability of the material between land surface and water table, and amount of water intercepted by plant roots or lost by evaporation. A water-level rise of 6 in. to 1 ft is common as a result of prolonged rain or heavy snowmelt. Seepage of irrigation water to the water table also is believed to be a source of some recharge but, because this type of recharge occurs concurrently with the seasonal lowering of the water table, its effect is to lessen the rate of decline rather than to cause a perceptible rise. Some recharge occurs also along the streams when their stage is higher than that of the adjacent water table. It is probable that the streams in the Prairie Creek unit are not very effective agents of recharge because the stream beds are likely to be dry when the water table is lower than the stream bed. However, pumping a well situated near a flowing stream induces recharge from the stream if the cone of depression of the pumped well intersects the stream bed. The average cumulative rise of the water table in the part of the Prairie Creek unit south of the sandhill divide amounted to about 2.3 ft in 1946, 1.2 ft in 1947, 1.5 ft in 1948, 1.9 ft in 1949, and 0.5 ft in 1950. (See fig. 7.) These rises, when multiplied by the average specific yield, give minimum values for the average recharge from precipitation because ground-water discharge is continuing while the water table is rising, thus lessening the rise and preventing an accurate determination of the amount of recharge from precipitation.

Evapotranspiration, pumping of wells, discharge of ground water into streams and through springs, and underflow cause a lowering of the water table. Because the depth to the water table is less than 10 ft in much of the area south of Prairie Creek, evapotranspiration probably accounts for much of the discharge of ground water. The pumping of wells, however, accounts for some of the lowering of the water table during the irrigation season. Discharge through springs and by seepage into streams also accounts for a

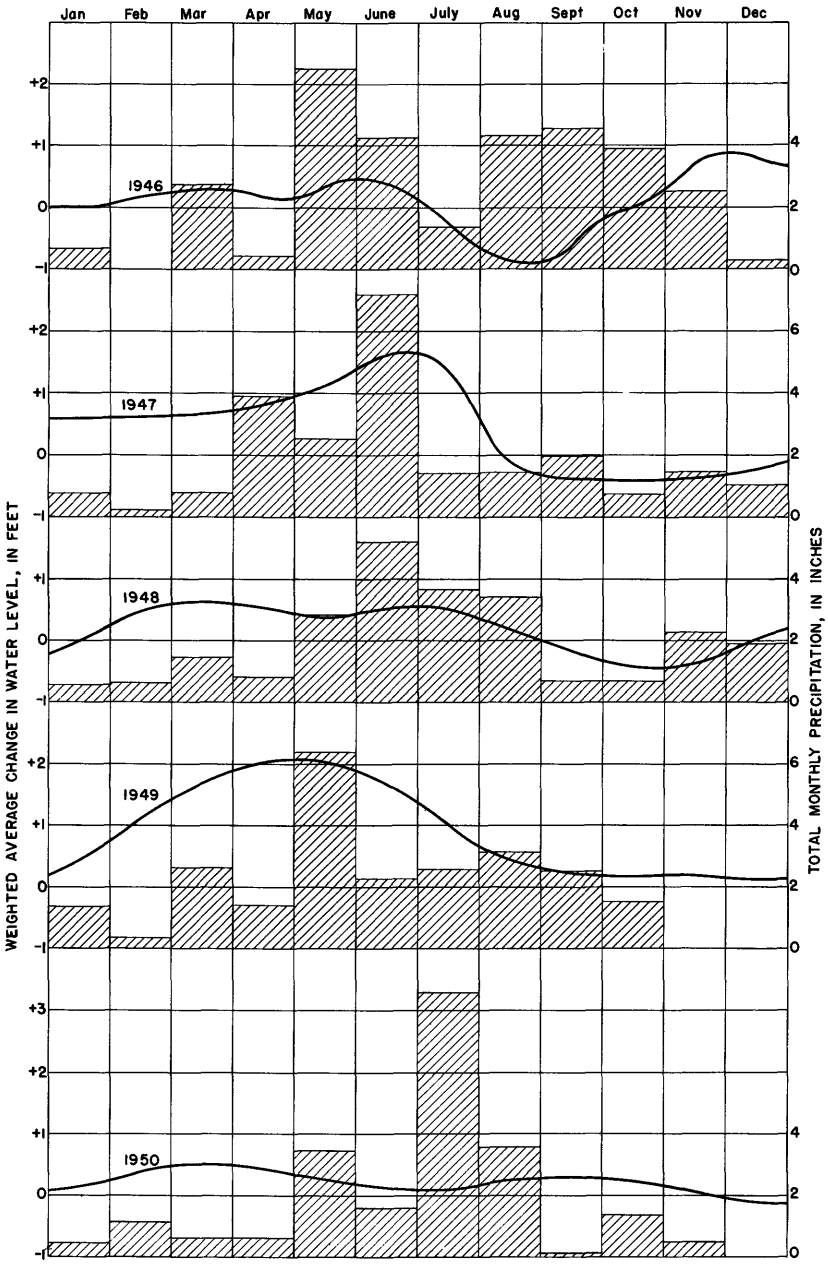

Figure 7. —Hydrographs showing weighted average change in water level in feet above or below water-table datum of January 1, 1946 (curve), and total monthly precipitation at Central City, Nebr. (shaded area).

part of the lowering of the water table; this is evidenced by the decline of the water table during the months when recharge is negligible and when the other agents of discharge within the area are essentially inoperative. The average cumulative decline of the water table in the part of the Prairie Creek unit south of the sandhill divide amounted to about 1.7 ft in 1946, 2.1 ft in 1947, 1.1 ft in 1948, 2.0 ft in 1949, and 0.8 ft in 1950. (See fig. 7.)

Because the amount and rate of recharge and discharge do not follow a fixed pattern from year to year, the seasonal fluctuation of the water table likewise does not follow a fixed pattern. This statement is illustrated by figure 7, which shows the weighted average change of the water level in observation wells in the Prairie Creek unit south of the sandhill divide and the total monthly precipitation for the period 1946-50. From this illustration it may be seen that the periods of higher water levels generally coincide with periods of plentiful precipitation. This principle, however, does not hold true for the summer months, when plentiful precipitation, instead of causing a rise of water level, simply prevents or lessens the decline of water level that generally coincides with the season of greatest pumping for irrigation and greatest discharge by evapotranspiration. Figure 7 shows also that during the period 1946–50 the withdrawal of ground water for irrigation obviously did not deplete the water supply of the aquifer—the stage of the water table at the end of the 5-year period was essentially the same as at the beginning. Precipitation during this period was about normal; if precipitation had been considerably less, the water table at the end of the period undoubtedly would have been correspondingly lower. This probably would have been the case, however, even if ground water had not been pumped for irrigation. The fact that the level of the water table was about the same at the end as at the beginning of a period of approximately normal precipitation suggests strongly that the water table was not affected much by the pumping; hence, in effect, the pumpage represented salvage of water that otherwise would have been discharged by natural means.

Water-level measurements made in the Prairie Creek unit from January 1, 1945, to January 30, 1952, are listed in table 8.

USE OF THE GROUND WATER

Nearly all of the residents of the Prairie Creek unit obtain water for domestic use from privately owned wells of small diameter. These wells yield only a few gallons per minute and are pumped only when water is needed. The total volume of water pumped for domestic use is relatively small. The few industrial plants in the

area also obtain water from privately owned wells. The total pumpage is estimated to be roughly 30 to 50 acre-ft per year.

Many farmers, especially those living between Prairie Creek and the Platte River, pump ground water for irrigation. (See pl. 8.) The quantity pumped for this purpose depends largely on the amount and distribution of precipitation and consequently varies considerably from year to year. When precipitation is plentiful during the growing season much less water is pumped than when rainfall is scanty. For example, in 1950, when precipitation during May, June, and July was normal or above, irrigation was not started until late August or early September and many of the irrigation wells were not pumped at all. By contrast, during a dry growing season, irrigation is begun early in the season and is continued intermittently until late summer.

There are about 1,000 irrigation wells in the Prairie Creek unit. The locations of most of these wells were determined during the course of earlier work done by the U. S. Geological Survey in this area (Waite and others, 1949, pl. 9) and by the Central City office of the Soil Conservation Service, U. S. Department of Agriculture; a reconnaissance of the area to check the location of the wells was made by the author in February 1952. Nearly all the irrigation wells are south of Prairie Creek in the Platte River valley; the average density of irrigation wells in this part of the Prairie Creek unit is 2.5 wells per square mile. The greatest concentration of wells is in T. 13 N., R. 7 W., where a total of 125 was recorded. The absence of pronounced water-table depressions that could be correlated with heavy concentrations of irrigation wells and irrigation pumping is evidence that the water table has not been greatly affected by pumping (see pls. 7 and 8).

The abundance of irrigation wells south of Prairie Creek, and the rarity of wells north of the creek, apparently is related largely to the subsurface geology and ground-water hydrology of the area. The effective saturated thickness of the water-bearing materials is considerably greater south of Prairie Creek than it is north of the creek, owing largely to the presence of a buried bedrock valley filled with unconsolidated materials. (See pls. 1 and 2.)

According to information supplied by well owners, the yields of irrigation wells within the area range from about 500 to about 1,000 gpm. Well owners generally quote information received from the driller at the time the well was drilled; the yield of none of the wells was measured during this investigation.

CHEMICAL QUALITY OF THE GROUND WATER

By Frank H. Rainwater

The extent to which water may be effectively utilized depends in part on the chemical quality of the water. Therefore, in evaluating the ground-water resources of the Prairie Creek unit, it is necessary to consider the chemical quality of the water and its relation to the geology and hydrology of the area. The purpose of this section is (1) to describe the quality of the water in terms of predominant characteristics, (2) to correlate differences in chemical quality of ground water with direction of water movement and with soil and aquifer characteristics, (3) to evaluate the suitability of the water for present and proposed uses, and (4) to predict the effect of increased irrigation on the quality of the ground water.

During June 1951, water samples were collected from 16 shallow wells installed by the U. S. Geological Survey for observation of water-level fluctuations. Samples were collected also from two locations at Prairie Creek and one at Silver Creek. The depths of the sampled wells ranged from 10.6 to 21.5 ft. Chemical analyses of these samples are supplemented by analyses of municipal supplies presented by Swenson (Waite and others, 1949) and by analyses of municipal supplies on file at the Nebraska State Health Department at Lincoln.

The arrangements for the ground-water investigation were such that the samples were not collected until June 1951, after a period of heavy precipitation. Because shallow ground water is recharged rapidly in such periods, the ground water at the time of sampling probably was somewhat diluted. Therefore, most of these analyses represent water that is less concentrated than normal. Seasonal fluctuations in chemical quality have been observed even for the deeper wells that supply Central City, Columbus, Grand Island, and Silver Creek and for several wells in the lower Platte River basin; consequently, it is apparent that substantial fluctuations in the chemical character of the shallow water are to be expected.

CHEMICAL CHARACTER OF THE WATER FROM SHALLOW WELLS

The quantity of dissolved solids and the percentage composition are relatively uniform in samples of water from shallow wells in the Prairie Creek unit. The location of the sampling points, the mineral content in parts per million, and the depth of wells are shown in figure 8; the analytical results are presented in table 4. The ground water is essentially of the calcium bicarbonate type and is characterized by low dissolved solids, relatively high silica,

Table 4.—*Results of the chemical analyses of*

[Results in parts per

Location	Depth of well (feet)	Date of collection	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)
14-7- 8dd	14.0	6- 2-51	49	38	.....	86	18	17	9.5
26cc	21.5	6- 2-51	50	20	.....	26	5.1	7.0	3.9
15-3- 6aa	14.0	6- 4-51	48	18	.....	38	8.5	32	6.0
15-5- 8dd	19.4	6- 2-51	50	23	13	20	4.4	3.6	4.0
15-6- 2bb	18.5	6- 2-51	49	46	1.4	33	3.8	6.1	5.0
27dd	14.0	6- 2-51	51	29	.....	13	2.8	5.8	4.4
15-8-17dd	14.0	6- 2-51	48	35	.....	66	9.6	16	6.1
27dd	21.0	6- 2-51	50	43	.....	47	6.4	6.4	5.0
16-3- 5aa	14.0	6- 4-51	49	30	.....	20	3.4	9.4	4.8
7dd	10.6	6- 4-51	50	28	.....	30	6.1	20	2.2
24aa	14.0	6- 4-51	49	25	.....	28	6.3	11	7.0
16-4-15aa	21.0	6- 4-51	49	26	.....	24	3.9	8.2	2.6
27aa	14.0	6- 4-51	51	22	.....	31	6.0	18	3.9
16-5-21cc	14.0	6- 2-51	49	17	.....	49	4.7	4.4	5.2
17-1-27ad	13.5	6- 4-51	50	29	1.9	40	5.8	13	14
17-4-36aa	11.0	6- 4-51	50	26	5.5	51	7.5	17	9.3
Prairie Creek, 0.6 mile north of well 15-5-8dd, near Fullerton, Nebr	.....	6- 2-51	62	14	.02	15	3.5	11	9.0
Prairie Creek, about 3 miles northeast of Silver Creek, Nebr	.....	6- 4-51	74	18	.06	20	4.4	14	10
Silver Creek, ½ mile southwest of Silver Creek, Nebr	.....	6- 4-51	71	20	.11	31	5.7	25	7.8

water from shallow wells and streams

million except as indicated]

Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$		Percent sodium	Specific conductance (micromhos at 25°C.)	pH
								Calcium, magnesium	Noncarbonate			
348	10	29	5.5	0.3	0.9	0.07	385	288	0	11	574	8.3
49	0	30	2.0	.1	36	.04	178	86	46	14	233	7.2
142	0	88	3.0	.3	.8	.06	271	130	14	34	401	7.0
38	0	16	2.5	.1	37	.05	159	68	37	10	180	6.9
115	0	11	2.5	.2	12	.05	188	98	4	11	236	7.7
32	0	29	.5	.1	7.1	.03	119	44	18	20	136	6.5
249	0	42	3.0	.3	.9	.09	311	204	0	14	450	7.7
180	0	16	1.5	.3	1.1	.06	227	144	0	9	307	7.5
86	0	19	.5	.2	2.2	.11	132	64	0	23	183	6.9
104	0	26	3.0	.3	35	.02	218	100	15	30	297	6.8
120	0	27	4.5	.2	.9	.04	176	96	0	19	257	7.0
53	0	27	1.5	.2	28	.06	166	76	33	18	213	7.1
106	0	39	3.0	.4	18	.08	197	102	15	27	294	7.9
184	0	5.0	1.0	.3	1.9	.08	188	142	0	6	293	7.8
148	0	41	7.0	.2	2.8	.10	239	124	3	17	332	7.0
186	0	43	6.5	.3	3.5	.05	267	158	5	18	389	7.0
84	0	17	.5	.2	3.1	.07	122	52	0	27	176	7.6
107	0	23	.5	.3	2.2	.09	150	68	0	27	220	7.4
141	0	43	3.0	.4	2.2	.07	218	101	0	33	310	7.3

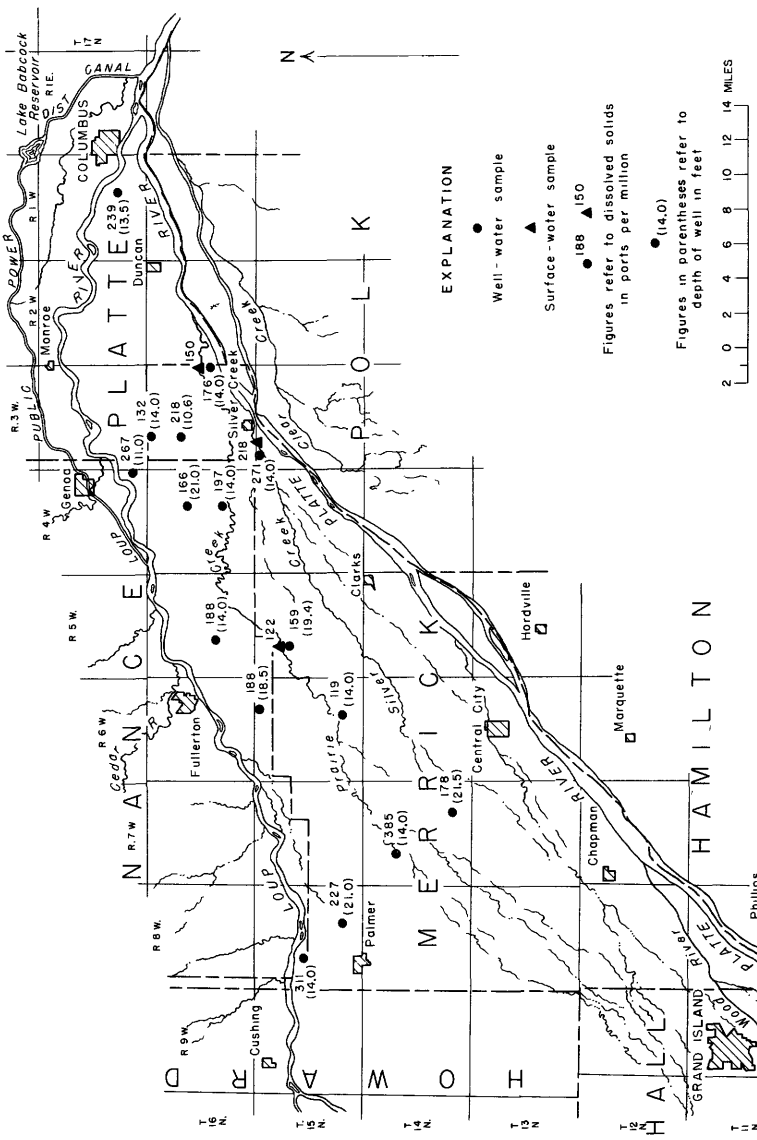

Figure 8. — Map of the Prairie Creek unit showing location of sampling points, concentration of dissolved solids, and depth of wells.

and high iron content. The maximum and minimum concentrations are shown below, but most analyses in table 4 fall within considerably narrower limits.

Constituent	Concentration (in parts per million)	
	Maximum	Minimum
Dissolved solids	385	119
Total hardness	288	44
Silica	46	17
Iron (total)	13	1.4

Chemical analyses of water from streams in the area show that surface runoff is essentially similar in type to the ground water.

In clear water iron may be present both as a colloid and in the ionic form. In turbid water it may be present in suspension also. Some of the collodial or dissolved iron may precipitate when a water sample is exposed to air; thus, some of the iron had probably precipitated in many of the water samples before they were received at the laboratory. If the sample as collected was turbid with soil particles, which themselves generally contain iron, a determination of total iron is difficult because the precipitated iron cannot be separated from the iron-bearing soil particles by ordinary chemical methods. This difficulty was encountered in analyzing 12 of the 16 ground-water samples; consequently, it was possible to make determinations of total iron on only the four remaining samples.

Concentrations of constituents in a chemical system may be expressed in terms of equivalents of the various components rather than, or in addition to, weight per unit weight (parts per million). Equivalents per million are calculated by dividing parts per million by the combining weight of the various ions in solution. When the results of a chemical analysis are expressed in equivalents per million, the total equivalents of the positively charged ions (calcium, magnesium, sodium, and potassium), termed "cations," are equal, except for small errors in the analysis, to the total equivalents of the negatively charged ions (carbonate, bicarbonate, sulfate, chloride, nitrate, and fluoride), termed "anions." This means of expression shows the true chemical relationship of the various ions in the water.

When water comes into contact with rocks and soils, some of the solid material is dissolved. Therefore, the chemical character of the water reflects the chemical composition of the solid materials, the solubility of the material, and the length of time the water has been in contact with the material. The salt content of

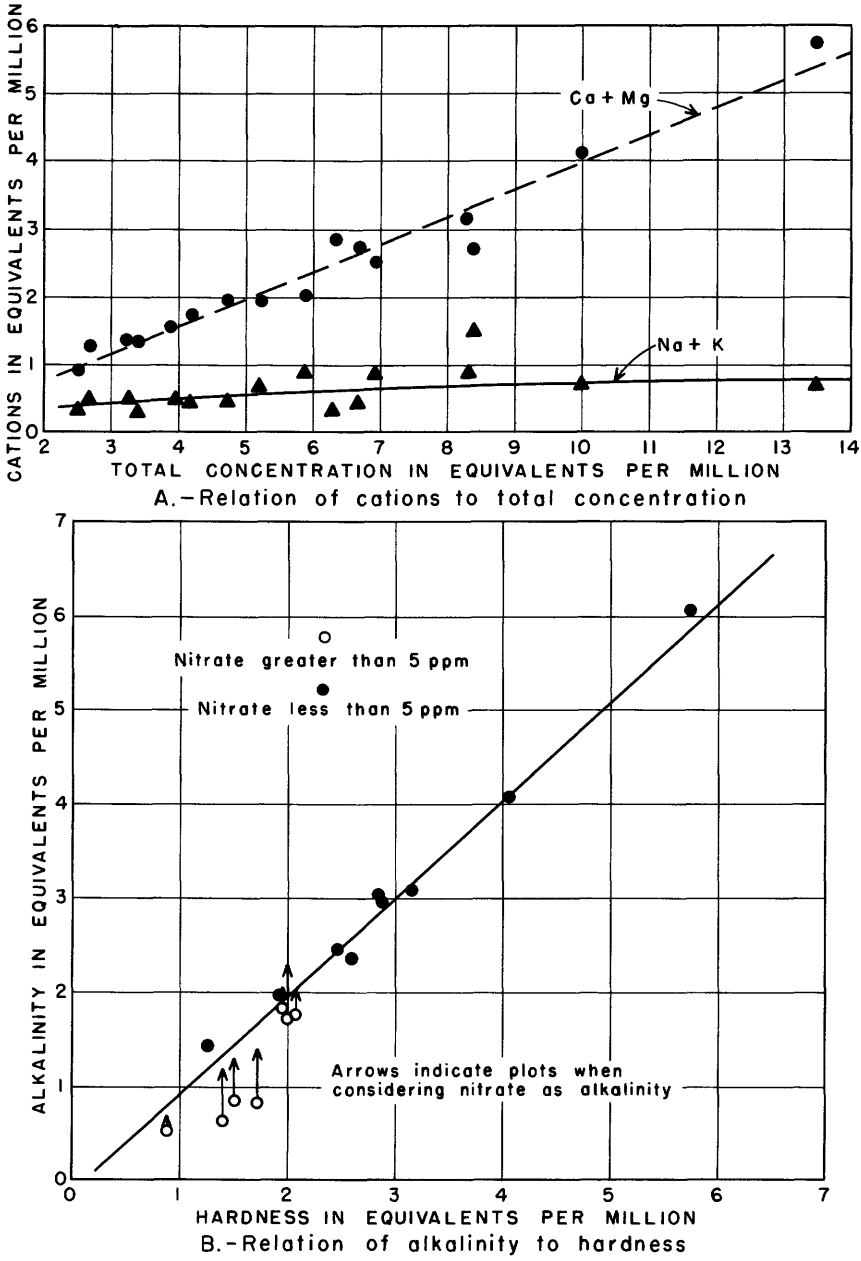

Figure 9. — Relations of cations to total concentration and of alkalinity to hardness.

the water, expressed as equivalents per million, plotted against calcium plus magnesium concentrations and against sodium plus potassium concentrations for the samples collected from shallow wells in the Prairie Creek unit is shown in part *A* of figure 9. The increase of calcium plus magnesium is proportional to the increase of total concentration; however, the increase of sodium plus potassium is much less pronounced. These relationships reflect the lithology of the water-bearing material.

The relations between predominant cations and anions are also of interest. The principal anions are carbonate and bicarbonate, together termed "alkalinity." Alkalinity versus hardness is shown graphically in part *B* of figure 9. Upon initial examination the correlation appears poor. However, those samples that are apparently deficient in alkalinity are found to have a high nitrate content. Nitrate of mineral origin is present in ground water in quantities greater than 5 ppm in relatively few places. In some places a high nitrate content indicates local pollution of the water. Microbiological metabolism is offered as a plausible explanation for an increase in nitrate content accompanied by a decrease in alkalinity. Nitrogenous material is decomposed in the presence of oxygen by nitrobacterial organisms normally present in the soil. One reaction in the decomposition produces nitric acid. The acid then reacts instantaneously with the bicarbonate ion to produce carbon dioxide, water, and nitrate. The resultant solution contains the nitrate ion in an amount equivalent to the amount of bicarbonate ion decomposed. Natural conditions that provide a favorable environment for these reactions are: during periods of heavy precipitation the water may be contaminated by the introduction of nitrogenous organic matter carried by surface water infiltrating around the well casing; or an elevated water table can raise the capillary zone to the normal nitrobacterial habitat of the nitrogen-bearing soil or mantle rock. Either condition could result in equivalent exchange of nitrate for bicarbonate in the water. Because aquifers of the Prairie Creek unit are extensive, the changes in water quality are probably local and the affected water is not typical of the aquifer as a whole.

If the higher nitrate content of the water is considered to have originated by local pollution, the low alkalinity values in part *B* of figure 9 can be increased by amounts equivalent to the nitrate, as shown by the arrows. The correlation between hardness and corrected alkalinity indicates strongly that the ratio of calcium and magnesium to alkalinity is stoichiometric through the entire range of concentrations in the samples of water from shallow wells in the Prairie Creek unit.

RELATION OF GROUND-WATER MOVEMENT TO CHEMICAL QUALITY

The direction of ground-water movement has been described in another part of this report. (See p. 30 - 31.) Information on the changes in chemical quality that occur with movement generally is an aid in defining the hydrology of an area and also augments the geologic investigations. The concentration of dissolved solids in the samples and the location of the sampled wells are shown on a map that also shows the contour of the water table. (See fig. 10.) The total concentration increases as the water moves from the ground-water divide north to the Loup River, south to the Platte River, and in the direction of underflow to the east. Water entering the ground-water reservoir, either through recharge from precipitation or by underflow, increases in concentration as it moves through the aquifer; hence, water samples obtained on or near the sandhill divide are more dilute than those obtained from the lower areas. The increase in calcium and magnesium with increase in concentration (part *A*, fig. 9) plus the stoichiometric ratio of calcium and magnesium to alkalinity (part *B*, fig. 9) indicate that calcium and magnesium carbonates are the prime constituents being dissolved. Most salts of sodium and potassium are more soluble than those of calcium and magnesium. The fact that the amounts of sodium and potassium in solution do not increase appreciably in transit excludes them as important soluble constituents in the water-bearing materials. This interpretation also can be extended to include the zone of aeration because the water table is close to the land surface. It is especially important to consider this aspect in connection with extensive irrigation where the sodium content of the water might be appreciably increased by reuse. (See p. 48.)

RELATION OF SOILS TO CHEMICAL QUALITY

Columnar samples of the soil profile at 20 places near Fullerton and Palmer in the Loup River drainage basin were collected in May 1951 by the Bureau of Reclamation; they were analyzed by the Soil Testing Service of the University of Nebraska. Use of ground water for irrigation is not extensive in this part of the Prairie Creek unit. Condensed extracts of the analyses are shown in table 5.

When classified according to standards prescribed by the U. S. Regional Salinity Laboratory, all the samples represent normal soil with the exception of some of the samples collected at 15-8-33cb. At this site, the top 18 in. of the profile (not shown in table 5) is classified as a saline-alkali soil; it is, however, underlain by normal soil.

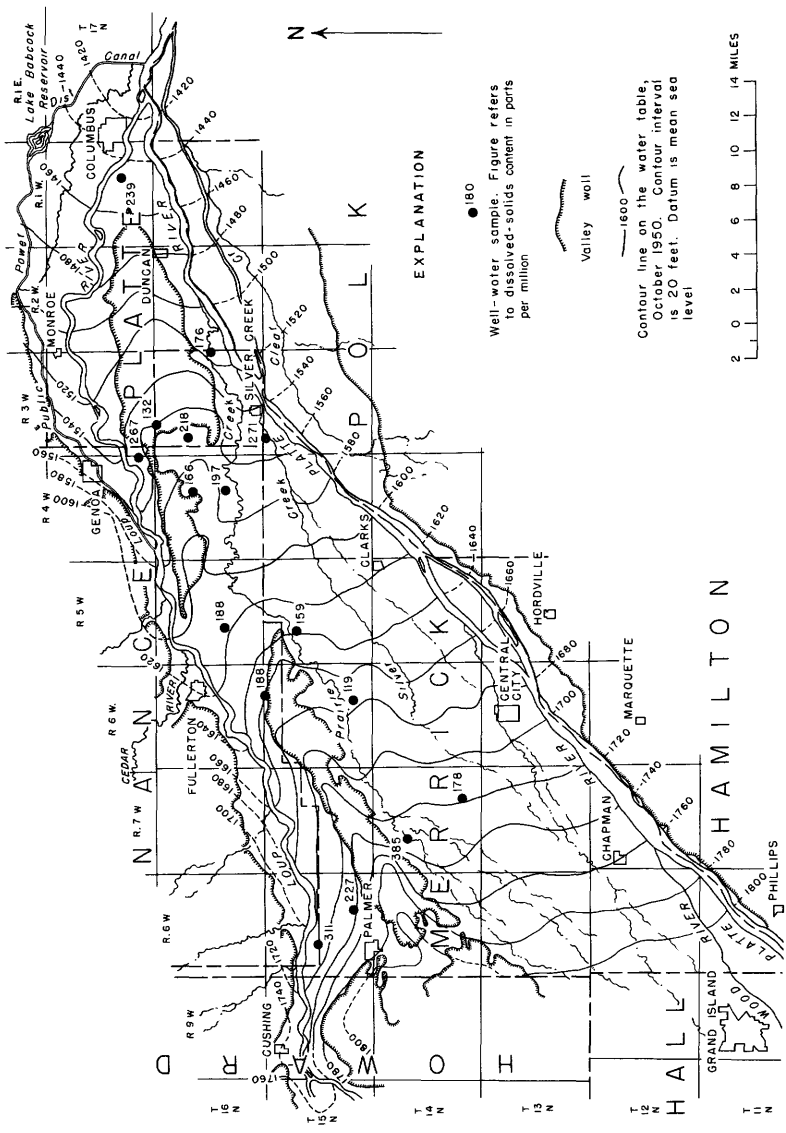

Figure 10.—Map of the Prairie Creek unit showing the relation of ground-water movement to dissolved-solids content of water.

Table 5.— *Results of the analyses of soil samples in the Loup drainage area*

[Analyses by Soil Testing Service, Univ. of Nebraska, May 1951]

Location	Profile depth (feet)	Range encountered			
		pH of paste	$CaCO_3$ (percent)	Exchangeable sodium percentage	Electric conductivity (millimhos per cm)
15-6-2bb.....	0-11	6.45-7.80	0.1-4.9	0.2-0.8	0.35-0.90
6bb.....	0-13.5	6.30-7.95	.1-1.3	.3-.8	.15- .48
7cc.....	0-30	6.95-7.60	.1-1.4	.2-.9	.16-.59
15-7-14ba.....	0-3.5	7.00 8.10	.1-.5	.4-.6	.25-.60
22aa.....	0-13	7.60-7.85	.2-6.4	.5-1.9	.38-.59
29aa.....	0-16.5	7.75-8.10	.5-6.4	.5-1.5	.39-.80
15-8-22ad.....	0-4.5	7.10-8.30	.6-3.5	2.1-9.5	.70-1.20
24aa.....	0-10	6.10-7.10	.1-.4	.6-.9	.15-.39
25aa.....	0-6	7.00-7.70	.2-.7	.9-1.3	.25-.55
28bb.....	0-5	6.60-7.40	.2-.3	.8-1.4	.20-.42
33cb.....	0-12	7.40-8.15	.7-4.0	.6-28.9	.45-6.60
34aa.....	0-10.5	7.30-8.20	.6-6.4	.9-4.7	.39-.95
16-5-9cb.....	0-6.4	6.70-7.60	.1-6.3	1.1-5.0	.25-4.00
11cb[1]....	0-1.5	5.50	.0	1.1	.12
16cc.....	0-5	7.30-7.70	.2-.6	.1-5.4	.42-.75
19bc.....	0-6.9	5.75-6.85	.2-.4	.0-.0	.15-.20
21cc.....	0-6	5.80-7.75	.1-3.4	.6-2.7	.34-1.19
23bb....	0-8	6.20-6.90	.1-.3	.0-1.4	.26-.44
16-6-26cc.....	0-3.5	6.05-7.40	.3-.3	.4-.7	.20-.20
36aa.....	0-3	7.90-8.10	1.9-3.1	.6-.6	.90-1.81

[1]Only one sample in profile.

The relatively high calcium carbonate percentages and the low exchangeable sodium percentages of the soils are reflected in the chemical content of the ground water, which also is characterized by carbonates of calcium and magnesium.

CHEMICAL CHARACTER OF WATER FROM DEEPER WELLS

The results of analyses of water samples collected by the Geological Survey in 1947-48 from municipal wells that tap deposits of Pleistocene age at depths greater than 25 ft were presented by Swenson (Waite and others, 1949); the results of other analyses of samples of municipal supplies are on file at the Nebraska State Health Department. (See table 6.) Partial results of these analyses are shown graphically in figure 11. Both the location and the time of sampling are too random to justify interpretation of the analyses; the information is presented here, however, to show that the chemical quality of ground water north of the Loup River is determined by different hydrologic and lithologic conditions than those of the rest of the unit. The preceding generalizations concerning relationships between concentrations and water movement south of the Loup River are not applicable north of the river, where the gradient of the water table is steep and the principal ground-water movement is toward the river. However, the lower permeability

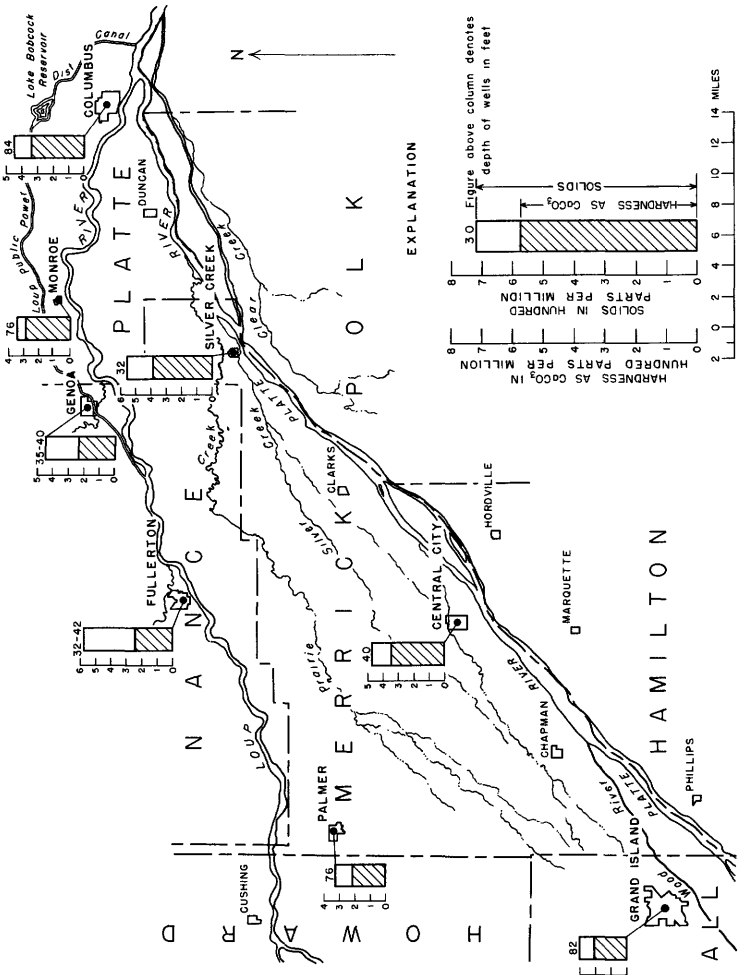

Figure 11. — Map of the Prairie Creek unit showing dissolved-solids concentration and hardness of water from municipal wells.

Table 6.—*Results of the chemical analyses*

[Results in parts per million except as indicated. Municipality: D, sample collected from State Health Department;

Well location	Municipality	Depth of well (s) (feet)	Date of collection	Agency making analysis	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)
U. S. Public Health Service drinking water standards					0.3		.....	125
13-6- 9ca	Central City S	40	4-14-47	USGS	0.04	.....	105	19
.....	.....do.....	39-41	1947-48	NSHD	.02	0.26	.....	.....
A17-1-20bc	Columbus S	84	4-14-47	USGS	.50	.....	106	18
.....	.....do.....	84-88	1947-48	NSHD	.03	.5	.....	.....
.....	Columbus D	84-88	1947-48	NSHD	2.9	.39	.....	.....
.....	Columbus S	84-88	1949-50	NSHD	.11	.3	.....	.....
.....	Columbus D	84-88	1949-50	NSHD	.01	.02	.....	.....
.....	Fullerton D	32-42	1947-48	NSHD	0	0	.....	.....
.....	Genoa S	35-40	1948-49	NSHD	.01	0	.....	.....
11-9-21cc	Grand Island S	82	4- 4-47	USGS	.24	.....	61	11
27bb	.....do.....	113	4- 4-47	USGS	.06	.....	71	22
.....	.....do.....	76-113	1947-48	NSHD	0	0	.....	.....
.....	Grand Island D	76-113	1947-48	NSHD	0	0	.....	.....
.....	.....do.....	76-113	1949-50	NSHD	0	0	.....	.....
.....	Monroe D	76	1947-48	NSHD	0	0	.....	.....
.....	Palmer S	76	1947-48	NSHD	1.2	.3	.....	.....
.....	Palmer D	76	1947-48	NSHD	.58	0	.....	.....
16-3-33db	Silver Creek S	32	4-14-47	USGS	.67	.....	123	20
.....	.....do.....	32-36	1947-48	NSHD	.48	.22	.....	.....
.....	Silver Creek D	32-36	1947-48	NSHD	.14	.27	.....	.....

of the water-bearing material in this part of the area results in a slower movement of the water. Consequently, the ground water is in contact with the materials for a longer time and the result is an increase in concentration.

CHEMICAL QUALITY OF GROUND WATER IN RELATION TO USE

DOMESTIC AND INDUSTRIAL USES

Hardness and concentrations of iron, fluoride, and silica are important to the homemaker and industrialist. Many municipalities adjust the chemical composition of their water by chemical or mechanical treatment, but rural residents cannot easily modify the quality of the available water. The U. S. Public Health Service (1946) has prescribed certain concentration limitations for water used by interstate carriers. These limitations and the analytical results (abridged) of municipal supplies in the area are shown in table 6.

of water from municipal supplies

distribution system; S, sample collected at source. Agency making analyses: NSHD, Nebraska USGS, U. S. Geological Survey]

Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Solids: Dissolved (residue on evaporation at 180°C)	Solids: Total	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Percent sodium	pH
.....	.....	.....	250	250	1.5	.....	.....	500	.....	.....	.....	.....	.....
20		256	127	17	0.4	20	0.14	471	.....	340	130	11	7.6
.....	.....	.....	137	18	.5	17	.....	.....	601	228	.....	.....	7.2
23		382	56	11	.2	.3	.08	449	.....	338	25	13	7.7
.....	.....	.....	54	39	.....	.....	.....	.....	470	244	.....	.....	7.5
.....	.....	.....	54	19	.3	.4	.....	.....	398	183	.....	.....	7.3
.....	.....	.....	96	48	.4	.....	.....	.....	400	361	.....	.....	7.4
.....	.....	.....	80	38	.4	.....	.....	.....	193	140	.....	.....	8.6
.....	.....	.....	43	29	.3	19	.....	.....	578	238	.....	.....	7.4
.....	.....	.....	53	11	.3	19	.....	.....	461	252	.....	.....	7.2
20		155	95	5.6	.2	8.0	.....	305	.....	197	70	18	7.6
3.9		239	65	6.0	.3	4.0	.....	339	.....	268	72	3	8.0
.....	.....	.....	52	21	.2	.....	.....	.....	274	151	.....	.....	7.2
.....	.....	.....	56	21	.....	.....	.....	.....	270	153	.....	.....	7.1
.....	.....	.....	69	9.3	.2	18	.....	.....	294	213	.....	.....	7.2
.....	.....	.....	26	7	.1	3.5	.....	.....	353	290	.....	.....	7.3
.....	.....	.....	0	7	.5	0	.....	.....	329	216	.....	.....	7.6
.....	.....	.....	4	8	.5	0	.....	.....	315	210	.....	.....	7.9
31		306	161	24	.5	4.0	.09	541	.....	389	138	15	7.9
.....	.....	.....	52	8	.4	0	.....	.....	197	144	.....	.....	7.4
.....	.....	.....	201	22	.6	1.8	.....	.....	540	223	.....	.....	7.4

Hardness is caused almost entirely by calcium and magnesium. Hard water is objectionable in the home because of its soap-consuming capacity. It is recognized not only by the quantity of soap required to produce a lather but also by the formation of an insoluble curd, which is objectionable in all washing processes. Hardness caused by the calcium and magnesium equivalent to the bicarbonate in the water is called carbonate hardness and the remainder, noncarbonate hardness. These terms are approximately equivalent to the expressions "temporary hardness" and "permanent hardness," which are based on the fact that when hard water is boiled, the bicarbonate is decomposed and most of the calcium equivalent to the bicarbonate is precipitated as calcium carbonate. Use of hard water is objectionable because the formation of scale in boilers, water heaters, radiators, and pipes causes loss in heat transfer, boiler failure, and reduction of flow. However, water containing a small amount of calcium bicarbonate is less corrosive than water free of it, and the calcium carbonate may produce a protective coating on pipes and other equipment. The noncarbonate hardness of the water in most of the shallow wells and public supplies of the Prairie Creek unit is relatively low.

A high iron content in water in the home is objectionable, because it stains fabrics and porcelain or enameled fixtures. Laundries, ice manufacturers, breweries, and other industrial users require water practically free of iron. Ground water from shallow wells in the Prairie Creek unit may contain objectionable amounts of iron. Public supplies from deeper wells as a general rule contain minor concentrations of iron.

The addition of small amounts of fluoride in drinking water to reduce tooth decay is being practiced by many municipalities. The concentrations of fluoride in municipal supplies and in water from shallow wells of the Prairie Creek unit are well below the amount that causes mottling of tooth enamel, a feature that results from the drinking of high-fluoride water (Dean, 1936).

The silica content of water is of industrial significance if the water is used in high-pressure boilers and steam turbines because silica contributes to the formation of hard boiler scale and also is deposited on steam-turbine blades. In this area silica may represent more than 20 percent of the mineral solids in ground water from shallow wells.

Quality-of-water requirements for industry are as varied as the types of industry. Interested water users are referred to a publication by Paulsen and Hastings (1950).

IRRIGATION

Wilcox (1948) developed a diagram for use in interpreting analyses of irrigation water in terms of percent sodium and specific conductance. Percent sodium is calculated by dividing the equivalents per million of sodium by the total equivalents per million of the cations (calcium, magnesium, sodium, and potassium) and multiplying the quotient by 100. Specific conductance is an electrical measurement that is generally indicative of the total concentration of salts in solution. The water samples collected by the U. S. Geological Survey in 1947 and 1951 were rated for irrigation by the method described by Wilcox (see fig. 12); the ratings indicate that the water is suitable for irrigation.

Magistad and Christiansen (1944) report that water containing less than 0.33 ppm of boron is excellent to good for irrigation and is generally suitable for most crops under most farming conditions. The maximum boron concentration was 0.11 ppm in samples collected from the observation wells and 0.14 ppm in the sample of the Central City public supply.

Other factors, such as soil composition, permeability, drainage, and irrigation practices, also must be considered in rating water for irrigation (Wilcox, 1948).

EFFECT OF IRRIGATION ON CHEMICAL QUALITY OF GROUND WATER

The effect of irrigation on the chemical quality of ground water is, of course, dependent on the particular practices followed. The proposed (1951) plan of the U. S. Bureau of Reclamation for the development of the Prairie Creek unit includes the importation of

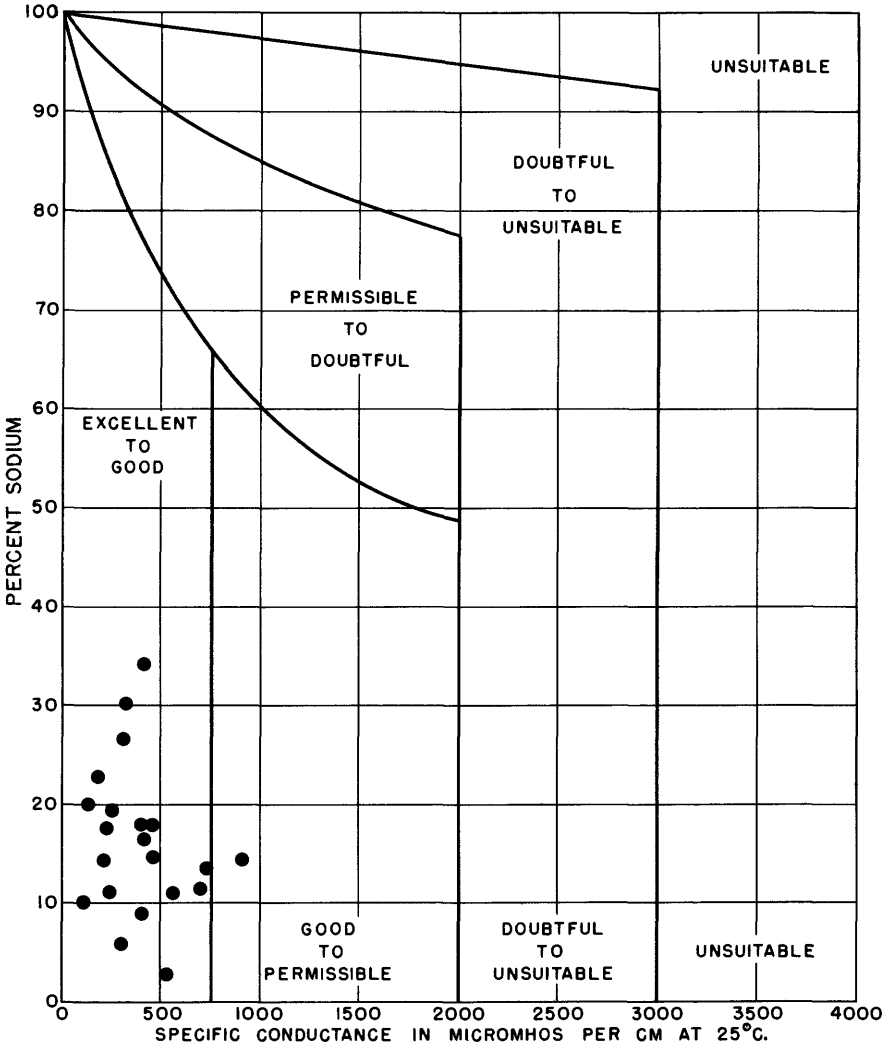

Figure 12. —Classification of water for irrigation use (after Wilcox).

Loup River water for use in irrigation. Although surface waters of the Loup River basin are suitable for irrigation (Connor, 1951) and the ground water of the Prairie Creek unit also is of good quality, some increase in mineralization of the ground water will probably accompany irrigation as a result of evapotranspiration and recirculation. However, because the ground water has a relatively low dissolved-solids content and the soil contains little sodium, limited reuse of the water will not materially lessen its suitability for irrigation if drainage is adequate.

In areas where the water table or the capillary zone above it is within a few feet of the land surface, evapotranspiration causes salts to become concentrated in the ground water and eventually to be precipitated in and on the soil. (The capillary zone ranges in thickness from a small fraction of a foot in coarse sand and gravel to 8 ft or more in fine-grained soil.) A few marshes and surface salt deposits are already present in the Prairie Creek unit, and more are likely to develop if the water table in other parts of the area should rise and remain close to the land surface. In the future, therefore, increases in the mineral content of shallow ground water should be regarded as a precursor of an excessive concentration of salts in the soil. In well 14-7-8dd, which is in a marshy area near Archer, the depth to water was only 1.43 ft. The mineral content of the water in this well was 385 ppm, which was significantly higher than that of water in nearby wells where the depth to water was greater.

The ground water in the Prairie Creek unit probably will also be affected to some extent by changes in the chemical quality of the water coming into the area by underflow.

CONCLUSIONS

Ground water is used extensively for irrigation in the part of the Prairie Creek unit that lies south of Prairie Creek. Less ground water is available for irrigation north of Prairie Creek because the underlying aquifer is thinner and less permeable than it is south of the creek.

The perennial yield of the ground-water reservoir in the report area is not known. The net change in ground-water levels south of Prairie Creek during the period 1946-50 is insignificant and does not indicate that the withdrawal of ground water has depleted the local supply. Although, strictly speaking, the maximum possible withdrawal of ground water from an aquifer is limited by hydrologic factors alone, the maximum actual withdrawal may be limited by legal factors, which are beyond the scope of this report.

A sucession of dry years with consequent increased pumping for irrigation probably would cause a significant lowering of the water table throughout the Prairie Creek unit. The rate of decline, however, probably would diminish with continued lowering of the water table because natural discharge by evaporation, transpiration by phreatophytes, and seepage into streams and springs would be reduced. Pumping during the period 1946-50 did not result in a net decline of the water table because, apparently, much of the pumpage represented salvage of natural discharge. The development of a balanced irrigation system in the Prairie Creek unit, as proposed by the U. S. Bureau of Reclamation, would result in the artificial recharge of the ground-water reservoir. This recharge would increase the perennial yield of the aquifer south of Prairie Creek, but it is doubtful that artificial recharge would be beneficial north of Prairie Creek because the aquifer in that part of the area apparently is too thin and is insufficiently permeable to yield more than small quantities of water to wells.

Ground water in the Prairie Creek unit is predominantly of the calcium bicarbonate type, and it is relatively uniform in dissolved solids and percentage composition. The calcium bicarbonate content of the water increases as the water moves from the ground-water divide toward the Platte and Loup Rivers and in the general direction of underflow to the east. Hydrologic and lithologic conditions are different north of the Loup River, and the differences are reflected in the quality of the water.

The water is of excellent quality for irrigation. Although the water has a large percentage of calcium bicarbonate, the hardness is not excessive for domestic use. The high iron content observed in the water from shallow wells might prove undesirable for domestic purposes, but the water supplied by most of the municipalities in the area does not contain an excessive amount of iron.

The major chemical-quality problem resulting from irrigation in the area will be the concentration of salts in the upper layers of the soil. It is suggested that future investigations include determination of areas where the capillary fringe above the water table reaches the land surface or may reach it if the water table rises as a result of increased irrigation, the extent of salt deposition in the soil in such areas, and the relation between depth to water and quantity of mineral substances in the water.

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Table 7. — *Logs of test holes*

12-9-1aa. Hall County. (323 ft south and 7 ft west of NE cor. sec. 1, on west shoulder of road.) Surface altitude, 1,814.5 ft. Depth to water, 7.2 ft, July 30, 1951.

	Thickness (feet)	Depth (feet)
Road fill	2.5	2.5
Soil, clay, silty, slightly sandy, dark-brown	1	3.5
Sand, fine to coarse; consists of quartz and feldspar	16.5	20
Sand, medium, to medium gravel; consists of quartz and green silicates	17.5	37.5
Silt, slightly to moderately clayey, light-gray to light greenish-gray; contains very fine sand below 40 ft	5	42.5
Sand, fine to very coarse, green; consists of quartz and light and dark silicates; contains some fine gravel	9.3	51.8
Silt, sandy, and fine sand, light-grayish-green	.2	52
Sandstone, fine- to medium-grained, cemented with lime; consists of light-green silicates; contains silt below 59 ft	25	77
Sand, fine, slightly clayey to very silty, light-green; contains nodular sandy lime layers	1.5	78.5
Sand, fine to coarse, consists of quartz and green silicates; contains limy zones and reworked clay	7	85.5
Silt, clayey, granular, light-greenish-gray to medium-gray	1	86.5
Clay, grayish-yellow to mottled-gray or medium-gray	2	88.5
Shale, clayey, medium-gray	2	90.5
Clay, moderately to very calcareous, light-gray to yellowish-brown; contains some limonite concretions	3.5	94
Clay shale, moderately to very calcareous, medium-gray and yellow-brown	2.5	96.5
Clay shale, moderately to very calcareous, medium-gray; contains a hard layer at 111.5 ft	33.5	130
Clay shale, silty, very calcareous, light-grayish-brown	1.5	131.5
Clay shale, moderately to very calcareous, medium-gray	4.5	136
Clay shale, light- to medium-dark-gray, calcareous, contains a bentonite layer from 136 to 136.2 ft; iron stained below 144 ft	9	145
Bentonite, light-yellowish-brown to orange or light-gray	.5	145.5
Clay shale, slightly silty, very calcareous, medium-gray; contains a light-gray bentonite seam at 165.5 ft	20.5	166
Clay shale, slightly silty, partially noncalcareous in lower part, medium-gray	4	170
Shale, chalky, light-gray, very light-gray below 178 ft	10	180

13-5-1da. Hamilton County. (67 ft south and 9 ft west of NE cor. SE ¼ sec. 1, on west shoulder of road.) Surface altitude, 1,785 ft. Depth to water, 115.52 ft, Aug. 23, 1946.

Loam, silty, dark-brown	1	1
Silt, clayey, soft, medium-brownish-gray	2	3
Silt, clayey, soft, light-brownish-buff; contains shells of tiny pelecypods and fragments of other shells	27.5	30.5
Silt, clayey, medium-dark-brown	4.5	35
Silt, clayey, soft, light-pinkish-brown	5	40
Clay, silty, soft, light-pinkish-brown; contains fine sand	4	44
Silt, sandy, soft, light-pinkish-brown	4	48
Sand, fine to medium, light-brown to gray; contains some silty streaks	7	55
Silt, soft, light-pinkish-brown	5	60
Silt, sandy, soft, light-brownish-tan	4.5	64.5
Sand, fine to medium, light-brownish-gray	5.5	70
Sand, silty, very fine, light-brownish-tan	10	80
Sand, fine to medium, light-brownish-gray; contains some silty sand zones	5	85
Sand, silty, fine to coarse, interbedded, light-pinkish-tan	8	93
Clay, silty, soft to firm, light-brownish-tan	7	100
Silt, soft, brownish-tan to pink	6.5	106.5
Sand, fine to coarse, brownish-gray to pink	3.5	110
Sand and gravel, pinkish-gray to brown	9	119
Clay, silty, soft, light-brownish-tan and light-gray	11.5	130.5
Sand, fine to coarse, light-gray to pink	6	136.5
Clay, silty, firm to soft, light-brownish-gray	6.5	143
Sand, medium to coarse, pink to gray; contains fine gravel	2	145
Sand, medium to coarse, pink to gray; contains fine to medium gravel	5	150
Sand, medium to fine gravel, pinkish-brown to green	13	163

Table 7.—*Logs of test holes*—Continued

13-5-1da—Continued

	Thickness (feet)	Depth (feet)
Clay, silty, soft, light-brownish-tan	5	168
Sand, fine to medium, light-gray to brown	5	173
Clay, silty, light-grayish-tan; contains some calcareous nodular material	10	183
Sand, fine to coarse, light-brownish-gray; contains some interbedded light-gray to green silt	7	190
Clay, silty, firm, noncalcareous, light-bluish-gray; contains some fine to medium sand	12	202
Silt, soft to firm, light-brownish-gray	10	212
Sand, fine to medium, light-brownish-gray; contains a few thin zones of greenish-gray silt	12.5	224.5
Clay, silty, soft, light-gray to white	5.5	230
Clay, silty, firm to soft, medium-gray to bluish-gray	10	240
Clay, silty, firm, medium-blue to gray; contains many dark shale fragments at 230 to 240 ft	20	260
Clay, silty, medium- to dark-gray; contains many shale fragments	5	265
Clay, silty, medium-gray to medium-brown	5	270
Clay, silty, soft, light-bluish-gray; contains white calcareous nodules and shale fragments	10	280
Clay, silty, firm, medium-gray to brown; contains shale fragments and olive-brown siltstone	16	296
Clay, silty, calcareous, firm, light-brownish-gray and light-gray	14	310
Clay, silty, slightly calcareous, firm, light-brown; contains clay shale fragments and many calcareous nodules at 325 to 340 ft	55	365
Clay, silty to sandy, light-brownish-tan; contains many chalk fragments	6	371
Shale, chalky, hard, dark brownish-black, flecked with white	3.5	374.5
Chalk, hard, light-grayish-white; white and somewhat softer from 383 to 387 ft	12.5	387
Shale, silty to sandy, hard, dark-gray	3.5	390.5
Clay shale, hard, black; contains fine sandy shale layers from 390.5 to 391.5 ft	9.5	400

13-9-1aa. Howard County. (377 ft south and 8 ft west of NE cor. sec. 1, on west shoulder of road.) Surface altitude, 1,841.1 ft. Depth to water, 23.17 ft, July 24, 1951.

Soil, sand, fine to medium, silty, medium-brown	1	1
Sand, fine to medium, moderately silty, light-brown	4	5
Sand, silty, light-medium-brown; dark soil-like material in upper 2 ft	4	9
Sand, very fine to medium, slightly silty, light-brown	1.3	10.3
Silt, slightly clayey to sandy, light-brown	.7	11
Sand, very fine to medium, slightly silty; consists principally of quartz; contains some light feldspar	1.7	12.7
Silt, light-brown; contains much very fine to fine sand	.6	13.3
Sand, very fine to coarse, slightly silty light-grayish-brown; consists of quartz and some pink feldspar; contains some silt lenses	6.7	20
Clay, silty, blocky, very light-gray; contains limonite nodules	.5	20.5
Sand, very fine to medium, slightly silty; consists principally of quartz	3.2	23.7
Clay, silty to clayey silt, light-gray; contains many limonitic nodules and rootlets	1.3	25
Sand, very fine to medium, white; consists of quartz	5	30
Silt and clayey silt, light-brownish-gray; contains very fine to fine sand, iron stain, and nodules	3	33
Sand, very fine to medium; consists principally of quartz and has dark and pink speckling	17	50
Sand, fine to coarse; consists of quartz with some pink feldspar	20	70
Sand, medium, to medium gravel; consists principally of quartz, pink feldspar, and green silicates	20.5	90.5
Silt, slightly clayey, to silty clay, light-gray; contains shells of some small pelecypods	9	99.5
Silt, slightly clayey to sandy, light-brownish-gray	1.5	101
Sand, fine to medium; consists of quartz and dark-green silicates; contains some coarse sand to fine gravel	9	110
Sand, fine to coarse, very slightly silty, contains many green silicates; contains a few layers of peat, silty clay and silt and some fine gravel	50	160

Table 7.—*Logs of test holes*— Continued

13-9-1aa—Continued

	Thickness (feet)	Depth (feet)
Sand, very fine to medium, and silt, moderately clayey, interbedded, medium-gray; consists of quartz and pink silicates	5	165
Sand, fine to very coarse; consists of quartz with light and dark silicates; contains some fine gravel	5	170
Sand, very fine to coarse; consists principally of quartz with light and dark silicates; contains occasional thin silt lenses	52	222
Silt, medium-brown	1	223
Sand, very fine to medium, and a little coarse sand; consists principally of quartz and light and dark silicates	25	248
Silt, medium-gray; contains very fine sand and snail shells	1.5	249.5
Sand, very fine to medium, and a little coarse sand; consists of quartz and light silicates; contains reworked chalk, clay fragments, and some pelecypod shells below 264 ft	24.5	274
Silt, light- to medium-gray; contains very fine sand in part	9.5	283.5
Sand and gravel, reworked; contains Niobrara chalk fragments	2	285.5
Chalk, weathered, white to yellowish-white	.2	285.7
Shale, chalky, light-gray, medium-gray below 287 ft	14.3	300

13-9-24aa. Howard County. (75 ft south and 10 ft west of NE cor. sec. 24, on west shoulder of road.) Surface altitude 1,805.1 ft. Depth to water, 3.00 ft, July 24, 1951.

Road fill	0.5	0.5
Soil, silt, clayey, dark-gray	.5	1
Silt, slightly clayey, sandy, light-grayish-brown	2.5	3.5
Silt, clayey, to silty clay, slightly calcareous, light-brown	1	4.5
Soil, silt, clayey, moderately calcareous, medium-brownish-gray	1	5.5
Silt, slightly clayey, moderately to slightly calcareous, light-brownish-gray; contains limy and iron nodules	3.5	9
Sand, very fine to medium, slightly silty; consists of quartz	1	10
Sand and gravel; consists of pink feldspar and quartz, with some green silicates; contains iron stain at 11 ft	20	30
Sand and gravel; consists of quartz, much feldspar, and green silicates	5.5	35.5
Clay, slightly silty, medium-light-gray	1	36.5
Clay, silty, light-brownish-gray to pale-brown	7.5	44
Silt, slightly clayey to sandy, light-brownish-gray; contains very fine sand and limy zones	2	46
Silt, slightly clayey in part, light-grayish-brown	6	52
Silt, slightly to moderately clayey, pale-brown	3	55
Silt and siltstone, light-brown; blocky to granular; contains a volcanic ash layer between 60 and 63.5 ft	9	64
Silt, sandy, light-grayish-brown	2	66
Silt, slightly to moderately clayey, light-grayish-brown to light-brown	4	70
Silt, slightly clayey, sandy, light-brown	8.5	78.5
Silt to slightly clayey silt, calcareous, light-brown; contains some limy nodules	9	87.5
Silt, clayey, moderately to very calcareous, light-brown to white	.5	88
Silt, slightly clayey to sandy, moderately to very calcareous, light-brown	10	98
Silt, slightly to moderately clayey, moderately calcareous, light-brown	12	110
Siltstone, granular, blocky, very calcareous above 120 ft, light-brown	25	135
Silt, moderately calcareous, slightly consolidated, light-brown	10	145
Silt, slightly clayey, moderately calcareous, light-brown	12.5	157.5
Silt, moderately clayey, slightly calcareous, light-brown	2.5	160
Silt, clayey, very calcareous, light-yellowish-brown; contains a few chalk fragments	.5	160.5
Shale, chalky, yellowish-white to white, light-gray below 167.5 ft	14.5	175

15-9-24aa. Howard County. (18 ft south and 83 ft west of NE cor. sec. 24, south side of road.) Surface altitude, 1,737.6 ft. Depth to water, 4.98 ft, July 20, 1951.

Soil, sand, silty, very fine to medium, dark-brown to black	0.5	0.5
Sand, very fine to medium, silty to slightly silty, light-brown to light-grayish-brown	4.5	5

Table 7.—*Logs of test holes*—Continued

15-9-24aa—Continued

	Thickness (feet)	Depth (feet)
Sand, very fine to very coarse, light-brown; consists mostly of quartz and some pink feldspar	25	30
Gravel, fine to medium and some fine to coarse sand	3.5	33.5
Silt to sandy silt, slightly clayey, grading from slightly to very calcareous with depth, very light to light-brown; contains siltstone layer from 36.5 to 37 ft	13	46.5
Sand, slightly silty, slightly calcareous, light-brown; moderately clayey to sandy silt from 49 to 49.3 ft	4	50.5
Silt to sandy silt, slightly calcareous above 55 ft, light-brown	7	57.5
Silt, moderately clayey, light-brown; contains very fine to medium sand	16	73.5
Silt, clayey to slightly sandy, light-grayish-brown	2	75.5
Sandstone, very fine grained to very coarse grained; poorly consolidated	9.5	85
Sand, very fine to medium, slightly consolidated, light-green to light-brownish-gray; contains reworked clay granules	13	98
Silt, slightly clayey to very sandy, light-greenish-gray	3.5	101.5
Sand, very fine to medium; consists of quartz, some green silicates and pink feldspar	17.5	119
Silt, very slightly clayey to very sandy, light-greenish-gray	1.5	120.5
Silt, slightly clayey to sandy, slightly calcareous, light-greenish-gray	1	121.5
Limestone, light-gray	1	122.5
Silt, moderately clayey, moderately calcareous, granular, light-greenish-gray	1.5	124
Marl, white	1	125
Silt, clayey, very calcareous, light-grayish-brown	.5	125.5
Clay to silty clay, pale-brown to light-grayish-brown; in part calcareous and iron stained	12.5	138
Clay, calcareous in part above 140 ft, mottled-gray and mostly yellow-brown; iron stained in part; bentonite layers from 153.5 to 155 ft	22.5	160.5
Shale, clayey, dark-gray-black	11	171.5
Shale, clayey to chalky, medium-gray chalk formation	2.5	174
Shale, chalky, medium-gray to greenish-gray to light-gray	6	180

13-6-6bb. Merrick County. (6 ft south and 66 ft east of NW cor. sec. 6, on south shoulder of road.) Surface altitude, 1,708.1 ft. Depth to water, 2.64 ft, July 11, 1951.

Soil, sandy, dark-brown to black	1.5	1.5
Silt, sandy, light-brown	3	4.5
Sand, very fine to medium, poorly sorted; contains iron stain	1.9	6.4
Silt, clayey, dark-brown to dark-gray	1.1	7.5
Sand, medium to coarse, and fine gravel; composed of quartz and pink and green feldspar	22.5	30
Sand, fine, to medium gravel	15.5	45.5
Silt, clayey to sandy, yellowish-brown	3.5	49
Sand, medium, to fine gravel	7	56
Silt, clayey, light-brownish-gray	1.5	57.5
Silt, granular, gray	.5	58
Clay, silty, gray	13.5	71.5
Silt, sandy, grayish-brown; may contain some peat	1.5	73
Sand, very fine to very coarse, green and gray	12.5	85.5
Silt, clayey, calcareous, gray to light-brown; contains limy nodules	31.5	117
Silt, clayey, brown; contains some very fine sand	3.5	120.5
Silt, clayey, calcareous, light-brown	1	121.5
Siltstone, calcareous, granular, light-brown; contains zones of calcium carbonate	14	135.5
Silt, clayey, slightly calcareous, light-brown	4.5	140
Silt, clayey, calcareous, light-brown; contains limy nodules	5	145
Silt, clayey, very calcareous, light-brown	7	152
Silt, clayey, calcareous, light-brown; contains limy nodules	33	185
Silt, clayey, very calcareous, light-brown; contains a few chalk fragments	3	188
Clay, chalky, pale-yellow	3.5	191.5
Clay, silty, very calcareous, light-gray	13	204.5
Clay, silty, very calcareous, gray	15.5	220

Table 7.—*Logs of test holes*— Continued

13-7-24aa. Merrick County. (10 ft south and 170 ft west of NE cor. sec. 24, on south edge of road.) Surface altitude, 1,720.2 ft. Depth to water, 7.0 ft, July 11, 1951.

	Thickness (feet)	Depth (feet)
Road fill	1.5	1.5
Soil, silty, dark brownish-gray to black	.5	2
Silt, clayey, slightly calcareous, light-grayish-brown	1.5	3.5
Soil, silty, moderately calcareous, black	1	4.5
Silt, sandy, moderately calcareous, grayish-brown; contains rootlets	2.5	7
Sand, fine to very coarse; composed of quartz and pink feldspar	3	10
Sand, medium, to medium gravel; composed of quartz and pink feldspar	25.4	35.4
Silt, clayey, light-gray to pale-brown; contains fine sand	8.6	44
Sand, fine to very coarse, and fine gravel; composed of quartz with light-colored feldspar	22	66
Silt, light greenish-gray; contains volcanic ash below 68.5 ft	4	70
Silt, clayey, dark-brown; contains peat	1.5	71.5
Clay, silty, light-brownish-gray; contains rootlets	10.5	82
Clay, silty, moderately calcareous, light-greenish-gray	5.5	87.5
Silt, clayey, slightly calcareous, light-grayish-green	7	94.5
Sand, fine to coarse, and with fine gravel; composed of light- and dark-colored silicates and quartz	20	114.5
Sand, medium, to medium gravel	15.5	130
Sand, fine to very coarse, and fine gravel	32	162
Silt, clayey, moderately calcareous, light-gray; contains fragments of snail shells below 165 ft	12.5	174.5
Silt, clayey, moderately calcareous, light-brownish-gray; contains wood fragments below 180 ft	12.5	187
Silt, sandy, dark-gray	1.5	188.5
Silt, sandy, moderately calcareous, light-gray	9.5	198
Silt, sandy, dark-gray to black	2	200
Silt, sandy, slightly calcareous, dark-gray to light-greenish-gray; contains limy zones	11	211
Silt, clayey, slightly calcareous, greenish-gray	4	215
Silt, clayey, moderately calcareous, greenish-gray	7.5	222.5
Sand, fine to coarse, and fine gravel; contains dark silicates, quartz, chalk and aragonite fragments	15.5	238
Silt, clayey, slightly calcareous, light-gray	2.5	240.5
Silt, clayey, slightly calcareous, light-brown to light-gray; contains very fine sand and limy nodules	19.5	260
Silt, sandy, slightly calcareous, light-gray to light-greenish-gray	7	267
Sand, medium, to fine gravel; contains light- and dark-colored silicates and rounded limy fragments	2.5	269.5
Silt, sandy, slightly calcareous, light-greenish-gray	2	271.5
Sand, fine to coarse; contains a few pelecypod fragments	28.5	300
Silt, sandy, very calcareous, light-greenish-gray	4.5	304.5
Sand, fine to very coarse; contains much silt	4.5	309
Shale, chalky, grayish-brown; contains much speckling	18	327
Shale, chalky, white	3	330

13-7-36ad. Merrick County. (2,480 ft south and 34 ft west of NE cor. sec. 36, on south edge of road.) Surface altitude, 1,728.6 ft. Depth to water, 5.86 ft, July 6, 1951.

Soil, sandy, dark-brownish-gray	2.5	2.5
Soil, silty, slightly calcareous	1.5	4
Sand, silty, moderately calcareous, light-brownish-gray	.8	4.8
Sand, medium, to medium gravel; composed of quartz and feldspar	39.5	44.3
Silt, clayey, yellowish-gray	.6	44.9
Sand, medium, to medium gravel	7.4	52.3
Silt, clayey, light-yellowish-gray	1.7	54
Clay, silty, light-gray with green cast	5.5	59.5
Silt, clayey, pale-brown	.5	60
Silt, clayey, brown to white	4	64
Silt, clayey, moderately calcareous, granular below 70 ft	16.5	80.5
Silt, clayey, moderately calcareous, brown	3.5	84
Sandstone, very fine to fine, brown; contains rootlets	5	89
Sand, fine to coarse, light-green and pink	5.3	94.3
Silt, clayey, slightly calcareous, light-gray to brown	12.7	107
Silt, clayey, dark-gray	5	112

Table 7.—*Logs of test holes*—Continued

13-7-36ad—Continued

	Thickness (feet)	Depth (feet)
Silt, clayey, slightly calcareous, dark-gray; contains shell fragments	3	115
Silt, clayey, slightly calcareous, greenish-gray	5	120
Silt, moderately calcareous, light-brown; contains limy fragments	30	150
Silt, clayey, dark-brown	5	155
Silt, clayey, light-brown	1	156
Silt, clayey, yellowish-brown	9	165
Silt, clayey, moderately calcareous, light-brown	10.5	175.5
Clay, silty, moderately calcareous, brown	1.5	177
Clay, silty, very calcareous, whitish-gray; contains chalk fragments	3.5	180.5
Silt, clayey, very calcareous, pale-yellow	2.5	183
Clay, silty, very calcareous, yellowish-gray	7	190
Clay, very calcareous, yellowish-gray; contains bentonite traces from 200 to 205 ft	26	216
Shale, clayey, very calcareous, dark-gray to yellowish-brown	14	230

14-6-18cc. Merrick County. (8 ft north and 92 ft east of SE cor. sec. 18, on north shoulder of road.) Surface altitude, 1,713.4 ft. Depth to water, 9.92 ft, July 11, 1951.

Soil, slightly sandy, dark-brown	1.5	1.5
Silt, clayey, light-brown; contains some sand	.5	2
Sand, very fine to very coarse; composed of quartz and pink feldspar	.5	2.5
Sand, fine to very coarse; composed of quartz and pink feldspar	2.5	5
Sand, fine, to medium gravel; composed of quartz and feldspar with some ironstone	10	15
Sand, fine, to coarse gravel	33	48
Chalk, silty, pale-yellow to white	3	51
Chalk, pale-yellow to white	19	70

14-7-1aa. Merrick County. (9 ft south and 72 ft west of NE cor. sec. 1, on south shoulder of road.) Surface altitude, 1,707.0 ft. Depth to water, 6.61 ft, July 11, 1951.

Road fill	1.5	1.5
Soil, sandy, dark-brown	.5	2
Sand, silty, dark-brown	1	3
Sand, very fine to medium, brown	1	4
Sand, very fine to coarse, and fine to medium gravel; composed of quartz and pink feldspar	34	38
Silt, light-greenish-brown	1	39
Clay, silty, greenish-gray	2	41
Clay, silty, light-grayish-brown; contains limy nodules below 44 ft	4.5	45.5
Clay, silty, light-brown	4	49.5
Limestone, nodular, light-brown; contains some silt	1	50.5
Silt, clayey, light-brown; contains limy nodules	19.5	70
Silt, clayey, slightly calcareous, light-brown; contains limy nodules	10	80
Silt, clayey, slightly calcareous, light-brown; contains limy nodules and limy streaks	8	88
Silt, slightly calcareous, light-grayish-brown	7	95
Silt, light-grayish-brown; contains very fine sand	8	103
Silt, sandy, light-grayish-brown; contains limy fragments	4	107
Silt, clayey, very calcareous; contains limy fragments	2.5	109.5
Sand and gravel, brownish-yellow; contains limy fragments	7.5	117
Silt, sandy, very calcareous, gray to brown; contains limy fragments	2	119
Sand, silty; contains white chalk	1	120
Chalk, yellow to white	1	121
Chalk, yellow and white	5	126
Shale, chalky, yellowish-brown to gray	4	130
Shale, chalky, brown to gray	1.5	131.5
Shale, chalky, gray, speckled	8.5	140

14-8-6bb. Merrick County. (90 ft south and 6 ft east of the NW cor. sec. 6, on the east shoulder of the road.) Surface altitude, 1,809.9 ft. Depth to water, 12.36 ft, July 20, 1951.

Road fill	1	1
Soil, silt, medium- to light-brown; contains very fine to medium sand	1.5	2.5

Table 7.—*Logs of test holes*—Continued

14-8-6bb—Continued

	Thickness (feet)	Depth (feet)
Clay, silty, to clayey silt, light-grayish-brown	1	3.5
Clay, silty, light-grayish-brown	1	4.5
Clay and silt, granular, light-brown	2	6.5
Soil, clay and silt, humic, medium-grayish-brown	1	7.5
Clay, silty, light- to medium-brown to light-gray	1.5	9
Clay and silt, light-yellow-gray; grayish-yellow limonite stain below 12 ft	4.5	13.5
Silt, moderately clayey; less limonite stain, some limonite rootlets below 16.5 ft	4	17.5
Silt, slightly clayey, yellow-grayish-brown to yellow-gray; many limonite rootlets	7	24.5
Silt to sandy silt, light-bluish-gray to medium-brownish-gray; slightly peaty below 30 ft	12.5	37
Silt, light-gray; contains very fine sand	4.5	41.5
Sand, fine to coarse, very slightly silty, composed of quartz and light and dark silicates; contains scattered grains of very coarse sand	7	48.5
Clay, silty, to clayey silt, moderately calcareous, blocky, light-gray	1.5	50
Sand, very fine to medium; composed of quartz with light and dark silicates; contains very little coarse sand	5	55
Silt, slightly clayey, moderately calcareous, granular, light-brownish-gray	2	57
Sand, fine to medium gravel; composed of quartz and pink feldspar	13	70
Sand, medium to coarse gravel; composed of quartz with green silicates and some feldspar	2	72
Silt, clayey, light-brownish to light-bluish-gray; contains very fine to fine sand	4.5	76.5
Silt, very sandy, to silty sand, light-greenish-gray to light-gray; contains limy layer at 87.5 ft	15	91.5
Silt, very sandy, slightly clayey, moderately calcareous below 95 ft, very light greenish gray to white	6.5	98
Sandstone, very fine to medium-grained, poorly cemented, moderately calcareous; consists of quartz and some green silicates; contains limy nodules and rootlets	4.5	102.5
Silt, moderately to very calcareous, light-greenish-gray; contains very fine to fine sand	9.5	112
Sandstone, poorly cemented, slightly silty, very calcareous, very light greenish gray; contains limy zones	3	115
Sand, silty, to sandy silt, moderately calcareous, some partly consolidated, very light greenish gray	2	117
Sandstone, very fine to medium-grained, poorly consolidated, silty, moderately calcareous, light-greenish-gray	3	120
Silt, moderately calcareous, light-gray; contains very fine to medium sand and some hard zones	5	125
Sand, very fine to medium, silty, very calcareous, light-gray-white; contains some hard zones	10	135
Silt, slightly clayey, light-gray to light-greenish-gray; contains fine to medium sand and limy nodules	6.5	141.5
Silt, slightly clayey to very sandy, very calcareous, very light gray to white	3.5	145
Marl, white	.3	145.3
Silt, very sandy	.2	145.5
Sandstone, very fine to fine-grained and a little medium-grained sandstone, consists principally of quartz	4.5	150
Silt, light-greenish-gray; contains very fine to fine sand with pebbles of green clay	5	155
Sandstone, very fine to fine-grained, very silty; consists principally of quartz; contains limy zones	2.5	157.5
Marl, white	.5	158
Sandstone, very fine to fine-grained, silty, light-greenish-gray	1	159
Silt, sandy, calcareous in part, very light greenish gray	.5	159.5
Sand, very fine to medium sand, light-gray, consists principally of quartz with a little pink feldspar	24	183.5
Sand, very fine to coarse, slightly silty; consists of quartz and green silicates; contains some limy or chalk fragments	3.8	187.3
Silt, slightly calcareous, light-gray; contains very fine sand	1.7	189
Sandstone, very fine to fine-grained, moderately silty; light-gray; consists principally of quartz	.5	189.5

Table 7.—*Logs of test holes*— Continued

14-8-6bb—Continued

	Thickness (feet)	Depth (feet)
Silt, clayey to very sandy, moderately calcareous below 191 ft, light-gray to light-yellow-gray	6	195.5
Silt, slightly clayey to sandy, moderately calcareous, light-brownish-gray	3.5	199
Sand, very fine to very coarse, slightly silty; consists of quartz, some green silicates and feldspar	4.5	203.5
Clay, light-grayish-yellow with gray mottling; contains some yellow staining	4.5	208
Clay shale, dark-brown to black shale	2.5	210.5
Clay, dark-yellowish-brown and black calcareous clay shale; contains a light-bluish-gray layer of bentonite	1	211.5
Clay shale, dark-brown-black	4	215.5
Clay shale, moderately calcareous, medium- to dark-gray	2.5	218
Shale, chalky, medium-brownish-gray chalk formation	4	222
Shale, chalky, light-gray	8	230

14-8-19bb. Merrick County. (106 ft south and 7 ft east of the NW cor. sec. 19, on the east shoulder of the road.) Surface altitude, 1,828.9 ft. Depth to water, 12.77 ft, July 20, 1951.

Road fill and soil: silt, clayey and sandy, dark-brownish-gray	1	1
Silt, slightly clayey to very sandy, light-grayish-brown to light-yellowish-brown	2	3
Sand, very fine to very coarse, consists of quartz with some light and pink feldspar	25.5	28.5
Clay, silty, to clayey silt, slightly sandy in part, slightly to moderately calcareous, light-brownish-gray; contains many limonitic nodules and rootlets; blocky structure below 30 ft	5.5	34
Sand, very fine to medium, and a little coarse sand, consists of quartz	3.5	37.5
Silt, slightly clayey, in part sandy, slightly calcareous, dark-gray; contains many wood fragments below 45 ft and a light-bluish-gray layer of clay and silt	9	46.5
Sand, very fine to very coarse; consists of quartz with light and dark silicates	18.5	65
Sand, medium, to medium gravel; consists of quartz with light and dark silicates	21.5	86.5
Silt, clayey, light- to medium-dark-gray; contains very fine sand below 90 ft	5	91.5
Sand, fine to very coarse; consists of quartz with light and dark silicates	8.5	100
Sand, medium, to fine gravel and some medium gravel; consists of quartz with light and dark silicates	18	118
Silt, moderately calcareous, light-bluish-gray	3	121
Silt, clayey, very light gray; contains very few limy nodules	2.5	123.5
Silt to siltstone, sandy in part, moderately to very calcareous, light-brown with white limy nodular layers; contains very fine sand	6.5	130
Siltstone, moderately to very calcareous, light-brown	20	150
Siltstone, poorly consolidated, and sandy silt; light-brown	5	155
Silt, sandy, calcareous in part, light-brown	31.5	186.5
Silt and marl, very calcareous, white to light-brown	1	187.5
Silt, sandy, to silty, very fine to coarse sand, light-brown; contains limestone fragments and some aragonite	12.5	200
Clay, yellow with gray mottling; contains bentonite from 203 to 204 ft	8	208
Shale, clayey, moderately calcareous below 220 ft, dark-gray to black; contains light-gray bentonitic clay at about 221 ft	18.5	226.5
Shale, chalky, light-brownish-gray	1.5	228
Shale, chalky, slightly clayey, very light gray	4	232
Bentonitic layer, very calcareous, light-brownish-gray	.2	232.2
Shale, chalky, light-gray to light-brownish-gray	7.8	240

15-5-10bc. Merrick County. (11 ft east of the center of west section line, on east shoulder of road.) Surface altitude, 1,647.3 ft. Depth to water, 21.45 ft, Sept. 4, 1946.

Sand, silty, brown	1	1
Sand, silty, light-brown	4	5

Table 7.—*Logs of test holes*—Continued

15-5-10bc—Continued

	Thickness (feet)	Depth (feet)
Sand, fine to coarse, light-pink to brown; contains fine gravel	12	17
Sand, fine, and medium gravel, light-brownish-gray to pinkish; contains pebbles in lower part	11	28
Sand, fine to medium, light-gray; contains light-gray clay layer at top	12	40
Silt, clayey, soft, light-gray; contains interbedded fine gray sand	6	46
Sand, fine to medium, light-brownish-gray	7	53
Silt, clayey, tan at top, green in lower part	2	55
Silt, clayey, soft to firm, dark-gray; contains many wood fragments and some peat	4.5	59.5
Sand, fine to medium, gray; contains thin silt streaks at top	34.5	94
Silt, clayey, light-gray to bluish-gray; contains some white calcareous material at top	4	98
Silt, clayey, soft to firm, light-brownish-tan	11	109
Silt, clayey, noncalcareous, bluish-gray to brown; contains some light-gray calcareous concretions	6	115
Silt, clayey, firm, light-brownish-tan; contains some calcareous concretionary material	5	120
Silt, soft, light-brown to tan	16	136
Silt, soft, light-bluish-gray	8	144
Silt, soft, light-brownish-tan	11	155
Silt, sandy, soft, light-pinkish-tan; contains some tan clayey silt layers	8	163
Sand, fine to coarse, light-pinkish-gray; contains some fine gravel	7	170
Shale, chalky, firm, light-yellow	3	173
Shale, chalky, firm to hard, dark-gray	17	190

15-5-35aa. Merrick County. (98 ft west and 9 ft south of NE cor. sec. 35, on south shoulder of road.) Surface altitude, 1,617.09 ft. Depth to water, 4.5 ft, Aug. 23, 1946.

Road fill	1	1
Loam, sandy, dark-brown to black	1.5	2.5
Silt, sandy, to silty sand, brown	1	3.5
Sand, fine to coarse, light-brownish-gray to red; contains mixed gravel	6.5	10
Sand, medium, and coarse gravel, reddish-brown	9	19
Silt, clayey, firm, brownish-yellow	1	20
Silt, clayey, soft to firm, light-brown; contains brown streaks	4.5	24.5
Silt, sandy, soft, light-gray	13	37.5
Sand, fine to coarse, light-gray	26.5	64
Silt, clayey, soft, light-gray to brown	1	65
Silt, light-gray; contains interbedded sand, gastropod shells, and a rodent jaw	4.5	69.5
Silt, clayey, gray; contains light-gray fine sand and many gastropod shells	5.5	75
Sand, fine, light-brownish-gray; contains shells and chalk fragments	16.5	91.5
Silt, clayey, firm, moderately calcareous, light-gray	12.5	104
Shale, clayey to chalky, light-yellow	16.5	120.5
Shale, clayey to chalky, hard, medium-gray	9.5	130
Shale, chalky, hard, medium to dark-gray	70	200
Shale, chalky, medium-dark-gray; contains interbedded chalk zones	63	263
Chalk, firm, light-gray to white	10	273
Shale, silty to fine sand; hard, black	2.5	275.5
Shale, clayey, dark-gray to black	4.5	280

15-6-19bb. Merrick County. (1,008 ft south and 6 ft east of NE cor. sec. 19, on east shoulder of road.) Surface altitude, 1,759.7 ft. Depth to water, 42 ft, July 18, 1951.

Sand, very fine to medium, silty, brown	5	5
Sand, very fine to medium, silty, light-brown	3	8
Silt, clayey, yellowish-brown	7	15
Sand, silty; contains fine to medium sand	5	20
Sand, very fine to medium; contains silt layer at 42.5 ft	28	48
Sand, very fine to fine; composed of quartz and pink feldspar	2	50
Sand, very fine to medium; contains rounded clay pebbles and snail shells above 60 ft	20	70
Sand, very fine to coarse; contains some fine gravel	15	85

Table 7.—*Logs of test holes*—Continued

15-6-19bb—Continued

	Thickness (feet)	Depth (feet)
Sand, medium, to fine gravel	7.5	92.5
Silt, clayey, light-gray to gray-brown	2	94.5
Siltstone, gray-brown to light-brown; contains limy nodules	5.5	100
Siltstone, gray-brown	4	104
Silt, clayey, slightly calcareous, light-brown; contains limy nodules	13.5	117.5
Silt, slightly calcareous, granular, slightly consolidated	2.5	120
Silt, clayey, light-brown; contains manganese concretions	3.5	123.5
Silt, clayey, slightly calcareous, light-brown; contains clay zones	7.5	131
Silt, sandy, light-brown; contains limy nodules	3.5	134.5
Silt, clayey, grayish-brown	1.7	136.2
Silt, sandy, grayish-brown	2.8	139
Sand, very fine to medium; contains some clay and silt	15	140.5
Silt, clayey to sandy, light-reddish-brown	4.5	145
Sand, very fine to fine, light-brown; contains some silt and clay	16	161
Sand, very fine to medium, greenish-gray; contains silt	4	165
Sand, very fine to coarse; contains some silt	7.5	172.5
Silt, sandy, light-gray	7	179.5
Sand, silty, yellowish-brown; contains chalk fragments	10.5	190
Silt, clayey, pale-yellowish-brown; contains very fine sand	5.5	195.5
Sand, medium, to coarse gravel; contains chalk fragments	12	207.5
Chalk, yellow to yellowish-brown	5	212.5
Shale, chalky, dark-gray; contains limy layer at 217.8 ft	17.5	230

15-6-6cc. Nance County. (468 ft north and 7 ft east of SW cor. sec. 6, on east shoulder of road.) Surface altitude, 1,680 ft. Depth to water, 8.39 ft, July 18, 1951.

Road fill	1.5	1.5
Soil, silty, medium-brown	1.5	3
Silt, slightly sandy, light-brown	2.5	5.5
Silt, clayey, moderately calcareous, light-brown; contains limy nodules	2.5	8
Silt, sandy, moderately calcareous, light-brown; contains iron stain	2.5	10.5
Sand, very fine to medium, slightly silty, light-brown; composed of quartz and pink feldspar	4.5	15
Sand, very fine to medium; consists principally of quartz and pink feldspar	5	20
Sand, very fine to very coarse, some fine gravel; composed of green quartz and pink feldspar	1	21
Silt, clayey to sandy, pale-brown	7	28
Silt, marly, very calcareous, brown to white	3.5	31.5
Siltstone, calcareous, light-brown; contains limy nodules and very fine sand	28.5	60
Silt, sandy to slightly clayey, light-gray-brown	6.5	66.5
Silt, clayey, moderately calcareous, light-grayish-brown	2	68.5
Chalk, white to yellow-white; contains bentonite layer at 77.5 ft	23	91.5
Shale, chalky, dark-yellowish-brown to medium-gray	8.5	100

16-4-19bc. Nance County. (1,336 ft south and 14 ft east of NW cor. sec. 19, on east shoulder of road.) Surface altitude, 1,601.5 ft. Depth to water, 5.51 ft, July 26, 1951.

Silt, sandy, medium-brown	2.5	2.5
Clay, silty to sandy, light-brown	.3	2.8
Soil, clay, silty, light-brown	.7	3.5
Clay, silty, granular, slightly calcareous, light-brown; contains limy nodules below 7 ft	4.5	8
Clay, silty to sandy, slightly calcareous, light-brown; contains limy nodules	1	9
Sand, fine to medium, slightly silty, light-brown; contains quartz and some fine feldspar	1	10
Silt, sandy, slightly calcareous, granular, light-brown	.8	10.8
Silt, sandy, slightly clayey, light-brown; contains many limy nodules	3.2	14
Sand, fine to coarse, brown and green; consists of quartz, silicates, and feldspars; contains some fine gravel	3	17
Silt, clayey, moderately calcareous, light-yellowish-brown; contains many limy nodules and zones	10	27

Table 7.—*Logs of test holes*—Continued

16-4-19bc—Continued

	Thickness (feet)	Depth (feet)
Clay, silty, calcareous, light-yellowish-brown; contains limy nodules and zones	6.5	33.5
Clay, silty, light-yellowish-brown	1.5	35
Silt, clayey to sandy, light-grayish-brown; contains limonitic stain below 41 ft and chalk fragments below 45 ft	11.5	46.5
Chalk, white and yellow iron stain	1.5	48
Shale, chalky, weathered yellowish-white to white; contains some yellow iron stain	3.8	51.8
Chalk, shaly, white; contains yellow iron stain	.6	52.4
Shale, chalky, white to yellowish-brown; contains a light-gray bentonite layer below 69.4 ft	17.3	69.7
Shale, chalky, light-brownish-yellow to grayish-yellow	4.8	74.5
Shale, chalky, light-gray to light-yellowish-gray	5.5	80

16-5-19cd. Nance County. (10 ft north of center of south section line, on north shoulder of road.) Surface altitude, 1,629.18 ft. Depth to water, 9.4 ft, Sept. 5, 1946.

Loam, very sandy, dark-brown	1	1
Sand, silty, medium-gray to brown	1.5	2.5
Sand, fine to coarse, light-gray	5.5	8
Sand, medium, reddish-brown to grayish; contains medium gravel and some pebbles in lower part	9.5	17.5
Silt, clayey, soft, noncalcareous, grayish-tan; contains a few bluish-gray particles and limonitic streaks	9.5	27
Silt, soft, noncalcareous, gray, with a blue tinge	3	30
Silt, moderately calcareous, gray to blue; contains a few limy and chalky concretions	10	40
Silt, sandy, somewhat indurated gray	3	43
Limestone, nodular, hard, gray	1	44
Silt, firm, noncalcareous, gray; contains a few small concretions	13	57
Silt, sandy, gray; contains some fine gravel	1.5	58.5
Silt, firm, dark-gray; contains chalky concretions	2	60.5
Chalk, firm, light-gray to white	1.5	62
Shale, chalky, firm, light-yellow	13	75
Shale, chalky, iron stained, yellowish-orange; contains limonitic fragments	26.5	101.5
Shale, chalky, firm, dark-gray	18.5	120

16-2-5bb. Platte County. (110 ft south of NW cor. sec. 5.) Surface altitude, 1,534.0 ft. Depth to water, 16.5 ft, July 20, 1942.

Soil, sandy	5	5
Sand and fine to medium gravel, red	31	36
Sand and fine to coarse gravel, red	14	50
Gravel, very coarse, red	6	56
Gravel, fine to coarse, loose, red	10	66
Sand and fine to coarse gravel, red	3	69
Shale, chalky, white to buff	5	74
Shale, chalky, cream to tan; contains white streaks	23.5	97.5
Shale, hard, calcareous, brownish-gray to steel-gray	2.5	100

16-2-6dd. Platte County. (60 ft north of SE cor. sec. 6.) Surface altitude, 1,538.9 ft. Depth to water, 22.4 ft, July 20, 1942.

Soil, sandy, dark-brown	4.5	4.5
Sand, reddish-brown; contains small amount of clay	2.5	7
Sand and fine to coarse gravel, red	7	14
Sand and fine gravel, red	8	22
Sand and fine to coarse gravel, red	12	34
Sand with a little fine gravel, compact, red	5	39
Sand and fine to medium gravel, red	10	49
Gravel, coarse, red	1	50
Sand and fine gravel, red	4	54

Table 7.—*Logs of test holes*—Continued

16-2-6dd—Continued

	Thickness (feet)	Depth (feet)
Gravel, fine to very coarse, red	16	70
Gravel, fine to coarse, red	10	80
Gravel, medium to coarse, red	28.5	108.5
Shale, white to tan	2.5	111
Shale, greenish-gray to tan	1	112
Shale, dark-brown to brownish-gray	1	113
Shale, hard, steel-gray	2	115

16-2-7dd. Platte County. (30 ft north of SE cor. sec. 7.) Surface altitude, 1,519.0 ft. Depth to water, 7.8 ft, July 20, 1942.

Soil, sandy, dark-brown	4	4
Sand, clayey, light-gray	3	7
Clay, silty, gray	7	14
Sand and fine to medium gravel, red	6	20
Sand and fine to coarse gravel, red	8	28
Gravel, fine to coarse, red	7	35
Sand and fine gravel, red	3	38
Gravel, fine to coarse, red	8	46
Gravel, fine to very coarse, red	36	82
Clay, sandy, tan	3	85
Clay, silty, greenish-gray	3	88
Shale, reworked, tan	3	91
Shale, chalky, white	1	92
Shale, hard, calcareous, dark-olive-gray	1.5	93.5
Shale, very hard, calcareous, light-steel-gray	4.5	98

16-2-17cc. Platte County. (0.12 mile north of SW cor. sec. 17, on north edge of road.) Surface altitude, 1,606 ft. Depth to water, 5.0 ft, July 20, 1942.

Sand, fine, slightly cemented; contains a small amount of silt	6	6
Sand, silty, black	3	9
Sand and fine to medium gravel, green to red	7	16
Gravel, fine to very coarse, some large loose pebbles, green to red	24	40
Sand and fine to medium gravel, green to red	6	46
Gravel, fine to coarse, loose, green to red	18	64
Sand and fine to coarse gravel, loose, red	6	70
Gravel, fine to coarse, red	30	100
Gravel, fine to coarse, red; contains a few pieces of clay	5	105
Gravel, fine to coarse, loose, red	4.5	109.5
Shale, rusty-colored	1.5	111
Shale, green	1	112
Shale, soft, black	2	114
Shale, tough, compact, dark-gray to black with a slight green cast	63.5	177.5
Shale, very dark gray to black; contains thin hard streak at 177.5 ft	22.5	200

17-1-2cc1. Platte County. (714 ft north of SW cor. sec. 2, east edge of road, 710 ft north of test hole 17-1-2cc2.) Surface altitude, 1,472.2 ft. Depth to water, 12.0 ft, July 7, 1942.

Road fill	4	4
Clay, compact, brown	2	6
Sand, red; contains some fine gravel	4	10
Sand and fine to medium gravel, red	13	23
Gravel, fine to coarse, red; becomes finer below 40 ft	28	51
Gravel, coarse to very coarse, red	10	61
Gravel, fine to medium, very loose, red to yellow	27	88
Clay, sandy, light-gray	9.5	97.5
Gravel, fine to coarse, red	3.5	101
Clay, tan to pink	2	103
Gravel, fine to coarse, red	2	105
Clay, soft, tan to pink	3	108
Clay, soft, dark-gray	12	120
Clay, soft, light-gray	20	140

Table 7.—*Logs of test holes*—Continued

17-1-2cc1—Continued

	Thickness (feet)	Depth (feet)
Clay, light-gray to tan; may contain lime	13	153
Shale, dark-gray to black; first 2 ft are yellowish	6.5	159.5

17-1-2cc2. Platte County. (75 ft east of SW cor. sec. 2, north edge of road.) Surface altitude, 1,463.2 ft. Depth to water, 4.3 ft, July 8, 1942.

Road fill	5	5
Clay, silty to sandy, tough, gray	5	10
Sand, fine; contains silt and scattered gravel	4	14
Gravel, fine to coarse, very loose, red	6	20
Gravel, medium, very loose, red to yellow; contains shale pebbles	14	34
Gravel, medium to coarse, loose; contains shale pebbles	5	39
Gravel, medium to coarse, loose; contains lime pebbles	10	49
Gravel, fine to medium, loose, red to yellow; contains some sand, rusty-colored gravel, and lime and shale fragments	6	55

17-1-14cc. Platte County. (15 ft east of sec. line, south edge diagonal road.) Surface altitude, 1,461.7 ft. Depth to water, 11.0 ft, July 8, 1942.

Road fill	5	5
Clay, silty to sandy, light-gray	3	8
Sand and fine to coarse gravel, red	5	13
Clay, silty, gray	2	15
Gravel, fine to coarse, gray to green	5	20
Gravel, medium, gray to green; contains some sand and coarse gravel	15	35
Gravel, fine to coarse, green and red; contains some sand	10	45
Gravel, medium to coarse, green and red	3	48
Gravel, coarse, green and red	3	51
Gravel, fine to coarse, green and red	2	53
Gravel, coarse, green and red	4	57
Clay, sandy, compact, greenish-gray	1.5	58.5
Gravel, fine to very coarse, green and red	9.5	68
Clay, compact, greenish-gray	1	69
Clay, sandy, soft, tan to greenish-gray	5	74
Gravel, fine to medium, red	3.5	77.5
Sand, clayey, brown to gray	1	78.5
Sand, clayey, soft, brown	3.5	82
Sand, clayey, tan	5	87
Gravel, fine to coarse, well-sorted, red	17	104
Sand, clayey to silty, gray to green	1.5	105.5
Gravel, fine to coarse, red	14.5	120
Gravel, fine to medium, red and green; contains some sand	9	129
Clay, sandy, light-gray	4	133
Clay, soft, tan	3	136
Gravel, fine to medium, red, pink and green	7	143
Clay, sandy, tan	1	144
Clay, sandy, tan to dark-brown	1	145
Clay, sandy, soft, gray to dark-gray	17	162
Gravel, fine to medium, dark-gray, green and yellow	8	170
Shale, tough, sticky, dark-gray to black with a green cast	5	175

17-1-15aa. Platte County. (400 ft south of NE cor. sec. 15, west edge of road.) Surface altitude, 1,459.1 ft. Depth to water, 2.9 ft, July 8, 1942.

Road fill	5	5
Clay, silty to sandy, greenish-gray	3	8
Sand and fine gravel, loose, gray to green; contains some coarse gravel	6	14
Gravel, fine to coarse, gray-green; contains some sand	16	30
Sand and fine to medium gravel; contains a thin clay layer at 32 ft	17	47
Gravel, coarse, gray-green	3	50
Gravel, fine to medium, gray to green; contains some coarse gravel and sand	18	68

Table 7.—*Logs of test holes*— Continued

17-1-15aa—Continued

	Thickness (feet)	Depth (feet)
Gravel, fine to very coarse, gray-green	3	71
Clay, rusty-colored	1	72
Clay, greenish-gray	3	75
Clay, gray, light-buff	10	85
Clay, soft, tan	2	87
Gravel, fine to coarse, loose, red	11	98
Clay, sandy, sticky, micaceous, gray to tan	9	107
Gravel, fine to medium, red; contains some coarse gravel	2	109
Clay, sandy, tan to pink	8	117
Gravel, fine to medium, green to red	9	126
Clay, sticky, tan; contains white limy streaks	13	139
Gravel, fine, green to red	9	148
Gravel, fine to coarse, red and yellow	12	160
Gravel, fine to medium, yellow and green	4.5	164.5
Shale, dark-gray to black; has a green cast when wet	15.5	180

17-1-27dd. Platte County. (¼ mile north of SE cor. sec. 27, west edge of road.) Surface altitude, 1,449.4 ft. Depth to water, 4.3 ft, July 6, 1942.

Sand, fine; contains a rust-colored zone at 3 ft	5	5
Gravel, fine to medium, green and gray	5	10
Gravel, fine to coarse, green	9	19
Gravel, fine to coarse, red	5	24
Gravel, fine to coarse, red; coarser below 30 ft	11	35
Clay, tough, green	3	38
Gravel, very coarse, loose, red and brown; contains some fine gravel	7.5	45.5
Sand, clayey, rust-colored	1	46.5
Gravel, very coarse, reddish-brown	3.5	50
Gravel, medium, red	7	57
Gravel, fine to coarse, red, brown, and green	7	64
Gravel, fine to coarse, pink, green, yellow; may contain thin clay layer at 65 ft	6	70
Gravel, fine to very coarse, loose, pink and red	22	92
Gravel, fine to coarse, well-sorted, red	8	100
Gravel, fine, red	2.5	102.5
Clay, sandy, rusty-colored	1.5	104
Gravel, fine to coarse, red	7	111
Shale, rusty	1	112
Shale, black to green	2	114
Shale, soft, light-gray rusty streaks	11	125
Shale, tough, compact, dark-blue to gray	5	130

17-1-35cb. Platte County. (60 ft east of NW cor., south edge of road.) Surface altitude, 1,455.5 ft. Depth to water, 7.3 ft, July 6, 1942.

Road fill	5	5
Gravel, fine to coarse, loose, red	14	19
Gravel, fine to medium, red; contains some sand	5	24
Gravel, fine to coarse, loose, red	13	37
Clay, sandy, greenish-gray	6	43
Clay, sticky, tan	5	48
Gravel, fine to medium, red	5	53
Gravel, fine to coarse, red	4.5	57.5
Clay, sandy, tan to rust	1.5	59
Gravel, fine to coarse, red	6	65
Gravel, fine to coarse, red	5	70
Gravel, medium, red; contains fine and coarse gravel	15	85
Clay, sandy, rust stained	2	87
Clay, green to tan	3	90
Clay, dark-gray to black	11	101
Shale, rust stained, light- to dark-gray	3	104
Shale, soft, light-gray	3	107
Shale, black, green cast	33	140

Table 7.—*Logs of test holes*—Continued

17-2-6dd. Platte County. (25 ft north of SE cor. sec. 6, on west edge of road.) Surface altitude, 1,503.8 ft. Depth to water, 4.2 ft, July 20, 1942.

	Thickness (feet)	Depth (feet)
Road fill	2	2
Sand, reddish	3	5
Gravel, fine to coarse, red	4	9
Gravel, fine to coarse, loose, green, gray, and red	9	18
Gravel, fine to medium, red	4	22
Gravel, fine to very coarse, red	8	30
Gravel, fine, red	2	32
Gravel, fine to very coarse, loose, red	17	49
Gravel, fine to coarse, very loose, red	5.5	54.5
Clay, sandy, sticky, compact, brown to pink	4.5	59
Clay, sandy, brown to pink	2	61
Shale, weathered, white to yellow	1	62
Shale, chalky, yellow to gray-white	24	86
Shale, light-gray-brown	2	88
Shale, compact, olive-gray to steel-gray	6	94
Shale, very hard, light-gray	5	99

17-2-7dd. Platte County. (900 ft north of SE cor. sec. 7, on west edge of road.) Surface altitude, 1,504.8 ft. Depth to water, 5.8 ft, July 20, 1942.

Road fill	5	5
Sand and fine to medium gravel, red	5	10
Sand and fine to coarse gravel, gray, green, and red	8	18
Sand and fine to medium gravel, gray, green, and red	5	23
Gravel, fine to coarse, gray, green, and red	2	25
Sand and fine to medium gravel, gray, green, and red	4	29
Gravel, fine to coarse, gray, green, and red	16	45
Gravel, fine to very coarse, gray, green, and red	6	51
Gravel, fine to medium, gray, green, and red	2.5	53.5
Clay, sticky, pink	2.5	56
Shale, chalky, white to yellow	30.5	86.5
Shale, light-gray to brownish-gray to olive-gray	3.5	90

17-2-18dd. Platte County. (60 ft north of SE cor. sec. 18, on west edge of road.) Surface altitude, 1,514.2 ft. Depth to water, 12.5 ft, July 20, 1942.

Road fill	3	3
Sand, fine; contains a little gravel	2	5
Sand and fine gravel, red	9	14
Sand and fine to coarse gravel, red	4	18
Sand and fine to medium gravel, red	7	25
Gravel, fine to very coarse, red	5	30
Sand and fine to medium gravel, red	4	34
Gravel, fine to very coarse, red	5	39
Gravel, fine to medium, red	5	44
Gravel, fine to coarse, red	7	51
Gravel, fine, red	2	53
Gravel, fine to coarse, red	6	59
Gravel, fine, red	8	67
Gravel, fine to medium, red	7	74
Gravel, fine to coarse, red	5	79
Clay, sandy, brown and tan	2	81
Gravel, fine to medium, and a little coarse sand, red	6	87
Clay, sandy, brown and yellow	.5	87.5
Gravel, fine to coarse, red	11.5	99
Clay, sandy, gray to rusty	5	104
Gravel, fine, and some coarse gravel, red	9	113
Gravel, fine to coarse, red	7	120
Gravel, fine to medium, red	7	127
Gravel, fine to coarse, red	12	139
Clay, sandy, gray and pink	7	146
Gravel, fine, red; contains clay	4	150
Gravel, fine, yellow and red	14	164
Shale, first 2 ft whitish-gray, then blue-gray to steel-gray	6	170

Table 7. — *Logs of test holes* — Continued

17-2-19dd. Platte County. (25 ft north of SE cor. sec. 19, on west edge of road.) Surface altitude, 1,524.5 ft. Depth to water, 20.4 ft, July 20, 1942.

	Thickness (feet)	Depth (feet)
Road fill	7	7
Sand and fine to medium gravel, red	6	13
Sand, fine, compact	5	18
Gravel, fine to coarse, red	2	20
Sand and fine gravel, red	14	34
Sand and fine to coarse gravel, red	8	42
Gravel, fine to very coarse, red	11	53
Sand and fine gravel, red	2	55
Gravel, fine to very coarse, red	5	60
Sand and fine to coarse gravel, red	5	65
Gravel, fine to coarse, red; contains reworked shale	4	69
Clay, sandy, gray	1	70
Gravel, fine to very coarse, red	7	77
Clay, sandy, gray to tan	.5	77.5
Gravel, fine to coarse, red	16.5	94
Gravel, medium to coarse, red	6	100
Gravel, fine to medium, red	.5	100.5
Shale, chalky, cream-colored	18.5	119
Shale, chalky, light-gray to tan	5	124
Shale, calcareous, dark-olive-gray to dark-gray-brown	5	129
Shale, calcareous, light-gray to steel-gray	1	130

17-2-31aa. Platte County. (485 ft south of NE cor. sec. 31.) Surface altitude, 1,529.9 ft. Depth to water, 15.6 ft, July 20, 1942.

Dune sand	4	4
Sand, compact, with some fine to coarse gravel	43	47
Gravel, fine to coarse, red	8	55
Gravel, fine to very coarse, red; contains lime and shaly pebbles	7	62
Gravel, medium to very coarse, red	6.5	68.5
Shale, chalky, cream-colored to yellow	6.5	75
Shale, chalky, hard, white to cream-colored	9	84
Shale, tan	7	91
Shale, whitish-gray	1	92
Shale, hard, steel-gray	5	97
Shale, hard, steel-gray	3	100

18-1-23bc. Platte County. (110 ft east of SW cor. sec. 23, north edge of road.) Surface altitude, 1,505.1 ft. Depth to water, 7.3 ft, June 19, 1942.

Road fill	3	3
Clay, silty to sandy, buff to brown	18	21
Silt, green to gray	9	30
Silt to silty clay, sticky; contains a few pebbles and shells	18	48
Gravel, fine, dirty, gray	4	52
Clay, gray; contains some pebbles	7.5	59.5
Clay, similar to above, but harder	2.5	62
Silt to silty clay, sticky, dark-gray; contains several lime pebbles	23	85
Gravel, fine to very coarse, well-rounded in part, pink to gray	10	95
Shale, compact, rubbery, dark-gray to black; contains some ochre-colored streaks; green cast from 95-96 ft	15	110

18-1-27dd. Platte County. (225 ft west of SE cor. sec. 27, north edge of road.) Surface altitude, 1,520.7 ft. Depth to water, 49.5 ft, July 8, 1942.

Clay, dark reddish-brown	6	6
Clay, silty, buff; contains some scattered gravel	19	25
Clay, silty, buff; contains a little gravel	12	37
Gravel, fine to medium, mostly loose; contains some coarse gravel	11	48
Sand, fine, red; contains a little fine gravel	7	55
Gravel, fine to medium, red	6	61
Sand, fine, red	4	65

Table 7.—*Logs of test holes*—Continued

18-1-27dd—Continued

	Thickness (feet)	Depth (feet)
Gravel, fine to medium, red	2	67
Clay, rusty	.5	67.5
Gravel, medium to very coarse, clean; contains some fine red gravel	7.5	75
Gravel, slightly finer than above	5	80
Gravel, fine to coarse, red	5	85
Gravel, very coarse, red; slow drilling	5	90
Gravel, fine to medium, some coarse, red	4	94
Gravel, fine to coarse, mostly red	15.5	109.5
Clay, green-gray	1	110.5
Gravel, fine to medium, green to red	4.5	115
Gravel, fine to coarse, very good, green red	4	119
Gravel, fine to coarse; contains much soft clay or shale resembling mud balls	11	130
Gravel, fine to coarse, green to red; contains less clay than above	8	138
Sand and fine to medium gravel, green; contains some sandy clay	7	145
Clay, sandy, gray, and some gravel	3.5	148.5
Sand, shaly or sandy shale, rusty, gray to yellowish-gray	1.5	150
Shale, tough, compact, rusty to dark-gray	5	155
Shale, tough, rubbery, dark-gray to black	5	160

18-1-35cc. Platte County. (95 ft north of SW cor. sec. 35, east edge of road.) Surface altitude, 1,538.7 ft. Depth to water, 74.6 ft, July 8, 1942.

Road fill and clay-loam, dark-brown to black	5	5
Clay, silty, dark-brown to light-brown	5	10
Clay, silty, buff (loess)	14	24
Clay, silty, buff; rusty streaks (loess)	4	28
Clay, silty to sandy, soft, buff; contains scattered gravel below 32 ft	7	35
Sand, fine to coarse, red; contains small amount of fine gravel	8	43
Sand, coarse, reddish-brown; contains fine gravel	11	54
Gravel, fine to medium, slightly compact, red	11	65
Sand, hard, compact, greenish-gray	2	67
Gravel, fine to medium, well-sorted, red	13	80
Sand, fine; contains some coarse sand and fine gravel	3	83
Gravel, medium, red	8	91
Gravel, coarse, compact, red	8	99
Gravel, very coarse, red	1	100
Sand, fine to coarse, red; contains some fine gravel	12	112
Gravel, fine to coarse, red and black; lower few feet is very coarse	7	119
Clay, tan	1	120
Gravel, fine to coarse, red and black	2	122
Gravel, medium to coarse, red	4	126
Gravel, very coarse; contains pebbles and boulders	15	141
Gravel, fine, compact, red; contains sharp fragments	3	144
Gravel, fine to coarse, compact; contains some tan clay	2	146
Clay, sandy, pink to greenish-gray	3	149
Clay, sandy, pink to tan; contains small amount of gravel	6	155
Gravel, coarse, compact, red; may contain some clay	3	158
Clay, sandy, tan to pink	6	164
Gravel, medium to coarse, red; contains some clay	8	172
Clay, sandy, brownish-gray to pink; may contain some calcium carbonate	18	190
Clay, sandy, similar to above but not so pink	9	199
Clay, sandy, unworked, dark-gray	3	202
Shale, clay, light-gray to green	8	210
Shale, green to greenish-gray; contains ochre-colored streaks	10	220
Shale, tough, sticky, dark-gray to black	10	230

18-2-29cc. Platte County. (75 ft north of SW cor. sec. 29, on east edge of road.) Surface altitude, 1,589.4 ft. Depth to water, 62.4 ft, July 20, 1942.

Road fill	3	3
Clay, granular, dark-brown	2	5
Clay, silty, brown to buff	5	10

Table 7.—*Logs of test holes*— Continued

18-2-29cc—Continued

	Thickness (feet)	Depth (feet)
Clay, silty, light-brown	27	37
Silt, brown; contains some gravel	3	40
Sand, silty, buff; contains some red gravel	12	52
Clay, silty, compact, buff	7	59
Sand and gravel; contains some silt	11	70
Sand, very fine, hard, tan	23	93
Sand, somewhat cemented, buff; contains some gravel	10	103
Gravel, fine to coarse, red	7	110
Gravel, fine to medium, red	4	114
Gravel, fine to coarse, red	6	120
Gravel, coarse, red	3	123
Gravel, fine to medium, red	5	128
Gravel, fine to coarse, red	9.5	137.5
Clay, greenish-gray	2.5	140
Clay, white	1	141
Shale, tough, cream-colored	2	143
Shale, compact, dark-gray	2	145
Shale, compact, olive-gray to steel-gray	5	150

18-2-31dd. Platte County. (105 ft west of SE cor. sec. 31, north edge of road.) Surface altitude, 1,519.5 ft. Depth to water, 13.2 ft, July 20, 1942.

Road fill	2	2
Clay, dark-brown to black	2	4
Clay, compact, buff	4.5	8.5
Silt, buff; contains concretions	1.5	10
Clay, silty, buff	6	16
Clay, silty, gray	7	23
Gravel, fine to medium, red	3	26
Gravel, coarse, red	9	35
Clay, compact, gray	2	37
Clay, white	1	38
Clay, sticky, gray	6	44
Gravel, fine to coarse, reddish-yellow	10.5	54.5
Clay, sandy, pink to gray	1.5	56
Gravel, fine to coarse, red	3.5	59.5
Clay, soft, tan	4.5	64
Clay, soft, yellow	1	65
Clay, sandy, dark-brown	4	69
Gravel, fine, red	1	70
Clay, sandy, dark-brown	3	73
Clay, sandy, greenish-gray	5	78
Clay, sandy, soft, light-gray	3	81
Clay, sandy, white	2	83
Shale, chalky, white	2	85
Shale, chalky, compact, yellow	3.5	88.5
Shale, chalky, very compact, yellow	4.5	93
Shale, chalky, compact, white	1.5	94.5
Shale, chalky, compact, yellow	2.5	97
Shale, compact, steel-gray	3	100

13-1-10aa. Polk County. (9 ft south and 98 ft west of NE cor. sec. 10.) Surface altitude, 1,575 ft. Depth to water, 12.97 ft, August 20, 1945.

Soil, clay, silty, dark-brownish-gray	4	4
Clay, silty, medium-brownish-gray	3	7
Clay, silty, light-gray to brown; contains ferruginous concretions	15	22
Sand, medium to coarse, feldspathic, gray to brown	3	25
Sand, medium to coarse, brownish-gray; contains fine to medium feldspathic gravel	5.5	30.5
Silt, sandy, soft, light-gray	4.5	35
Silt, sandy, light-gray to slightly green	5	40
Sand, fine to coarse, feldspathic, light-gray; contains fine to medium gravel	5	45

Table 7.—*Logs of test holes*— Continued

13-1-10aa—Continued

	Thickness (feet)	Depth (feet)
Sand, medium, fine to coarse, light-gray; contains some fine gravel	25	70
Clay, silty, slightly calcareous, medium-gray to greenish-gray	2	72
Clay, silty, medium-gray; contains green clay inclusions and chalky calcareous zones	9	81
Silt, sandy, part calcareous, medium-gray; contains green clay inclusions	4	85
Silt, clayey to sandy, moderately calcareous; contains some green clay inclusions	5	90
Silt, clayey, part calcareous, medium-gray	5	95
Clay, silty, moderately calcareous, light-gray to green; contains chalky concretionary fragments	5	100
Sand, fine to coarse, gray; contains black feldspathic grains	13	113
Clay, silty, fossiliferous, very calcareous, dark-bluish-gray	27	140
Clay, silty, fossiliferous, moderately calcareous, dark-bluish-gray; contains clay inclusions	4.5	144.5
Sand, coarse, to medium gravel, greenish-gray to pink	5.5	150
Sand, coarse, greenish-gray to pinkish; contains fine to medium gravel	66	216
Silt, very calcareous, medium-light-gray to slightly green	37	253
Silt, calcareous, dark-gray to black	2	255
Silt, clayey, slightly calcareous, medium-dark-gray	5	260
Silt, calcareous, medium-light-gray to slightly green	20	280
Silt, slightly sandy, medium-light-gray to slightly green	8.5	288.5
Sand, coarse, to fine gravel, greenish-gray to pink	1	289.5
Silt, slightly calcareous, medium-light-gray	1	290.5
Gravel, fine to medium, greenish-gray to pink	2	292.5
Shale, calcareous, dark-gray to black; contains light-gray specks	7.5	300

13-1-27aa. Polk County. (86 ft south and 60 ft west of NE cor. sec. 27.) Surface altitude, 1,665 ft. Depth to water, 86.45 ft, August 28, 1945.

Soil, clay, silty, medium-brown	1	1
Silt, light-brownish-buff	4	5
Silt, soft, light-brownish-gray	21	26
Clay, silty, dark-pinkish-brown	4	30
Clay, silty to sandy, pinkish-brown	5	35
Clay to sandy silt, pinkish-brown	10	45
Silt, sandy to clayey, pinkish-brown	5	50
Sand, fine to medium, silty, brownish-gray	10	60
Silt, light-brownish-gray	10	70
Silt, light-brownish-gray; contains pinkish-brown bentonitic inclusions	10	80
Silt, slightly clayey, gray to slightly green	8.5	88.5
Sand, fine to medium, light-gray to brown	11.5	100
Sand, fine to coarse, light-gray	10	110
Sand, fine to coarse, light-gray; contains some fine gravel	15	125
Sand, fine to coarse, light-gray; contains considerable fine gravel	6	131
Silt, clayey, bentonitic, slightly calcareous, light-gray to green	3	134
Silt, clayey, bentonitic, moderately calcareous, greenish-gray-blue	6	140
Silt, clayey, bentonitic, slightly calcareous, medium-greenish-gray	10	150
Sand, fine to coarse, light-gray	2.5	152.5
Silt, clayey, slightly calcareous, light-greenish-gray	3.5	156
Silt, light-greenish-gray; contains gray interbedded fine to coarse sand	4	160
Silt, slightly to moderately calcareous, light-gray to green	30	190
Sand, fine to medium, interbedded with calcareous silt, light-gray; contains a few small pelecypod and gastropod shells	8	198
Clay, silty, calcareous, medium-dark-greenish-gray; contains many shell fragments	5	203
Clay, silty, dark-gray to bluish-gray; contains some pelecypod and gastropod shells and shell fragments	23.5	226.5
Sand, medium to coarse, dark-gray to green; contains some fine gravel	33.5	260
Sand, coarse, dark-gray to green; contains fine gravel	38	298
Silt, clayey, calcareous, firm, medium-light-gray	62	360
Sand, fine to coarse, and fine to medium gravel	11	371
Clay shale, calcareous, dark-gray to black-speckled	9	380

Table 7.—*Logs of test holes*— Continued

13-2-6dd. Polk County. (76 ft north and 9 ft west of SE cor. sec. 6, on west shoulder of road.) Surface altitude, 1,674 ft. Depth to water, 70.86 ft, August 27, 1949.

	Thickness (feet)	Depth (feet)
Road fill: silt, loamy, dark-brownish-gray	0.5	0.5
Silt, moderately clayey, medium-dark-gray	.5	1
Silt, moderately clayey, buff-gray	2.5	3.5
Silt, slightly clayey, buff-gray; contains a slightly yellow limonitic tinge	1.5	5
Silt, slightly clayey, slightly calcareous; contains some snails	15	20
Silt, slightly clayey, noncalcareous, gray, with limonitic flecks	9	29
Silt, slightly clayey, loamy, dark-brownish-gray to tannish	3	32
Clay, silty, slightly sandy, tannish-gray to red	7	39
Silt, slightly clayey, buff-gray to tan	1	40
Silt, moderately clayey, medium-gray to light-brownish-gray	5	45
Silt, fine to coarse, buff-gray to tan	3	48
Silt, clayey, light-gray to light-brown	3.5	51.5
Silt, slightly sandy, light-brownish-gray	7.5	59
Silt, clayey to sandy, medium-gray	8.5	67.5
Sand, medium to coarse, tannish-gray	1.5	69
Sand, moderately clayey to silty, light-gray	4.5	73.5
Sand, fine to coarse, brownish-gray; contains fine to coarse gravel	5.5	79
Clay, silty, slightly calcareous, light-gray; contains a large limy nodule	2	81
Clay, light-gray	9	90
Clay, silty to sandy, light-gray with yellow stain	2	92
Sand, medium and fine gravel, brownish-gray	5.5	97.5
Sand and gravel, moderately clayey to silty, light-gray	3.5	101
Sand, silty, very fine to coarse, light-gray	5	106
Silt, sandy, moderately dark gray with a brown tinge; contains a soil zone	3.5	109.5
Sand, silty, fine to medium, light-gray to green	7.5	117
Sand, fine to coarse, light-gray to brown	14.5	131.5
Sand, fine to coarse, light-brownish-gray	13.5	145
Sand (no sample obtained)	5	150
Sand, fine to coarse, brownish-gray; contains fine to coarse gravel	5	155
Sand, fine to coarse, brownish-gray; contains some fine gravel and cementation at 175 ft	30	185
Sand, fine to medium, and some coarse sand, light-brownish-gray	38	223
Silt, slightly clayey, firm, calcareous, light-bluish-gray; contains limy nodules	4	227
Siltstone, slightly sandy, fine, calcareous, light-medium-gray; contains many rootlets	3	230
Silt, slightly sandy, fine, calcareous, light-medium-gray to medium-brownish-gray	10	240
Clay, silty, firm, calcareous, brownish-gray; contains limy nodular zones	10	250
Silt, slightly clayey, calcareous, brownish-gray; contains many limy nodular fragments	1.5	251.5
Silt, clayey to sandy, brownish-gray	4	255.5
Sand, fine to medium, firm, brownish-gray	2.5	258
Sand, very fine, slightly silty, firm, slightly calcareous, brownish-gray; contains some rootlets	12	270
Silt, sandy, fine, firm, brownish-gray; contains large amount of clay granules	40	310
Silt, sandy, fine, medium-gray	30	340
Silt, sandy, fine, medium-gray; contains limonitic fragments	9	349
Clay shale, hard, dark-gray to black	21	370

13-2-31cc. Polk County. (80 ft north and 21 ft east of SW cor. sec. 31, on east side of road.) Surface altitude, 1,682 ft. Depth to water, 72.28 ft, August 29, 1949.

Clay, silty, loamy, medium-gray to brown	2	2
Silt, clayey, medium-gray	.5	2.5
Silt, slightly clayey, light-medium-gray with a brown tinge	1.5	4
Silt, slightly clayey, buff-gray with limonitic flecks	16	20
Silt, light to tannish-gray; contains a few limonitic flecks	3.5	23.5
Sand, very fine, silty, loamy, dark-brownish-gray, tan tinge	1.5	25

Table 7.—*Logs of test holes*—Continued

13-2-31cc—Continued

	Thickness (feet)	Depth (feet)
Silt, moderately clayey, medium-gray, slight tan tinge	3	28
Silt, moderately clayey, light-tannish-gray with a brown tinge	5.5	33.5
Silt, moderately clayey, highly iron stained, yellowish-orange	1	34.5
Silt, moderately clayey, tannish-gray with buff tinge	2	36.5
Silt, slightly clayey, tannish-gray with a buff tinge	3.5	40
Silt, slightly clayey to sandy, fine to medium, tannish-gray to buff	3	43
Silt, sandy, tannish-gray to buff	4	47
Sand, fine to coarse, silty, tannish-gray	3	50
Silt, sandy, tannish-gray to buff	10	60
Silt, moderately clayey to sandy, tannish-gray to pinkish-gray	3.5	63.5
Silt, slightly clayey to sandy, tannish-gray to buff	3	66.5
Sand, fine to medium, slightly silty, tannish-gray	7	73.5
Sand, very fine to medium, light-gray	16.5	90
Sand, silty, fine to medium, light-gray with a green tinge	8	98
Sand, very fine to medium, firm, light-gray	7	105
Sand, fine to very coarse, brownish-gray	5	110
Sand, fine to very coarse, silty, light-gray with some medium-dark-brownish-gray	4.5	114.5
Sand, fine to very coarse, brownish-gray; contains some fine gravel	5.5	120
Sand, fine to very coarse, light-brownish-gray	10	130
Sand, fine, to medium gravel, light-brownish-gray	7	137
Sand, fine to coarse, light-brownish-gray	40	177
Sand, very fine to medium, and some coarse sand, light-brownish-gray	10.5	187.5
Sand, fine, silty, light-gray with yellow stain	2.5	190
Silt, clayey to fine sandy, light-gray	4.5	194.5
Sand, fine to medium, brownish-gray; contains some fine gravel	17.5	212
Silt, sandy to clayey, calcareous, medium-dark-gray	5.5	217.5
Sand, fine to medium, brownish-gray	15.5	233
Sand, medium to coarse, brownish-gray with dark speckling; contains a small amount of coarse gravel	8.5	241.5
Silt, slightly clayey to fine sandy, light-medium-gray to blue tinge; contains limy nodular fragments	2.5	244
Silt, clayey to sandy, calcareous, medium-olive-gray	6	250
Silt, fine sandy, slightly clayey, calcareous, light-brownish-gray; contains thin, limy, nodular layers	16.5	266.5
Siltstone, very fine sandy, calcareous, brown to brownish-gray; contains rootlets and limy nodular material	7	273.5
Silt, fine sandy, calcareous, light-brownish-gray	3	276.5
Silt, sandy, calcareous, light-brownish-gray; contains dense limy nodular layers	13.5	290
Silt, clayey, calcareous, light-gray	10	300
Silt, slightly clayey, calcareous, light-gray; contains limonitic grains	10	310
Silt, clayey, tannish-gray; contains chalk fragments and ironstone	43.5	353.5
Clay shale, dark-gray to black	6.5	360

13-3-24ad. Polk County. (42 ft west and 15 ft north of SE cor. NE ¼ sec. 24, on west side of road.) Surface altitude, 1,676 ft. Depth to water, 67.46 ft, August 27, 1949.

Silt, loamy, medium-dark-brownish-gray	1	1
Silt, moderately clayey, medium-brownish-gray	2	3
Silt, moderately clayey, buff-gray; contains limonitic flecks	4	7
Silt, fine, buff-gray, yellow limonitic tinge	15	22
Silt, slightly clayey, light-buff-gray with yellowish-orange iron flecks	3	25
Silt, slightly clayey, loamy, dark-brownish-gray; contains a few limonitic rootlets and a rusty stain	3.5	28.5
Silt, moderately clayey to sandy, brownish-tan to gray	7.5	36
Clay, silty, light- to medium-gray	4.5	40.5
Silt, clayey, light-gray to green and light-brownish-gray; contains many iron concretions	7.5	48
Silt, moderately clayey, light-tannish-gray to light-gray; contains rust staining and iron concretions	2	50
Silt, slightly clayey, tannish-gray; contains a few light-gray limy flecks	11	61
Sand, very fine to medium, slightly silty, brownish-gray	4	65

Table 7.—*Logs of test holes*— Continued

13-3-24ad—Continued

	Thickness (feet)	Depth (feet)
Sand, fine to coarse, highly iron-stained, brownish-gray	14	79
Sand, fine to coarse, light-brownish-gray; contains a trace of fine gravel	13.5	92.5
Silt, moderately clayey to sandy, light-brownish-gray	3	95.5
Sand, fine to very coarse, light-brownish-gray; contains some fine gravel	24.5	120
Sand, fine to coarse, light-brownish-gray	11	131
Silt, sandy, fine, calcareous, light-bluish-gray; contains many pelecypod shells and a few snail shells	8	139
Sand, fine to coarse, slightly silty, brownish-gray	4.5	143.5
Sand, fine to very coarse, light-brownish-gray	6.5	150
Sand, fine to coarse, light-brownish-gray, and light-medium-gray at 153 ft; contains silt granules at 160 to 166.5 ft	16.5	166.5
Sand, fine, to fine gravel, light-medium-gray	7.5	174
Silt, clayey to slightly sandy, light-medium-gray	1	175
Sand, very fine to medium, light-gray; contains wood at 183 ft	10	185
Sand, fine to medium, well-rounded, dark speckling, light-medium-gray	9	194
Silt, slightly clayey to moderately sandy, slightly calcareous, medium-gray; contains a few snail shells	10	204
Sand, fine to coarse, slightly silty, medium-gray	6	210
Sand, medium to very coarse, medium-gray, with a brown tinge	17	227
Silt, slightly sandy, calcareous, light-gray; contains some hard limy nodular layers from 230.5 to 240 ft	13	240
Siltstone, granular, medium-gray	3	243
Silt, slightly sandy, calcareous, light-brownish-gray with a buff tinge; contains a few limy layers and intermittent hard layers	17	260
Silt, clayey to sandy, calcareous; contains hard limy zones from 280 to 282 ft	25	285
Clay, reworked, granular, calcareous, brownish-gray	5	290
Clay, granular, calcareous, light-buff-gray to buff-gray	17	307
Silt, moderately clayey, slightly micaceous, slightly sandy, slightly pyritic from 342 to 345 ft	38	345
Silt, clayey, calcareous, medium-gray	45	390
Sand, coarse, to fine gravel, green	4	394
Clay shale, dark-gray	6	400

13-4-19cc. Polk County. (119 ft north and 10 ft east of SW cor. sec. 19, on east shoulder of road.) Surface altitude, 1,758 ft. Depth to water, 62.63 ft, August 1, 1946.

Loam, silty, dark-brown	1.5	1.5
Silt, clayey, medium-brown	2	3.5
Clay, silty, firm, medium-brownish-gray	1.5	5
Silt, clayey, light-grayish-tan to buff with limonitic stain	10	15
Silt, light-grayish-buff with a faint limonitic stain	17	32
Silt, fine sandy, carbonaceous, dark-brown; soil	3.8	35.8
Silt, clayey to sandy, firm, medium-gray	2.2	38
Clay, silty, firm, light-gray; contains some calcareous nodules	22	60
Silt, clayey to sandy, medium-dark-brown to light-gray	5	65
Sand, fine, to fine gravel, light-brownish-gray to pink; contains some medium to coarse gravel and pebbles	35	100
Silt, sandy, soft, light-brownish-gray	4	104
Sand, medium, to coarse gravel, light-brownish-gray	17.5	121.5
Silt, clayey, light-bluish-gray to medium-light-gray	2.5	124
Sand, fine, silty, partly indurated, medium-gray	9	133
Silt, sandy, moderately calcareous, light-gray to brownish-gray	4.5	137.5
Clay fragments and sand, dark-green	2.5	140
Sand, fine to coarse, light-greenish-gray	10	150
Sand, silty, partly indurated, medium-gray to greenish; contains green clay fragments	10	160
Sand, fine to medium, medium-gray	3	163
Silt, carbonaceous, chocolate-brown	3	166
Sand, fine, silty, firm, medium-light-gray to green	3	169
Sand, silty, slightly indurated, medium-greenish-gray	2	171
Sand, fine, silty, light-greenish-gray to gray	3	174

Table 7.—*Logs of test holes*— Continued

13-4-19cc—Continued

	Thickness (feet)	Depth (feet)
Sand, fine, light-gray	7.5	181.5
Silt, clayey, medium-light-gray to blue	3.5	185
Clay, silty, firm, medium-light-gray with blue tinge	5	190
Silt, clayey, medium-light-gray; contains a sandy silt zone at 197 to 198 ft	12	202
Sand, fine to medium, medium-light-gray to brown; contains a thin grayish to black sandy silt zone at 202 ft	15.5	217.5
Clay, silty, light-gray to green; contains a thin peat zone at 217.5 ft	1.5	219
Sand, fine to medium, medium-light-gray	11	230
Sand, fine to coarse, medium-light-gray; contains some fine gravel	26.5	256.5
Silt, soft, slightly calcareous, interbedded with medium-light-gray to greenish sand	11.5	268
Sand, fine to medium, light-gray	4	272
Silt, soft, light-greenish-gray	5	277
Sand, fine to medium, medium-light-gray	18	295
Silt, clayey, soft, medium-dark-gray	1	296
Silt, clayey, very soft, medium-light-gray to brown	24	320
Silt, soft, light-gray to green	4.5	324.5
Sand, fine to medium, medium-light-gray	1.5	326
Silt, clayey, soft, medium-dark-gray	14	340
Silt, soft, medium-light-gray to green; contains many shell fragments	5	345
Sand, fine to medium, light-gray; contains many shell fragments	7	352
Clay, silty, moderately calcareous, soft, sticky, medium-gray	8	360
Clay, soft to firm, medium-dark-gray	25	385
Sand, fine to medium, medium-gray	9.5	394.5
Silt and fine sand, interbedded, soft, medium-gray	5.5	400
Silt containing fine sand to fine gravel, medium-dark-gray; contains chalk fragments	9.5	409.5
Clay shale, silty to clayey, black	10.5	420

14-1-22da. Polk County. (7 ft west and 61 ft south of NE cor. SE¼ sec. 22.) Surface altitude, 1,633.0 ft. Depth to water, 83.71 ft, August 20, 1945.

Road fill: clay, silty, dark-gray to brown	1	1
Clay soil, silty, dark-gray to brown	1	2
Clay, silty, medium-brownish-gray	2	4
Silt, clayey, light-brownish-gray with ferruginous spots	6	10
Silt, clayey, slightly to moderately calcareous, light-gray to brown with ferruginous spots, noncalcareous at 25 to 30 ft	20	30
Clay, silty, soft, dark-brownish-gray (old soil zone)	2	32
Clay, silty, brownish-gray with pink tinge	2	34
Silt, clayey, light-brownish-gray, pinkish-gray	16	50
Silt, slightly sandy, light-brownish-gray to pink	4	54
Sand, silty, light-brownish-gray	6	60
Sand, fine to medium, light-gray to brown	5	65
Sand, medium to coarse, light-yellowish-gray; contains some gravel	3	68
Clay, silty, pinkish to brownish-gray	2	70
Silt, sandy, light-brownish to pink	4	74
Silt, clayey, soft, light-gray to green	17	91
Silt, clayey, and bentonitic clay, light-pinkish-brown	4	95
Silt, clayey, with bentonitic clay inclusions, light-gray	5	100
Silt, clayey to sandy, medium-light-gray	4	104
Sand, medium to coarse, pinkish-gray to brown; contains some fine gravel	6	110
Sand, medium, to fine gravel	15	125
Silt, slightly clayey, medium-light-gray	10	135
Silt, sandy in part, medium-light-gray	5	140
Silt, slightly calcareous, medium-light-gray; contains bentonitic clay inclusions	10	150
Silt, calcareous, somewhat fossiliferous, medium-light-gray	20	170
Silt, clayey, calcareous, fossiliferous, medium-light-gray	5	175
Silt, clayey, calcareous, medium-light-gray	6	181
Clay, silty, calcareous, fossiliferous, medium-dark-gray to blue	15	196
Clay, silty, calcareous, medium-dark-gray to bluish; contains white chalky inclusions	4	200

Table 7.—*Logs of test holes*—Continued

14-1-22da—Continued

	Thickness (feet)	Depth (feet)
Sand, greenish-gray to pink; contains some fine gravel and a few small pebbles	10	210
Sand, coarse, and fine gravel, somewhat feldspathic, greenish-gray to pink	66	276
Sand, coarse, greenish-gray to pink; contains much fine gravel	24	300
Sand, medium, to medium gravel, pinkish- to greenish-gray	15	315
Sand, medium to coarse, pinkish- to greenish-gray; contains fine gravel	23	338
Shale, hard, calcareous, dark-gray to black	2	340
Shale, hard, calcareous, dark-gray to black with light-gray specks	10	350

14-2-4cc. Polk County. (49 ft east and 32 ft north of SW cor. sec. 4.) Surface altitude, 1,693 ft. Depth to water, 87.78 ft, August 24, 1946.

Loam, silty, dark-brown	2	2
Clay, silty, medium-brownish-gray	4	6
Silt, clayey, light-tan to buff	4	10
Silt, soft, light-brown to gray	10	20
Silt, light-gray to brown	5	25
Silt, light-gray; contains a few limonitic pellets	11	36
Silt, clayey, light to dark-brownish-gray	6	40
Silt, clayey, firm, medium-light-gray	5	45
Silt, clayey, light-gray with a yellow-brown limonitic layer at 45 ft	5	50
Silt, light-gray with pink tinge	5	55
Silt, sandy, pinkish-buff	5	60
Silt, sandy, light-grayish-tan	10	70
Sand, silty, fine, light-brownish-gray	10	80
Sand, fine to coarse, light-brownish-gray; contains some fine gravel	5	85
Sand, medium, to coarse gravel, pinkish-gray to brown; contains a light-gray clay seam at 108 ft	28	113
Silt, clayey, light-gray to a light-green	23	136
Sand, silty, light-gray to brown	14	150
Silt, sandy, firm, light-brownish-gray	2.5	152.5
Silt, clayey, firm, light-gray	3.5	156
Sand, silty, light-brown to gray, silt seam at 6.5 to 7.5 ft	4	160
Sand, fine to coarse	16	176
Silt, sandy, light-bluish-gray; contains gray clay shale fragments	14	190
Silt, clayey, firm, light-gray to blue	5	195
Clay, silty, dark-gray to brown; contains many fragments of pelecypod and gastropod shells	5	200
Silt, clayey to sandy, dark-grayish-black; contains shell fragments	2	202
Silt, clayey to sandy, brown tinge	3	205
Silt to sand, dark-gray; contains shell fragments	5	210
Sand, medium, to coarse gravel, brownish-gray to grayish-white; contains chalk fragments from 220 to 227 ft	17	227
Clay, soft, medium-light-gray	2	229
Gravel, coarse, composed of chalk	7	236
Chalk, soft, white to pale-yellow	4	240
Chalk, firm to hard, pale-yellow	14	254
Clay shale, noncalcareous, dark-gray to black	16	270

14-2-18da. Polk County. (1,428 ft north and 8 ft west of SE cor. sec. 18, on west shoulder of road.) Surface altitude, 1,681 ft. Depth to water, 91.03 ft, August 27, 1949.

Silt, loam, dark-brownish-gray	0.5	0.5
Silt, slightly to moderately clayey, slightly calcareous, buff-gray with a brown tinge	1.5	2
Silt, slightly sandy, yellowish-gray with a limonitic tinge	8	10
Silt, sandy, contains a few snail shells at 20 ft	20.5	30.5
Silt, loamy, clayey to sandy, dark-brownish-gray with a tan tinge	3.5	34
Silt, slightly clayey to slightly sandy, tannish-gray with a pink tinge	6	40
Silt, slightly clayey to very slightly sandy, light-medium-gray; contains a soil zone	5	45
Silt, clayey to sandy, tannish-gray	6	51

Table 7.—*Logs of test holes*—Continued

14-2-18da—Continued

	Thickness (feet)	Depth (feet)
Sand, very fine to fine, silty, tannish-gray	11.5	62.5
Sand, very fine to coarse, slightly silty, brownish-gray	7.5	70
Sand, very fine to coarse, brownish-gray	10.5	80.5
Sand, silty, very fine to coarse, calcareous, light-gray; contains many large pelecypod shells at 93 ft	13.5	94
Silt, clayey to slightly sandy, light-gray to tannish-gray	11	105
Silt, moderately clayey to very sandy, light-medium-gray	3.5	108.5
Sand, fine to very coarse, brownish-gray	14	122.5
Silt, clayey to sandy, light-gray with yellow stain at 123 to 125 ft	2.5	125
Sand, silty, very fine to fine, light-brownish-gray	5	130
Silt, clayey to sandy, light-brownish-gray	5	135
Silt, very fine sandy, brownish-gray; contains many yellowish-brown clay granules	5	140
Siltstone, sandy, brownish-gray	4.5	144.5
Siltstone, whitish to light-brownish-gray; may contain volcanic ash	2	146.5
Clay and silt, light-medium-gray; becomes sandy at 150 ft and contains a dark-brownish-gray sandy layer at 155 ft	13.5	160
Sand, silty, with silty clay granules, light-brownish-gray	5	165
Sand, fine to medium, silty; contains many clay granules	5	170
Silt, clayey to sandy, light-brownish-gray; contains some fine gravel	10	180
Sand, fine to coarse, silty, brownish-gray	10	190
Sand, fine to coarse, silty, brownish-gray; contains some fine to very coarse gravel	10	200
Sand, fine to very coarse, brownish-gray	10	210
Sand, medium, to fine gravel, brownish-gray; contains a few limy grains	3	213
Silt, slightly clayey, calcareous, light-medium-gray	2	215
Silt, moderately clayey, calcareous, brownish-gray; contains limy nodules	15	230
Limestone, chalky, white	2	232
Limestone, chalky, yellow to white to yellowish-gray	28	260
Shale, yellowish-brown with a light-gray tinge; contains very fine to fine sand; contains some ironstone	3	263
Clay shale, dark-gray	7	270

14-2-28cc. Polk County. (130 ft north and 9 ft east of SW cor. sec. 28, on east shoulder of road.) Surface altitude, 1,705 ft. Depth to water, 17.82 ft, August 24, 1945.

Loam, silty, dark-brown	1	1
Clay, silty, medium-dark-brown	2	3
Silt, light-brown to tan with a few limonitic flecks	5	8
Silt, clayey, soft, tan-gray to buff	12	20
Silt, clayey, soft, tan-gray to buff; contains limonitic pellets	8	28
Clay, silty, carbonaceous, dark-brown-gray	2	30
Clay, silty, firm, light- to dark-gray to brown	5	35
Clay, silty to sandy, orange tinge	3	38
Sand, silty, light-brownish to orange	12	50
Silt, slightly sandy, olive-brown	3	53
Silt, sandy, olive-brown to gray	7	60
Sand, silty, brown-gray	10	70
Sand, silty, gray to tan	5	75
Silt, sandy, gray to tan	15	90
Silt, slightly sandy, firm, light-gray to tan	10	100
Sand, fine to coarse, light-gray to brown; contains some fine gravel	5	105
Sand; contains much fine to medium gravel	5	110
Gravel, fine to coarse, sandy, pinkish-gray to brown	20	130
Sand and gravel, pinkish-gray to brown	15	145
Sand, with silt layers; contains medium gravel	5	150
Silt, sandy, light-gray to green	5	155
Sand, fine to coarse, light-gray to brown; contains some medium gravel	15	170
Silt, clayey, light-bluish-gray	20	190
Sand and gravel, brownish-gray to pink	36	226
Silt, soft, light-gray to tan	19	245
Silt, whitish; contains calcareous concretionary nodules and a few limestone fragments at 260 ft and from 270 to 290 ft	45	290

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Table 7.—*Logs of test holes*—Continued

14-2-28cc—Continued

	Thickness (feet)	Depth (feet)
Silt, sandy, light-brownish-gray to tan; contains some limonitic fragments	30	320
Silt, light-grayish-tan; contains many limonitic fragments	7	327
Clay shale, firm to hard, dark-brownish-black	23	350

14-4-19ab. Polk County. (435 ft east and 35 ft south of NW cor. sec. 19, on south shoulder of road.) Surface altitude, 1,625.5 ft. Depth to water, 4.61 ft, August 22, 1946.

Loam, very sandy, medium-dark-brown	1.5	1.5
Sand, fine to coarse, pinkish-gray to brown; contains a small amount of gravel	3.5	5
Sand, fine, to coarse gravel, reddish-brown to gray; contains many large pebbles at 15 ft	30	35
Clay, silty, firm, light-gray to tan	4	39
Clay, silty, firm, pinkish-tan	8	47
Silt, clayey, soft to firm, light-gray	4	51
Clay, silty, soft to firm, light-pinkish-tan	6	57
Clay, firm, medium-pinkish-brown in upper part, light-gray below	3	60
Clay, silty, firm, somewhat calcareous; contains many limy nodules	5	65
Clay, silty, very firm, light-brownish-tan; contains a few limy nodules above, and many reworked Niobrara fragments below	45.5	110.5
Shale, clayey to chalky, very calcareous, firm, cream-colored; contains hard chalky layers	14.5	125
Shale, chalky, calcareous, softer, light-yellow; contains some chalky layers	16.5	141.5
Shale, chalky, very firm to hard, dark-gray	8.5	150

15-1-2bb. Polk County. (125 ft south of NW cor. sec. 2, east edge of road.) Surface altitude, 1,494.8 ft. Depth to water, 16.2 ft, July 2, 1942.

Road fill	5	5
Clay, sticky, gray	3	8
Sand and fine gravel, red	8	16
Gravel, coarse, red	4	20
Sand, and fine to medium gravel	3	23
Sand, clayey to silty, gray	4	27
Clay, sandy, gray; contains fossil shells	2	29
Clay, sandy, gray-brown	7	36
Sand, clayey, soft, gray to tan	2.5	38.5
Sand, and fine to medium gravel, red	7.5	46
Sand, and fine to medium gravel, red; coarser than interval above	7	53
Gravel, fine to coarse, red, some yellow	53	106
Gravel, fine to very coarse, red	4	110
Gravel, fine to coarse, red and black	5	115
Clay, sandy, tan	2	117
Gravel, fine, yellow and red	3	120
Clay, gray to tan	3	123
Gravel, fine to coarse, dark-red	13	136
Clay, sandy, gray to tan	2	138
Gravel, fine, red	2	140
Clay, hard, compact, gray to tan; contains limy streaks	4	144
Clay, gray to tan, slightly pink	5	149
Clay, blue-gray	5	154
Gravel, fine to coarse, loose, red	23	177
Clay, sandy, buff to gray	3	180
Gravel, fine to medium, red; contains thin clay at 192 ft	24.5	204.5
Shale, rubbery compact, dark-gray to black	5.5	210

15-1-2cc. Polk County. (90 ft east of SW cor. sec. 2, on north edge of road.) Surface altitude, 1,517 ft. Depth to water 30.2 ft, July 3, 1942.

Road fill	4	4
Clay, gray-brown	4	8

Table 7. —*Logs of test holes*— Continued

15-1-2cc—Continued

	Thickness (feet)	Depth (feet)
Clay, silty, buff	10	18
Sand, silty, soft, buff	9	27
Sand and gravel, red	13	40
Gravel, fine to coarse, red	7	47
Gravel, fine to coarse, red; contains some clay	3	50
Gravel, greenish-tan; contains clay	3	53
Clay, sandy, gray-tan	13.5	66.5
Gravel, fine to coarse, yellow, red, black	59.5	126
Clay, buff to pink	11.5	137.5
Gravel, fine to coarse, red	5.5	143
Clay, sticky, buff	5	148
Gravel, fine to coarse, red	5	153
Clay, sandy, light-gray	5	158
Gravel, fine to coarse, red	19	177
Clay, sandy, gray	2.5	179.5
Gravel, fine to medium, red	6.5	186
Clay, soft, gray	3	189
Gravel, fine to medium, red, yellow	4	193
Clay, soft, gray	4	197
Gravel, fine to medium, red, yellow	10	207
Gravel, fine to coarse, red	4	211
Clay, soft, gray	4	215
Gravel, fine to medium, red	8	223
Gravel, fine to coarse, green	6	229.5
Shale, dark-gray to black with a slight green cast	10.5	240

15-1-15dd. Polk County. (8 ft north and 79 ft west of SE cor. sec. 15.) Surface altitude, 1,670 ft. Depth to water not measured.

Clay, silty, dark-brownish-gray	4	4
Clay, very silty, light-brownish-gray	3	7
Silt, clayey, light-brownish-gray to yellow	3	10
Silt, clayey, light-gray to brownish with ferruginous spots	10	20
Silt, light-gray with ferruginous spots	10	30
Clay, silty, light-gray with a few ferruginous spots	5	35
Clay, silty, soil-like, soft, medium-dark-gray	4	39
Silt, clayey, mottled medium-dark-gray and light-gray	2	41
Silt, clayey, medium-light-gray to medium-dark-gray	9	50
Silt, slightly clayey, light-brownish-gray to pink	10	60
Silt, slightly sandy, light-pinkish-brown to gray	10	70
Silt, light-pinkish-brown to gray	10	80
Silt, sandy, light-pinkish-brown to gray	5	85
Silt, sandy, light-gray to green; contains some imbedded coarse sand and gravel	5	90
Silt, clayey to sandy, brownish-gray to pink	5	95
Silt, clayey, medium-light-brown to pinkish-brown	5	100
Silt, sandy, light-gray	10	110
Sand, medium to coarse, light-gray	12	122
Silt, sandy, light-gray; contains silt layers	12	134
Sand, fine to coarse, light to pinkish-gray	11	145
Silt, slightly clayey, light-gray	12	157
Sand, fine to medium coarse, light-gray with black grains	31	188
Silt, clayey, moderately calcareous, medium-light-gray; contains pelecypod shells and fragments of gastropod shells	21.5	209.5
Sand, coarse, feldspathic, light- to pinkish-gray	5.5	215
Sand, coarse to very coarse, feldspathic, light- to pinkish-gray	10	225
Sand, coarse, light- to pinkish-gray; contains some fine gravel and a few black grains	67	292
Silt, light-brownish-gray	18	310
Gravel, fine to medium, feldspathic, pinkish-gray	4	314
Clay shale, soft, slightly calcareous, yellowish to light-greenish-gray	11	325
Clay shale, moderately calcareous, medium- to yellowish gray; contains ferruginous seams	11	336
Clay shale, moderately calcareous, dark-gray to black; contains some aragonite and ironstone	14	350

Table 7.—*Logs of test holes*— Continued

15-1-34dd. Polk County. (8 ft north and 91 ft west of SW cor. sec. 34.) Surface altitude, 1,650 ft. Depth to water not measured; hole caved in at 105 ft.

	Thickness (feet)	Depth (feet)
Clay, loam, silty, dark-gray to brown	2	2
Silt, clayey, light-brownish-gray	4	6
Silt, clayey, light-gray to yellowish with ferruginous spots	4	10
Silt, slightly clayey, light-gray to slightly yellowish gray	23	33
Silt, clayey, light-pinkish to brownish-gray	2	35
Clay, silty, light-brownish to reddish-gray	5	40
Silt, clayey, slightly sandy, light-brownish to pinkish-gray	20	60
Silt, slightly sandy, light-brownish to pinkish-gray	6	66
Sand, fine to coarse, feldspathic, brownish-gray; contains some fine gravel	9	75
Sand, medium to coarse, with some fine gravel, brownish-gray	10	85
Sand, medium to coarse, brownish-gray	5	90
Sand, medium to coarse, brownish-gray; contains some fine gravel and a thin silt layer at 92 ft	10	100
Sand, medium to coarse, and fine to medium gravel, brownish-gray	5	115
Sand, medium to coarse, and fine gravel, brownish-gray	10	125
Silt, and interbedded fine sand, light-gray	5	130
Silt, sandy, medium-light-gray; contains a thin silt layer at 132 ft	5	135
Silt, soft, medium-light-gray	9	144
Sand, fine to medium, light-gray with a few black grains	21	165
Silt, clayey, soft, light-greenish-gray	15	180
Silt, clayey, moderately calcareous, fossiliferous, moderately calcareous, medium- to light-greenish-gray	5	185
Silt, clayey, calcareous, fossiliferous, medium-dark-gray to bluish-gray	5	190
Silt, clayey, calcareous, fossiliferous, medium-gray; contains many calcareous silt concretions	7	197
Sand, medium to coarse, silty, gray	3	200
Clay, silty, chalky, calcareous, dark-bluish-gray; contains a few fossil fragments	3.5	203.5
Sand, medium to coarse, and some fine gravel, greenish-gray	6.5	210
Sand, medium to coarse, and fine to coarse gravel, feldspathic, greenish- to pinkish-gray	79.5	289.5
Clay shale, soft, dark-gray, partly yellowish-gray	11.5	301
Clay shale, slightly calcareous, dark-gray; contains ferruginous seams	4	305
Clay shale, hard, moderately calcareous, grayish-black	15	320

15-2-6dd. Polk County. (255 ft north of SE cor. sec. 6, on west edge of road.) Surface altitude, 1,525 ft. Depth to water, 5.0 ft, July 21, 1942.

Road fill	5	5
Sand, and fine to coarse gravel, red and green	5	10
Clay, silty, greenish-gray	3	13
Clay, sticky, limy, buff to tan	23	36
Clay, limy, hard, white to tan	1	37
Clay, sticky, limy, tan to pink	22	59
Gravel, fine to coarse, green and red	24	83
Clay, silty, gray	2	85
Gravel, fine, green; contains some clay	2.5	87.5
Clay, sandy, greenish-gray	3.5	91
Gravel, fine, green	2	93
Clay, sandy, green	6	99
Clay, sandy, sticky, tan and gray	50	149
Limestone, very hard	.5	149.5
Gravel, fine, compact, green; contains some calcareous fragments in sample	18.5	168
Shale, gray to rusty	1	169
Shale, rubbery, compact, black	11	180

15-2-17bb. Polk County. (120 ft south of NW cor. sec. 17, on east edge of road.) Surface altitude, 1,533 ft. Depth to water, 5.5 ft, July 22, 1942.

Road fill	4	4
Sand and fine to coarse gravel, red	17	21

Table 7.—*Logs of test holes*— Continued

15-2-17bb—Continued

	Thickness (feet)	Depth (feet)
Clay, tan	1	22
Clay, sandy, greenish-gray	2	24
Clay, silty, dark-gray to black; contains a few sand grains and small pebbles	32	56
Clay, tan to pink; contains a few sand grains	7	63
Clay, tan to pink; contains limy streaks and lime pebbles	5	68
Clay, silty to sandy, sticky, tan	9	77
Clay, sandy, tan to gray-brown	6	83
Clay, sandy, gray	1.5	84.5
Gravel; contains tan sandy clay	4.5	89
Clay, sticky, light-gray	5	94
Clay, sandy, greenish-gray	6	100
Clay, sandy, gray-brown	4	104
Clay, tan; contains lime pebbles	1	105
Clay, sandy, gray	19	124
Clay, gray; contains lime pebbles	7	131
Clay, white to tan; contains limy pebbles	7	138
Clay, dark-gray	7	145
Sand and gravel, red	8	153
Clay, sandy, gray	12	165
Sand, clayey, gray	5	170
Gravel, fine, red	6	176
Clay, sandy, gray; contains a few calcareous pebbles	2	178
Gravel, fine to medium, green; contains calcareous pebbles	9.5	187.5
Shale, green	.5	188
Shale, tough, rubbery, black	12	200

15-2-19aa. Polk County. (145 ft south of NE cor. sec. 19, on west edge of road.) Surface altitude, 1,545 ft. Depth to water, 5.6 ft, July 26, 1942.

Road fill	3	3
Clay, sandy, buff	2	5
Clay, sandy, gray-brown	4.5	9.5
Sand and fine gravel, red	6.5	16
Sand and fine to coarse gravel, red	18.5	34.5
Clay, tan	1.5	36
Clay, silty, gray	10	46
Sand, clayey, gray; contains some pebbles	4	50
Sand and fine gravel	2	52
Silt, gray	2	54
Silt and fine gravel	2	56
Clay, silty, gray	4	60
Gravel and limestone pebbles	3	63
Silt, gray; contains limy pebbles	5	68
Clay, silty, gray	9	77
Sand and fine to coarse gravel, green, gray and red; contains some limy pebbles	12	89
Clay, silty, greenish-gray	4	93
Clay, silty, gray-brown to pink	26	119
Sand and gravel; contains some tan clayey sand	5	124
Clay, greenish to dark-gray	6	130
Clay, soft, sticky, dark-gray	26	156
Gravel, fine to medium, gray; contains some calcareous pebbles	3	159
Clay, sticky, tough, gray	17	176
Clay, sticky, dark-gray	14	190
Clay, dark-gray to black; contains marcasite	10	200

15-2-20cc. Polk County. (68 ft east of SW cor. sec. 20, on north edge of road.) Surface altitude, 1,579 ft. Depth to water, 29.9 ft, July 26, 1942.

Soil, brown	5	5
Clay, sandy, buff	34	39
Silt, dark-brown to black	3	42
Sand and fine to coarse gravel, red	12	54

Table 7.—*Logs of test holes*—Continued

15-2-20cc—Continued

	Thickness (feet)	Depth (feet)
Sand, silty, tan	3	57
Gravel, fine to medium, red	3	60
Sand with a little fine gravel, compact	15	75
Silt, dark-gray to black	1	76
Gravel, fine to coarse, gray; contains calcareous pebbles	1.5	77.5
Clay, black; contains some sand and few pebbles	7.5	85
Sand, fine, brown	7	92
Clay, silty, gray; contains calcareous pebbles below 95 ft	13	105
Clay, silty, brown	15	120
Clay, silty, brown to gray	10	130
Clay, hard, very sticky, gray	17	147
Clay, sandy, tan	3	150
Clay, silty, tan	9	159
Clay, limy, white; contains a little gravel	6	165
Sand, gray, green and red; contains a small amount of gravel	5	170
Sand and green gravel; contains some calcareous pebbles	3	173
Clay, light-gray to rusty	3	176
Shale, dark-gray to blue-black; contains marcasite below 190 ft	54	230

15-2-31aa. Polk County. (11 ft south of NE cor. sec. 31, on west edge of road.) Surface altitude, 1,696 ft. Depth to water, 132 ft, August 27, 1949.

Loam, silty, brownish-gray	1	1
Silt, clayey, buff	.5	1.5
Silt, clayey, buff; contains iron stain	5	6.5
Silt, sandy, calcareous, gray; contains rootlets and snail shells	3.5	10
Silt, sandy, calcareous, buff; contains snail shells	21	31
Silt, clayey, calcareous, buff	8	39
Silt, sandy, dark-brown to gray	4	43
Silt, clayey, gray; contains some medium sand	2	45
Silt, sandy, buff-gray with a tan tinge	5	50
Sand, fine to coarse, silty, tannish-gray	5	55
Sand, fine to coarse, light-gray	5.5	60.5
Sand, very fine to fine, silty, slightly calcareous, light-buff-gray	2.5	63
Silt, fine sandy, slightly calcareous, light-buff-gray	3	66
Sand, very fine to fine, medium-brownish-gray	4	70
Silt, very fine to fine sandy, slightly calcareous, light-gray; contains a few limonitic flecks	10	80
Sand, very fine to coarse, very silty, light-buff-gray with a few limonitic flecks	4	84
Sand, fine to very coarse, light-gray	3.5	87.5
Sand, fine, and gravel, medium, brownish-gray with very slight iron staining	16.5	104
Silt and sand, interbedded, light-gray	6	110
Sand, fine to coarse, light- to pinkish-brownish-gray; contains some fine to medium gravel	39.5	149.5
Clay, silty, light-gray; contains weathered clay granules	3	152.5
Sand, fine to coarse, light-gray	10.5	163
Silt and siltstone, brownish-gray with a green tinge; contains rounded silty-clay granules	2.5	165.5
Silt, moderately clayey, light-medium-gray, bluish tinge	4.5	170
Silt, slightly clayey to silty, light-buff-gray	1	171
Sand, very fine to coarse, light-brownish-gray	19	190
Sand, fine to coarse, slightly calcareous, light-medium-gray; contains scattered gravel	1.5	191.5
Silt, coarse, slightly clayey, calcareous, light-medium-gray	4.5	196
Clay, silty to moderately sandy, till-like, gravelly, calcareous, medium-dark-gray	5	201
Sand, very fine to coarse, calcareous, medium-gray	4	205
Silt, till-like, very sandy to gravelly, calcareous, medium-dark-gray	6	211
Sand, very fine to medium, slightly calcareous, medium-gray	9	220
Sand, medium, to medium gravel, slightly calcareous, light-medium-gray	4.5	224.5
Silt, white calcareous mottling, light-medium-gray; contains a few rootlets and limy nodules	5.5	230

Table 7.—*Logs of test holes*— Continued

15-2-31aa—Continued

	Thickness (feet)	Depth (feet)
Silt, sandy, calcareous, slightly consolidated, light-medium-gray with a brown tinge; contains many rootlets	5	235
Silt, clayey to sandy, calcareous, light- to medium-gray	5	240
Silt, sandy, calcareous, light-medium to brownish-gray with some mottling	20	260
Silt, fine sandy, calcareous, light-brownish-gray; contains a few shell fragments	23.5	283.5
Sand, very fine to fine, light-brownish-gray	4.5	288
Silt, very fine sandy, calcareous, light-brownish-gray	10.5	298.5
Clay, silty, calcareous, light-brownish to medium-dark-gray	37.5	336
Sand, fine to coarse, slightly calcareous, brownish-gray to medium-dark-gray to greenish-gray	33	369
Clay, shale, dark-gray with a slight-brown tinge; contains a hard zone at 371.5 ft	11	380

16-1-11bb. Polk County. (550 ft south of NW cor. sec. 11, east edge of road.) Surface altitude, 1,457.8 ft. Depth to water, 5.1 ft, July 6, 1942.

Road fill	5	5
Sand and fine to coarse gravel, red	5	10
Gravel, fine to medium, red	5	15
Gravel, fine to coarse, green, gray and red; contains some sand	14	29
Clay, thin, soft	1	30
Gravel, fine to coarse, green	10	40
Gravel, fine to medium, green	4	44
Gravel, fine to very coarse, green	5	49
Sand and fine to medium gravel, green	4.5	53.5
Clay, green	1.5	55
Gravel, coarse, green and red	3	58
Clay, sandy, gray to tan	7	65
Gravel, fine to medium, gray, green, and red	3.5	68.5
Clay, light-tan	1.5	70
Clay, gray to tan; contains limy streaks	16	86
Clay, yellow	4	90
Clay, reddish	4	94
Shale, light-greenish-gray to gray	3	97
Shale, dark-gray to black	13	110
Shale, black; contains gypsum crystals	30	140

16-1-14bb. Polk County. (75 ft south of NW cor. sec. 14, east edge of road.) Surface altitude, 1,457.8 ft. Depth to water, 4.5 ft, July 6, 1942.

Road fill	2	2
Sand and fine gravel, red	13	15
Sand and fine to medium gravel	7	22
Gravel, fine to medium, red	12	34
Gravel, fine to coarse, red	12	46
Gravel, coarse, red	5	51
Clay, sandy, gray	2	53
Clay, sandy, blue-gray	7	60
Clay, sandy, sticky, tan to gray	23	83
Clay, soft, sticky, red	11	94
Clay, somewhat laminated, light-gray to dark-green	6	100
Clay, gray to dark-green	6	106
Gravel, loose, yellow	2.5	108.5
Shale, soft, light-gray	3.5	112
Shale, gray to dark-gray	12	124
Shale, compact, dark-gray to black, with a greenish cast	79	203
Shale, dark-gray to black	8	211
Limestone, very hard; consists of thin shell fragments	5	216
Shale, very tough, dark-gray to brownish-black; contains thin limestone streaks	28	244
Shale, hard, dark-gray to brownish-black	12	256
Limestone, very hard; contains layers of dark-brown to black shell	14	270

Table 7.—*Logs of test holes*—Continued

16-1-23bb. Polk County. (120 ft south of NW cor. sec. 23, east edge of road.) Surface altitude, 1,458.4 ft. Depth to water, 3.5 ft, July 6, 1942.

	Thickness (feet)	Depth (feet)
Soil, sandy	2	2
Sand and fine gravel, red; contains some medium gravel	14	16
Sand and fine to medium gravel, red	7	23
Gravel, fine to coarse, loose, red	7	30
Sand and fine gravel, red	3	33
Gravel, fine to coarse, loose, red	17	50
Sand and fine to medium gravel, loose, red	10	60
Sand and fine gravel	4.5	64.5
Clay, sandy, tan to greenish-gray	5.5	70
Clay, sandy, greenish-gray to brown	13	83
Clay, sandy, compact, dark-brown to black	11	94
Clay, compact, dark-gray to brown	6	100
Clay, tan to brown	3	103
Gravel, water-worn, yellow	7	110
Gravel, fine, green to yellow	4	114
Shale, light-greenish-gray	1	115
Shale, compact, rubbery, dark-gray to black with a green cast	15	130

16-1-27aa. Polk County. (75 ft south of NE cor. sec. 27, west edge of road.) Surface altitude, 1,469.3 ft. Depth to water, 4.1 ft, July 6, 1942.

Sand, fine	5	5
Clay, silty, gray	3.5	8.5
Sand and fine gravel, red	15.5	24
Gravel, fine to coarse, red; contains some sand	21	45
Gravel, coarse, red	4	49
Gravel, fine, red	4	53
Gravel, coarse to very coarse, red	7	60
Gravel, fine to medium, red and yellow; contains some coarse gravel	12	72
Clay, sandy, tough, tan to brown	16	88
Clay, tan to brown; contains some gravel	6	94
Gravel, fine to coarse, compact, red; contains mostly medium gravel	18.5	112.5
Clay, sticky, compact, tan to gray-brown; contains some pink gravel	22.5	135
Gravel, very coarse, red	2	137
Clay, tough, compact, gray to brown	2	139
Gravel, very coarse, red; may contain clay	5	144
Gravel, very coarse, red; contains clay	9	153
Gravel, fine to medium, yellow and red	6	159
Shale, tough, rubbery, dark-gray to black	6	165

16-1-35bb. Polk County. (75 ft south, 15 ft east of NW cor. sec. 35, east edge of road.) Surface altitude, 1,483.0 ft. Depth to water, 7.8 ft, July 6, 1942.

Soil, sandy	2	2
Sand, red	3	5
Gravel, fine to coarse, red	4	9
Gravel, coarse, red	1	10
Gravel, fine to coarse, red	8	18
Clay, tough, compact, olive-gray	5	23
Clay, sticky, compact, steel-gray	2	25
Clay, sticky, gray	6	31
Clay, soft, tan to buff	3	34
Sand and fine gravel, yellow and red	11	45
Sand and fine to coarse gravel, loose, yellow and red	9	54
Gravel, fine to medium	11	65
Gravel, fine to coarse, red	13	78
Gravel, very coarse, red ½- to 1-in. diameter	12	90
Gravel, fine, red; coarse gravel from 110 ft	23	113
Clay, compact, gray-brown; contains black streaks	4	117
Gravel, fine, red; may contain clay	2.5	119.5
Clay, sticky, light-whitish-gray to tan	12.5	132
Gravel, fine, red and yellow	3	135
Clay, sandy, gray-brown	2	137

Table 7.—*Logs of test holes*— Continued

16-1-1-35bb—Continued

	Thickness (feet)	Depth (feet)
Gravel, fine to medium, red to rusty; contains some coarse gravel	11	148
Clay, dark-gray to black	2	150
Clay, compact, gray-brown	7.5	157.5
Gravel, fine to medium, yellow and green	9.5	167
Shale, compact, rubbery, black with a slight green cast	8	175

16-2-29bb. Polk County. (1,056 ft south of NW cor. sec. 27, on west edge of road.) Surface altitude, 1,601 ft. Depth to water, 4.6 ft, July 20, 1942.

Soil, sandy	5	5
Sand and fine to coarse gravel, red	24	29
Clay, gray-brown	2	31
Gravel, fine to coarse, red	16	47
Shale, chalky, soft, white	3	50
Shale, chalky, tan and yellow	17.5	67.5
Shale, calcareous, steel-gray	8.5	76
Shale, dark-gray to black	14	90
Shale, calcareous, dark-gray	5	95
Shale, calcareous, gray	4	99
Shale, hard, calcareous, light-gray	4	103
Shale, dark-gray to black	7	110
Shale, sticky, soft, black	20	130

16-2-30dd1. Polk County. (225 ft north of SE cor. sec. 30, on west edge of road.) Surface altitude, 1,519 ft. Depth to water, 5.0 ft, July 20, 1942.

Road fill	3	3
Sand and coarse gravel; contains large pebbles	6	9
Clay, tough, tan	1.5	10.5
Clay, hard, sticky, greenish-gray	4.5	15
Sand and green fine gravel	3	18
Sand and fine to coarse gravel, red	14.5	32.5
Clay, tough, sticky, gray	1.5	34
Shale, white	1	35
Shale, hard, hole covered at surface	2	37

16-2-30dd2. Polk County. (12 ft south of test hole 16-2-30dd1.) Surface altitude, 1,517 ft. Depth to water, 3.0 ft, July 18, 1942.

Road fill	3	3
Sand, with some fine to coarse gravel	6	9
Clay, sticky, tan	2	11
Clay, blue-gray	5	16
Gravel, fine to coarse, red	17	33
Clay, tough and sticky, tan to gray	1.5	34.5
Shale, chalky, white	1	35.5
Shale, soft, yellow	1.5	37

16-2-32cc. Polk County. (150 ft north of SW cor. sec. 32, on east edge of road.) Surface altitude, 1,526 ft. Depth to water, 8.5 ft, July 26, 1942.

Soil, sandy	5	5
Sand, clayey, buff	1	6
Sand and fine to coarse gravel, red	12	18
Clay, pinkish-tan	1	19
Clay, silty, gray; contains limy streaks and limy concretions	6	25
Clay, tan; contains a few limy concretions	4	29
Clay, sandy, tan to pink	9.5	38.5
Sand and fine gravel, green and red	6.5	45
Sand and fine to coarse gravel, green and red	11	56
Clay, silty, gray	2	58
Sand and fine gravel, green and red	9	67

Table 7. —*Logs of test holes*— Continued

16-2-32cc—Continued

	Thickness (feet)	Depth (feet)
Clay, sandy, gray	2.5	69.5
Clay, sandy, pinkish-brown	5.5	75
Clay, sticky, pinkish-tan	22	97
Chalk, yellow	3	100
Shale, chalky, yellow; contains hard streaks	15	115

16-2-36cd. Polk County. (75 ft west of SE cor. SW¼sec. 36, on north edge of road.) Surface altitude, 1,524 ft, July 26, 1942.

Soil, sandy	2	2
Sand, silty, soft, buff to gray	5.5	7.5
Sand and fine to coarse gravel, red	9.5	17
Gravel, fine to coarse, red	14	31
Clay, sandy, blue-gray	8	39
Clay, sandy, sticky, pinkish-brown	5	44
Sand and fine to coarse gravel, red	10.5	54.5
Clay, tan	1	55.5
Clay, dark brownish-black; contains shell fragments	9.5	65
Clay, sticky, tan to gray	3	68
Sand and fine gravel, red	5	73
Gravel, fine to coarse, red	9	82
Gravel, fine to coarse, red; contains flint fragments	12	94
Clay, rusty	1	95
Gravel, fine to coarse, red; contains some sand	17	112
Clay, sandy, gray	2	114
Gravel, fine to medium, red	5	119
Clay, silty, greenish-gray	2	121
Gravel, fine to coarse, red	4	125
Clay, sandy, gray	4	129
Gravel, fine to coarse, red	19	148
Clay, sandy, greenish-gray	2	150
Clay, sandy, calcareous, tan	14	164
Sand and fine gravel, red	3	167
Clay, sticky, tan	5	172
Clay, sticky, compact, dark-brownish-gray	8	180
Clay, sandy, gray	7	187
Clay, sandy, gray; contains some coarse sand	3	190
Gravel, fine, red and green	3	193
Clay, sticky, gray	1	194
Gravel, fine to coarse green and gray	9.5	203.5
Shale, tough, sticky, black	6.5	210

Table 8.—*Measurements of the water level in wells*

[In feet below land-surface datum]

Date	Water level	Date	Water level	Date	Water level
HOWARD COUNTY					
15-9-16dd					
Sept. 14, 1950	14.60	Oct. 31, 1950	14.83	Nov. 29, 1950	14.93
Oct. 2	14.58				
15-9-17cc					
Sept. 14, 1950	3.11	Jan. 4, 1951	3.87	Mar. 30, 1951	4.55
Oct. 2	3.34	30	4.07	Apr. 26	4.75
31	3.65	Feb. 21	4.27	May 28	4.55
Nov. 29	3.63				
15-9-17dd					
Sept. 14, 1950	3.27	Aug. 24, 1951	3.38	Nov. 23, 1951	3.77
Oct. 2	3.32	Sept. 25	3.60	Dec. 26	3.90
31	3.85	Oct. 23	3.66	Jan. 25, 1952	3.72
July 26, 1951	2.97				
15-9-23bb					
Sept. 14, 1950	4.64	Feb. 21, 1951	3.75	Sept. 25, 1951	3.75
Oct. 2	4.73	Mar. 30	1.89	Oct. 23	3.51
31	4.43	Apr. 26	1.50	Nov. 23	3.54
Nov. 29	4.28	May 28	1.92	Dec. 26	3.60
Jan. 4, 1951	3.82	July 26	3.48	Jan. 25, 1952	3.33
30	4.01	Aug. 24	3.49		
15-9-24aa					
Sept. 14, 1950	6.28	Oct. 31, 1950	6.90	Nov. 29, 1950	7.13
Oct. 2	6.67				
15-9-24bb					
Sept. 14, 1950	3.89	Oct. 31, 1950	4.33	Nov. 29, 1950	4.57
Oct. 2	3.86				
MERRICK COUNTY					
11-8-3dd					
May 7, 1946	2.31	Nov. 3, 1947	2.27	Jan. 3, 1950	1.45
June 4	2.10	Jan. 5, 1948	1.58	Feb. 27	1.17
July 9	2.90	Mar. 17	.55	May 1	1.82
Aug. 6	3.09	May 3	1.30	July 3	2.41
Sept. 4	3.22	July 5	2.41	Sept. 13	2.37
Oct. 3	2.29	Sept. 2	3.25	Oct. 12	2.14
Nov. 5	1.04	Nov. 2	2.29	Nov. 6	2.02
Dec. 2	1.88	Jan. 5, 1949	1.89	Jan. 8, 1951	1.42
Jan. 6, 1947	1.95	Apr. 12	1.37	Mar. 26	1.55
Mar. 7	1.54	July 5	1.80	May 1	1.39
May 8	2.34	Sept. 6	1.82	Nov. 6	1.66
July 10	1.85	Nov. 1	2.10	Jan. 25, 1952	1.58
Sept. 5	3.32				
11-8-8bb					
July 25, 1946	11.10	Apr. 12, 1949	8.69	Oct. 12, 1950	10.15
Mar. 7, 1947	10.02	Feb. 27, 1950	10.78	May 1, 1951	8.54
Mar. 17, 1948	10.20				

Table 8.—*Measurements of the water level in wells*— Continued

MERRICK COUNTY—Continued

11-8-16cb

Date	Water level	Date	Water level	Date	Water level
Mar. 7, 1947	5.40	Apr. 12, 1949	2.85	Oct. 12, 1950	5.58
Mar. 17, 1948	5.50	Feb. 27, 1950	5.71	May 1, 1951	4.62

12-7-4dc

Mar. 7, 1947	8.10	Apr. 12, 1949	7.51	Oct. 12, 1950	8.40
Mar. 17, 1948	8.38	Feb. 27, 1950	8.89	May 1, 1951	8.35

12-7-7aa

Jan. 4, 1946	6.36	July 10, 1947	4.34	Jan. 3, 1950	7.01
Feb. 13	6.37	Sept. 5	6.55	Feb. 27	6.94
Mar. 12	6.20	Nov. 3	7.12	May 1	6.79
Apr. 9	6.11	Jan. 5, 1948	7.10	July 3	6.69
May 7	6.46	Mar. 17	6.69	Sept. 13	6.48
June 4	6.37	May 3	6.72	Oct. 12	6.53
July 9	6.62	July 5	6.19	Nov. 6	6.79
Aug. 6	6.98	Sept. 2	6.47	Jan. 8, 1951	6.91
Sept. 4	7.32	Nov. 2	7.16	Mar. 26	6.56
Oct. 3	7.26	Jan. 5, 1949	6.82	May 1	5.93
Nov. 6	6.64	Mar. 9	6.19	July 24	5.15
Dec. 2	6.00	Apr. 13	4.72	Nov. 6	6.00
Jan. 6, 1947	6.24	July 5	5.13	Jan. 22, 1952	6.04
Mar. 6	6.25	Sept. 1	6.44	25	6.14
May 8	5.62	Nov. 1	6.74		

12-7-17bc

Mar. 7, 1947	7.68	Apr. 13, 1949	6.48	Oct. 12, 1950	7.67
Mar. 16, 1948	7.85	Feb. 28, 1950	8.15	May 1, 1951	7.98

12-8-7dc

May 8, 1946	12.50	Jan. 5, 1948	10.84	Feb. 27, 1950	9.62
June 4	11.32	Mar. 16	10.66	May 1	9.64
July 9	10.87	May 3	10.46	July 3	9.39
Sept. 4	13.79	July 5	10.16	Sept. 13	11.38
Oct. 3	12.40	Nov. 2	10.52	Oct. 12	9.61
Nov. 6	11.73	Jan. 5, 1949	10.60	Nov. 6	9.10
Dec. 2	11.44	Mar. 9	9.97	Jan. 8, 1951	9.47
Jan. 6, 1947	11.26	Apr. 13	9.79	Mar. 26	9.52
Mar. 7	11.15	July 5	8.55	May 1	9.43
May 8	10.92	Sept. 6	10.05	July 24	8.54
July 10	9.44	Nov. 1	9.50	Nov. 6	9.16
Nov. 3	10.98	Jan. 3, 1950	9.55	Jan. 25, 1952	9.25

12-8-10cc

Mar. 7, 1947	7.72	Apr. 13, 1949	8.52	Oct. 12, 1950	7.65
Mar. 16, 1948	8.02	Feb. 27, 1950	7.30		

12-8-12cc

Mar. 7, 1947	4.56	Apr. 13, 1949	2.82	Oct. 12, 1950	4.87
Mar. 16, 1948	5.30	Feb. 27, 1950	5.35	May 1, 1951	3.77

Table 8.— *Measurements of the water level in wells*— Continued

MERRICK COUNTY— Continued

12-8-20cc

Date	Water level	Date	Water level	Date	Water level
Mar. 7, 1947	18.40	Apr. 13, 1949	17.02	Oct. 12, 1950	18.41
Mar. 16, 1948	18.52	Feb. 27, 1950	17.55		

12-8-28dc

Jan. 4, 1946	1.95	July 10, 1947	0.59	Nov. 1, 1949	2.42
Feb. 13	1.80	Sept. 5	3.02	Jan. 3, 1950	2.35
Apr. 9	1.59	Nov. 3	3.30	Feb. 27	2.05
May 7	1.96	Jan. 5, 1948	2.77	May 1	1.86
June 4	1.55	Mar. 17	1.88	July 3	1.80
July 9	2.15	May 3	1.90	Sept. 13	1.61
Aug. 6	2.87	July 5	1.94	Oct. 12	1.70
Sept. 4	3.40	Sept. 2	2.60	Nov. 6	1.96
Oct. 3	3.32	Nov. 2	3.12	Jan. 8, 1951	1.94
Nov. 6	2.20	Jan. 5, 1949	3.42	Mar. 26	1.19
Dec. 2	1.24	Mar. 9	1.34	May 1	+.17
Jan. 6, 1947	1.52	Apr. 13	+.11	July 24	+.91
Mar. 7	1.52	July 5	1.80	Nov. 6	1.84
May 8	1.00	Sept. 6	1.75	Jan. 25	1.70

13-6-2bc

Jan. 4, 1946	5.36	Sept. 4, 1947	6.72	May 4, 1950	5.69
Feb. 12	5.29	Nov. 11	6.91	June 28	5.89
Mar. 12	5.04	Jan. 13, 1948	6.73	Aug. 29	5.09
Apr. 9	4.87	Mar. 18	5.86	Oct. 5	5.70
May 7	5.11	May 8	5.80	30	5.89
June 4	5.08	July 13	5.85	Nov. 27	5.98
July 9	5.46	Sept. 2	6.35	Jan. 8, 1951	6.04
Aug. 6	6.59	Nov. 2	6.85	May 7	4.93
Sept. 4	6.66	Jan. 5, 1949	6.52	July 26	4.85
Oct. 3	6.59	Mar. 8	5.25	Aug. 24	5.30
Nov. 6	5.82	Apr. 12	4.36	Sept. 25	5.49
Dec. 2	4.62	July 12	5.05	Oct. 23	5.31
Jan. 3, 1947	5.09	Sept. 2	6.30	Nov. 23	5.47
Mar. 7	5.10	Nov. 7	6.23	Dec. 26	5.43
May 7	5.57	Jan. 11, 1950	6.36	Jan. 24, 1952	5.13
July 8	4.41	Mar. 14	6.00		

13-6-4bb

Mar. 7, 1947	9.30	Apr. 12, 1949	8.53	Oct. 12, 1950	10.01
Mar. 18, 1948	9.62	Mar. 13, 1950	10.16	May 1, 1951	9.62

13-6-7bb

Jan. 4, 1946	5.58	May 8, 1947	4.47	Sept. 6, 1949	6.00
Feb. 13	5.61	July 10	4.09	Nov. 1	6.16
Mar. 12	5.45	Sept. 5	5.98	Jan. 3, 1950	6.30
Apr. 9	5.18	Nov. 3	6.54	Feb. 27	6.27
May 7	5.48	Jan. 5, 1948	6.60	May 1	5.92
June 4	5.20	Mar. 17	6.02	July 3	6.05
July 9	5.45	May 3	5.89	Sept. 13	5.98
Aug. 6	5.96	July 5	5.50	Oct. 12	6.09
Sept. 4	6.45	Sept. 2	5.94	Nov. 6	6.22
Oct. 3	6.50	Nov. 2	6.60	Jan. 8, 1951	6.33
Nov. 6	5.78	Jan. 5, 1949	6.42	Mar. 26	6.03
Dec. 2	5.00	Mar. 9	5.53	May 1	5.52
Jan. 6, 1947	5.15	Apr. 12	4.16	July 24	4.58
Mar. 7	5.26	July 5	4.50	Nov. 6	5.38

Table 8.—*Measurements of the water level in wells*— Continued

MERRICK COUNTY—Continued

13-6-15cb

Date	Water level	Date	Water level	Date	Water level
Mar. 7, 1947	6.54	Apr. 12, 1949	5.49	May 7, 1951	6.66
Mar. 17, 1948	6.86	Oct. 12, 1950	7.46		

13-6-19cb

Jan. 4, 1946	4.24	May 8, 1947	3.68	Sept. 6, 1949	4.73
Feb. 13	4.34	July 10	3.10	Nov. 1	5.18
Mar. 12	4.13	Sept. 5	5.13	Jan. 3, 1950	5.38
Apr. 9	3.98	Nov. 3	5.74	Feb. 27	5.29
May 7	4.17	Jan. 5, 1948	5.75	May 1	5.00
June 4	3.87	Mar. 17	5.07	July 3	5.10
July 9	4.47	May 3	4.86	Sept. 13	4.75
Aug. 6	5.18	July 5	4.72	Oct. 13	4.94
Sept. 4	5.50	Sept. 2	5.02	Nov. 6	5.18
Oct. 3	5.58	Nov. 2	5.75	Jan. 8, 1951	5.27
Nov. 6	5.00	Jan. 5, 1949	5.39	Mar. 26	4.78
Dec. 2	4.31	Mar. 9	4.59	May 1	4.14
Jan. 6, 1947	4.50	Apr. 12	3.34	July 24	3.82
Mar. 7	4.39	July 5	3.52	Nov. 6	4.19

13-6-28bb

Apr. 8, 1946	5.99	Sept. 4, 1947	7.40	Jan. 3, 1950	6.58
May 7	6.18	Nov. 3	7.15	11	6.55
June 4	6.32	Jan. 5, 1948	6.83	Feb. 27	5.94
July 9	6.77	Mar. 17	6.16	May 1	6.25
Aug. 6	7.25	May 3	5.82	July 3	7.00
Sept. 4	7.49	July 5	5.59	Sept. 13	6.95
Oct. 3	7.00	Sept. 2	7.22	Oct. 12	6.75
Nov. 6	6.78	Nov. 2	7.12	Nov. 6	6.69
Dec. 2	5.85	Jan. 5, 1949	6.40	Jan. 8, 1951	6.05
Jan. 6, 1947	5.12	Apr. 12	5.31	Mar. 26	5.54
Mar. 7	5.16	July 5	5.35	May 1	5.44
May 7	5.80	Sept. 2	7.14	Nov. 6	6.09
July 8	5.47	Nov. 1	6.85		

13-7-4bc

Jan. 4, 1946	7.19	May 8, 1947	6.29	Sept. 6, 1949	4.62
Feb. 13	7.20	July 10	5.23	Nov. 1	5.05
Mar. 12	7.34	Sept. 5	5.95	Jan. 3, 1950	5.36
Apr. 9	7.38	Nov. 3	6.06	Feb. 27	5.50
May 7	7.46	Jan. 5, 1948	6.36	May 1	5.60
June 4	6.20	Mar. 17	3.40	July 3	5.79
July 9	6.77	May 3	5.65	Sept. 13	5.21
Aug. 6	6.77	July 5	4.30	Oct. 13	5.27
Sept. 4	7.07	Sept. 2	4.61	Nov. 6	5.52
Oct. 3	7.20	Nov. 2	5.35	Jan. 8, 1951	5.88
Nov. 6	6.73	Jan. 5, 1949	5.52	Mar. 26	5.80
Dec. 2	6.48	Mar. 9	2.95	May 1	5.58
Jan. 6, 1947	6.57	Apr. 13	3.67	July 24	4.63
Mar. 6	6.88	July 5	4.25		

13-7-7cd

Mar. 7, 1947	8.45	Apr. 12, 1949	6.39	May 1, 1951	8.16
Mar. 17, 1948	7.86	Oct. 13, 1950	7.40		

Table 8.—*Measurements of the water level in wells*— Continued

MERRICK COUNTY—Continued

13-7-10cc

Date	Water level	Date	Water level	Date	Water level
Mar. 7, 1947	9.55	Apr. 12, 1949	7.81	Oct. 13, 1950	9.34
Mar. 17, 1948	9.08	Feb. 28, 1950	9.32	May 1, 1951	9.59

13-7-16cc

Oct. 26, 1949	11.35	Oct. 13, 1950	11.90		

13-7-22dc

Mar. 7, 1947	4.94	Apr. 12, 1949	2.79	Oct. 13, 1950	5.69
Mar. 17, 1948	5.36	Feb. 28, 1950	5.85	May 1, 1951	4.12

13-7-29cb

Mar. 12, 1946	2.07	July 10, 1947	2.75	Sept. 6, 1949	2.52
Apr. 9	2.62	Sept. 5	3.64	Nov. 1	2.72
May 7	2.88	Nov. 3	3.02	Jan. 3, 1950	2.40
June 4	1.98	Jan. 5, 1948	2.49	Feb. 27	1.85
July 9	3.58	Mar. 17	2.10	May 1	3.18
Aug. 6	4.07	May 3	1.73	July 3	3.24
Sept. 4	3.74	July 5	2.49	Sept. 13	3.08
Oct. 3	3.58	Sept. 2	3.50	Oct. 13	2.67
Nov. 6	1.00	Nov. 2	3.07	Nov. 6	2.72
Dec. 2	1.88	Jan. 5, 1949	2.09	Jan. 8, 1951	2.49
Jan. 6, 1947	2.50	Mar. 9	.40	Mar. 26	1.25
Mar. 7	2.20	Apr. 13	.68	May 1	.78
May 8	2.52	July 5	2.67	July 24	2.89

13-7-30cc

Mar. 7, 1947	16.60	Apr. 12, 1940	14.68	Oct. 13, 1950	15.97
Mar. 17, 1948	16.23	Feb. 27, 1950	16.22	May 7, 1951	15.36

13-7-36cb

Mar. 7, 1947	8.93	Apr. 12, 1949	7.51	Oct. 12, 1950	9.88
Mar. 17, 1948	9.29	Feb. 27, 1950	9.72	May 1, 1951	8.99

13-8-1cb

Oct. 26, 1949	6.02	Oct. 13, 1950	5.68		

13-8-9cd

Oct. 26, 1949	9.40	Oct. 13, 1950	8.98		

13-8-10cd

Mar. 7, 1947	6.30	Apr. 12, 1949	2.79	Oct. 13, 1950	6.17
Mar. 17, 1948	6.50	Feb. 27, 1950	6.30		

13-8-14cc

July 22, 1950	7.68	Oct. 13, 1950	8.31		

Table 8.—*Measurements of the water level in wells*—Continued

Date	Water level	Date	Water level	Date	Water level
		MERRICK COUNTY—Continued			
		13-8-19bb			
Oct. 25, 1949	5.70	Oct. 13, 1950	5.95		
		13-8-20cb			
Mar. 7, 1947	15.20	Apr. 12, 1949	11.13	Oct. 13, 1950	14.64
Mar. 17, 1948	15.10	Feb. 27, 1950	13.32	May 2, 1951	11.63
		13-8-27dc			
Mar. 7, 1947	14.58	Apr. 12, 1949	12.60	Oct. 13, 1950	12.33
Mar. 17, 1948	13.54	Feb. 27, 1950	12.44	May 2, 1951	12.90
		13-8-32dd			
Mar. 7, 1947	11.42	Feb. 27, 1950	9.22	May 2, 1951	9.06
Mar. 17, 1948	10.52	Oct. 13	8.78		
		14-4-18bb			
Apr. 9, 1946	3.98	Jan. 12, 1948	4.33	Mar. 14, 1950	3.90
May 7	4.04	Mar. 18	3.10	May 4	4.07
July 8	4.53	May 7	4.02	June 29	4.78
Aug. 5	5.29	July 12	4.32	Aug. 28	4.66
Sept. 3	5.72	Sept. 1	4.90	Oct. 5	4.59
Oct. 10	3.89	Nov. 1	5.05	Nov. 1	4.72
Nov. 4	4.22	Jan. 3, 1949	2.97	30	4.53
Dec. 9	3.52	Mar. 7	1.97	Jan. 8, 1951	4.47
Jan. 2, 1947	4.06	Apr. 12	2.62	Mar. 14	4.17
Mar. 7	3.68	July 12	3.75	May 7	3.78
May 7	3.97	Sept. 1	4.73	Aug. 22	3.72
July 7	3.46	Nov. 7	4.47	Nov. 6	4.44
Sept. 3	5.45	Jan. 9, 1950	4.55	Jan. 22, 1952	3.80
Nov. 10	4.92				
		14-5-3dd			
Aug. 1, 1950	3.92	Nov. 30, 1950	4.44	Mar. 30, 1951	2.47
28	3.45	Jan. 4, 1951	4.54	Apr. 30	2.13
Oct. 5	4.19	30	4.56	May 28	3.31
Nov. 1	4.60	Feb. 21	4.47		
		14-5-4bb			
Aug. 1, 1950	5.12	Oct. 5, 1950	5.56	Nov. 30, 1950	6.02
29	5.14	Nov. 1	5.71		
		14-5-4cb			
Aug. 1, 1950	10.21	Oct. 5, 1950	10.65	Nov. 30, 1950	11.01
29	10.10	31	10.89		
		14-5-6aa			
Mar. 7, 1947	7.42	Apr. 12, 1949	3.12	Oct. 17, 1950	8.49
Mar. 18, 1948	8.75	Mar. 13, 1950	8.83	May 7, 1951	7.17

Table 8.—*Measurements of the water level in wells*—Continued

MERRICK COUNTY—Continued

14-5-7bb

Date	Water level	Date	Water level	Date	Water level
July 31, 1950	3.00	Oct. 5, 1950	4.06	Nov. 30, 1950	4.01
Aug. 29	3.72	Nov. 1	4.24		

14-5-7cc

Mar. 7, 1947	5.35	Apr. 12, 1949	3.80	Oct. 17, 1950	6.22
Mar. 18, 1948	5.52	Mar. 13, 1950	5.00	May 7, 1951	4.95

14-5-8cc

May 15, 1950	5.84	Oct. 17, 1950	6.21		

14-5-9bc

Aug. 1, 1950	4.80	Oct. 5, 1950	4.84	Nov. 30, 1950	5.36
29	4.60	Nov. 1	5.12		

14-5-9cc2

Mar. 7, 1947	5.50	Mar. 8, 1949	5.93	Nov. 1, 1950	6.46
May 7	4.80	Apr. 12	4.84	30	6.62
July 8	4.56	July 12	5.05	Mar. 15, 1951	7.00
Sept. 4	6.65	Sept. 2	6.62	May 7	5.61
Nov. 11	7.14	Nov. 7	6.47	July 26	4.95
Jan. 13, 1948	7.06	Jan. 11, 1950	6.79	Aug. 24	5.60
Mar. 18	6.54	Mar. 14	6.52	Sept. 25	5.81
May 8	6.25	May 4	6.41	Oct. 23	5.91
July 13	6.00	June 29	6.53	Nov. 23	6.04
Sept. 2	6.44	Aug. 1	5.99	Dec. 26	6.15
Nov. 2	7.09	29	5.70	Jan. 24, 1952	5.93
Jan. 5, 1949	6.69	Oct. 5	6.23		

14-5-15da

Mar. 7, 1947	6.04	Apr. 12, 1949	4.36	Oct. 5, 1950	7.19
Mar. 18, 1948	5.68	Mar. 13, 1950	6.56	May 7, 1951	5.59

14-5-17dd

Aug. 1, 1950	9.53	Oct. 5, 1950	9.52	Nov. 30, 1950	9.94
29	8.94	Nov. 1	9.94		

14-5-19bb

July 31, 1950	6.06	Oct. 5, 1950	6.46	Nov. 30, 1950	6.80
Aug. 21	6.00	Nov. 1	6.63		

14-5-28cb

Mar. 7, 1947	6.61	Apr. 12, 1949	3.78	Oct. 17, 1950	5.95
Mar. 18, 1948	5.32	Mar. 13, 1950	5.84	May 7, 1951	5.32

Table 8.— *Measurements of the water level in wells*— Continued

Date	Water level	Date	Water level	Date	Water level
MERRICK COUNTY—Continued					
14-5-31bc					
Mar. 7, 1947	3.01	Apr. 12, 1949	2.05	Oct. 17, 1950	4.52
Mar. 18, 1948	2.92	Mar. 13, 1950	3.95	May 7, 1951	2.71
14-6-2cc					
July 31, 1950	1.94	Oct. 30, 1950	3.43	Mar. 13, 1951	5.53
Sept. 5	3.26	Nov. 27	3.20	Aug. 20	4.39
Oct. 4	2.80				
14-6-3bc					
Oct. 24, 1949	14.00	Aug. 3, 1950	14.46	Oct. 16, 1950	14.76
June 26, 1950	15.47				
14-6-4bb					
Aug. 8, 1950	5.83	Oct. 4, 1950	6.58	Nov. 27, 1950	6.92
Sept. 5	6.57	30	6.83		
14-6-6cb					
Oct. 24, 1949	7.75	Oct. 16, 1950	7.87		
14-6-9bb					
Aug. 8, 1950	5.85	Nov. 27, 1950	6.58	Mar. 30, 1950	7.08
Sept. 5	6.10	Jan. 4, 1951	6.80	Apr. 26	6.86
Oct. 4	6.23	30	6.90	May 28	6.77
30	6.34	Feb. 21	6.99		
14-6-15aa					
July 31, 1950	2.69	Oct. 4, 1950	2.90	Nov. 27, 1950	3.18
Sept. 5	3.53	30	3.45		
14-6-15bb					
Jan. 14, 1946	3.73	May 7, 1947	2.93	Sept. 2, 1948	4.96
Feb. 12	3.74	July 8	3.02	Nov. 7	4.38
Mar. 12	3.05	Sept. 4	5.48	Jan. 11, 1950	4.26
Apr. 9	3.44	Nov. 11	4.85	Mar. 14	3.19
May 7	3.55	Jan. 13, 1948	4.13	May 4	3.48
June 4	2.88	Mar. 17	2.43	June 28	4.50
July 9	4.02	May 8	3.21	Sept. 5	3.95
Aug. 6	5.02	July 13	3.29	Oct. 4	3.78
Sept. 4	5.64	Sept. 2	4.52	30	4.10
Oct. 10	3.30	Nov. 2	4.66	Nov. 27	3.94
Nov. 6	3.55	Jan. 5, 1949	3.40	Jan. 8, 1951	3.78
Dec. 10	2.60	Mar. 8	1.82	Mar. 13	3.07
Jan. 3, 1947	3.18	Apr. 12	2.24	May 7	2.80
Mar. 7	3.00	July 12	3.40	Aug. 20	3.42
14-6-17bc					
Mar. 7, 1947	14.35	Apr. 12, 1949	11.79	Oct. 12, 1950	13.56
Mar. 18, 1948	13.24	Mar. 13, 1950	13.09	May 1, 1951	13.63

Table 8.—*Measurements of the water level in wells*—Continued

MERRICK COUNTY—Continued

14-6-18bb

Date	Water level	Date	Water level	Date	Water level
Aug. 8, 1950	4.48	Oct. 3, 1950	5.26	Nov. 27, 1950	5.49
Sept. 5	5.03	30	5.34		

14-6-24bc

Mar. 7, 1947	4.45	Apr. 12, 1949	6.56	Oct. 16, 1950	8.21
Mar. 18, 1948	5.18	Mar. 13, 1950	8.52	May 7, 1951	7.39

14-6-25dd

July 31, 1950	4.87	Oct. 5, 1950	5.30	Nov. 30, 1950	5.69
Aug. 29	4.62	Nov. 1	5.61		

14-6-28cc

Mar. 7, 1947	4.80	Apr. 12, 1949	6.52	Oct. 12, 1950	5.67
Mar. 18, 1948	4.09	Mar. 13, 1950	5.05	May 1, 1951	3.69

14-7-2bb

Oct. 24, 1949	6.90	Oct. 16, 1950	6.51		

14-7-4cd

Oct. 26, 1949	7.45	Oct. 16, 1950	7.01		

14-7-5dd

Aug. 9, 1950	5.43	Oct. 3, 1950	6.75	Nov. 29, 1950	6.49
Sept. 5	6.39	31	6.82		

14-7-7bb

Aug. 4, 1950	6.74	Oct. 3, 1950	8.41	Nov. 29, 1950	10.91
Sept. 5	7.61	31	9.41		

14-7-8dd

Aug. 9, 1950	1.03	Jan. 30, 1951	2.24	Aug. 24, 1951	1.92
Sept. 5	2.01	Feb. 21	1.54	Sept. 25	1.65
Oct. 3	1.67	Mar. 30	.50	Oct. 23	1.43
31	1.85	Apr. 26	.15	Nov. 23	1.34
Nov. 28	1.47	May 28	1.43	Dec. 26	1.92
Jan. 4, 1951	1.68	July 26	2.21	Jan. 25, 1952	1.43

14-7-11bb

Mar. 7, 1947	9.92	Apr. 12, 1949	8.30	Oct. 16, 1950	8.99
Mar. 18, 1948	9.40	Feb. 27, 1950	9.06	May 1, 1951	9.15

14-7-11cc

Aug. 8, 1950	6.01	Oct. 3, 1950	6.59	Nov. 27, 1950	6.81
Sept. 5	6.78	30	6.68		

Table 8. — *Measurements of the water level in wells* — Continued

MERRICK COUNTY — Continued

14-7-13ab

Date	Water level	Date	Water level	Date	Water level
Oct. 24, 1949	8.41	Oct. 16, 1950	8.71		

14-7-21cb

Date	Water level	Date	Water level	Date	Water level
Dec. 12, 1945	7.65	May 8, 1947	5.87	Nov. 1, 1949	6.94
Jan. 4, 1946	7.42	July 10	5.39	Jan. 3, 1950	6.72
Feb. 13	7.36	Sept. 4	8.02	Feb. 27	6.52
Mar. 12	7.18	Nov. 3	7.96	May 1	6.27
Apr. 9	6.94	Jan. 5, 1948	7.56	July 3	6.94
May 7	7.32	Mar. 17	6.55	Sept. 13	6.93
June 4	6.82	May 3	6.54	Oct. 16	6.90
July 9	7.72	July 5	5.93	Nov. 6	6.89
Aug. 6	8.12	Sept. 2	7.10	Jan. 8, 1951	6.76
Sept. 4	8.29	Nov. 2	7.45	Mar. 26	6.09
Oct. 3	7.94	Jan. 5, 1949	6.84	May 1	5.11
Nov. 6	6.95	Mar. 9	4.85	July 24	5.64
Dec. 2	6.24	Apr. 13	4.16	Nov. 6	6.68
Jan. 6, 1947	6.47	July 5	5.00	Jan. 25, 1952	6.32
Mar. 6	6.33	Sept. 6	7.10		

14-7-26cc

Date	Water level	Date	Water level	Date	Water level
Apr. 9, 1946	12.95	Sept. 5, 1947	11.17	Sept. 6, 1949	10.19
May 7	13.00	Nov. 3	11.27	Nov. 1	10.32
June 4	12.66	Jan. 5, 1948	11.67	Jan. 3, 1950	10.59
July 9	12.47	Mar. 17	11.09	Feb. 27	10.83
Aug. 6	12.70	May 3	11.55	May 1	11.01
Sept. 4	12.84	July 5	11.04	July 3	11.20
Oct. 3	12.95	Sept. 2	11.19	Sept. 13	11.22
Nov. 6	12.79	Nov. 2	11.23	Oct. 16	11.28
Dec. 2	12.69	Jan. 5, 1949	11.45	Nov. 6	11.34
Jan. 6, 1947	12.48	Mar. 9	11.09	Jan. 8, 1951	11.54
Mar. 6	12.46	Apr. 13	10.51	Mar. 26	11.74
May 8	12.04	July 5	9.58	May 1	11.83
July 10	11.07				

14-8-3ab

Date	Water level	Date	Water level	Date	Water level
Oct. 25, 1949	10.08	Oct. 16, 1950	9.76		

14-8-4bb

Date	Water level	Date	Water level	Date	Water level
Oct. 26, 1949	23.10	Oct. 16, 1950	22.57		

14-8-7aa

Date	Water level	Date	Water level	Date	Water level
Oct. 25, 1949	20.72	Oct. 16, 1950	18.78		

14-8-7cd

Date	Water level	Date	Water level	Date	Water level
Oct. 25, 1949	31.80	Oct. 16, 1950	30.36		

14-8-9bb

Date	Water level	Date	Water level	Date	Water level
Aug. 3, 1950	3.07	Oct. 2, 1950	3.36	Nov. 28, 1950	3.70
29	3.35	31	3.61	Mar. 30, 1951	3.44

Table 8.—*Measurements of the water level in wells*—Continued

MERRICK COUNTY—Continued

14-8-9bb—Continued

Date	Water level	Date	Water level	Date	Water level
Apr. 26, 1951	3.54	May 28, 1951	3.48		

14-8-9cc

Date	Water level	Date	Water level	Date	Water level
Aug. 4, 1950	4.28	Jan. 4, 1951	10.29	Sept. 25, 1951	12.18
29	5.06	30	10.53	Oct. 23	12.27
Oct. 2	6.80	Feb. 21	10.70	Nov. 23	12.44
31	8.71	July 26	12.06	Dec. 26	12.69
Nov. 28	9.68	Aug. 24	12.12	Jan. 25, 1952	12.53

14-8-12dd

Date	Water level	Date	Water level	Date	Water level
Aug. 4, 1950	14.77	Oct. 3, 1950	13.83	Nov. 28, 1950	14.00
Sept. 5	13.73	31	13.73		

14-8-17ca

Date	Water level	Date	Water level	Date	Water level
Oct. 25, 1949	32.00	Oct. 16, 1950	30.75		

14-8-18dd

Date	Water level	Date	Water level	Date	Water level
Oct. 26, 1949	30.95	Oct. 16, 1950	29.60		

14-8-21bc

Date	Water level	Date	Water level	Date	Water level
Oct. 25, 1949	34.68	Oct. 16, 1950	33.43		

14-8-25dd

Date	Water level	Date	Water level	Date	Water level
Mar. 7, 1947	7.27	Apr. 12, 1949	4.51	Oct. 16, 1950	6.42
Mar. 17, 1948	7.00	Feb. 27, 1950	6.62	May 1, 1951	5.72

15-3-6aa

Date	Water level	Date	Water level	Date	Water level
Aug. 3, 1950	4.15	Oct. 9, 1950	4.24	Nov. 30, 1950	4.14
25	3.66	Nov. 2	4.33		

15-4-2bd

Date	Water level	Date	Water level	Date	Water level
Sept. 28, 1949	4.44	Oct. 6, 1950	5.16		

15-4-2cc

Date	Water level	Date	Water level	Date	Water level
Sept. 28, 1949	26.33	Oct. 6, 1950	27.48		

15-4-3aa

Date	Water level	Date	Water level	Date	Water level
Aug. 3, 1950	4.48	Oct. 6, 1950	4.95	Nov. 30, 1950	4.88
25	3.95	Nov. 1	5.12		

15-4-8bb

Date	Water level	Date	Water level	Date	Water level
Sept. 28, 1949	25.45	Oct. 17, 1950	26.89		

Table 8.— *Measurements of the water level in wells*— Continued

Date	Water level	Date	Water level	Date	Water level
		MERRICK COUNTY —Continued			
		15-4-8dd			
Aug. 2, 1950	5.49	Oct. 6, 1950	6.07	Nov. 30, 1950	6.39
25	5.38	Nov. 1	6.30		
		15-4-10bb			
Mar. 7, 1947	27.48	Apr. 12, 1949	26.92	Oct. 6, 1950	28.10
Mar. 17, 1948	26.77	Mar. 13, 1950	27.67	May 7; 1951	28.44
		15-4-12bc			
Mar. 7, 1947	5.43	Apr. 12, 1949	3.68	Oct. 6, 1950	6.47
Mar. 17, 1948	5.57	Mar. 13, 1950	6.10	May 7, 1951	5.29
		15-4-15aa			
Aug. 3, 1950	4.21	Oct. 6, 1950	4.72	Nov. 30, 1950	4.81
25	4.35	Nov. 1	4.84		
		15-4-15dd			
Jan. 4, 1946	7.95	Sept. 4, 1947	8.29	May 4, 1950	8.00
Feb. 12	7.96	Nov. 11	8.90	June 29	8.11
Mar. 12	7.76	Jan. 13, 1948	8.77	Aug. 25	8.24
Apr. 9	7.36	Mar. 18	8.14	Oct. 6	8.72
May 7	7.46	May 8	7.75	Nov. 1	8.83
June 4	7.77	July 13	7.64	30	8.93
July 9	7.75	Sept. 2	7.84	Jan. 9, 1951	9.01
Aug. 6	8.02	Nov. 2	8.65	Mar. 15	8.71
Sept. 4	8.30	Jan. 4, 1949	8.24	May 7	7.84
Oct. 10	7.71	Mar. 8	7.89	July 26	6.97
Nov. 6	7.44	Apr. 15	5.61	Aug. 24	7.68
Dec. 10	6.28	July 12	6.19	Sept. 25	7.98
Jan. 3, 1947	6.79	Sept. 2	7.84	Oct. 23	8.22
Mar. 6	7.06	Nov. 7	8.30	Nov. 23	8.30
May 7	6.16	Jan. 11, 1950	8.58	Dec. 26	8.36
July 8	5.50	Mar. 14	8.27	Jan. 24, 1952	8.12
		15-4-19ab			
Mar. 7, 1947	6.07	Apr. 12, 1949	4.56	Oct. 17, 1950	6.50
Mar. 17, 1948	5.99	Mar. 13, 1950	6.82	May 7, 1951	6.01
		15-4-21ab			
Mar. 7, 1947	4.52	Apr. 12, 1949	2.71	Oct. 6, 1950	6.30
Mar. 17, 1948	4.03	Mar. 13, 1950	4.86	May 7, 1951	4.37
		15-4-21cc			
July 23, 1950	5.77	Aug. 25, 1950	6.23	Nov. 1, 1950	6.87
Aug. 2	6.16	Oct. 6	6.69	30	6.78
		15-4-30cc			
June 19, 1950	7.32	Oct. 5, 1950	7.98		

Table 8.—*Measurements of the water level in wells*—Continued

MERRICK COUNTY—Continued

15-4-31cc

Date	Water level	Date	Water level	Date	Water level
Jan. 4, 1946	3.86	May 7, 1947	2.97	Sept. 2, 1949	4.03
Feb. 12	3.96	July 8	3.00	Nov. 7	4.06
Mar. 12	3.67	Sept. 4	4.89	Jan. 11, 1950	4.39
Apr. 9	3.44	Nov. 11	5.22	Mar. 14	3.87
May 7	3.28	Jan. 13, 1948	5.00	May 4	3.92
June 4	3.40	Mar. 18	3.83	June 29	4.40
July 9	3.89	May 8	3.94	Aug. 29	4.34
Aug. 6	4.70	July 13	3.65	Oct. 5	4.65
Sept. 4	5.02	Sept. 2	4.06	Nov. 1	4.72
Oct. 10	4.44	Nov. 2	4.69	30	4.94
Nov. 6	4.56	Jan. 3, 1949	4.12	Jan. 9, 1951	4.93
Dec. 10	3.11	Mar. 8	2.45	Mar. 15	4.58
Jan. 3, 1947	3.52	Apr. 15	2.13	May 7	3.87
Mar. 7	3.38	July 12	3.29	Aug. 21	3.97

15-4-33bc

Mar. 7, 1947	5.00	Apr. 12, 1949	3.68	Oct. 6, 1950	6.24
Mar. 17, 1948	5.60	Mar. 13, 1950	5.30	May 7, 1951	5.09

15-5-1da

Aug. 1, 1950	2.55	Oct. 5, 1950	2.88	Nov. 30, 1950	3.00
28	3.05	Nov. 1	3.28		

15-5-2cc

Aug. 1, 1950	2.44	Oct. 5, 1950	3.47	Nov. 30, 1950	3.85
28	3.10	Nov. 1	3.90		

15-5-7bb

July 31, 1950	17.98	Oct. 5, 1950	18.13		

15-5-8aa

Aug. 1, 1950	8.22	Oct. 5, 1950	8.66	Nov. 30, 1950	9.48
28	8.23	Nov. 1	9.10		

15-5-8dd

Apr. 9, 1946	14.02	May 8, 1948	12.68	Oct. 5, 1950	12.21
May 7	14.14	July 13	11.92	Nov. 1	12.39
June 4	14.15	Sept. 2	12.40	30	12.57
July 9	13.80	Nov. 2	14.63	Jan. 4, 1951	12.85
Aug. 6	13.68	Jan. 5, 1949	13.01	30	13.03
Sept. 4	13.83	Mar. 7	12.65	Feb. 21	13.18
Oct. 10	13.21	Apr. 12	12.40	Mar. 30	13.34
Nov. 6	13.67	July 12	11.35	Apr. 26	13.43
Dec. 10	13.19	Sept. 2	11.99	May 28	13.43
Jan. 3, 1947	13.07	Nov. 7	12.14	July 26	12.02
Mar. 7	13.37	Jan. 11, 1950	12.65	Aug. 24	12.47
May 7	13.00	Mar. 14	12.93	Sept. 25	12.44
July 8	11.15	May 4	13.17	Oct. 23	12.60
Sept. 4	11.19	26	13.20	Nov. 23	12.79
Nov. 11	11.93	June 26	13.29	Dec. 26	13.01
Jan. 13, 1948	12.55	Aug. 1	11.71	Jan. 24, 1952	13.09
Mar. 18	12.60	28	11.73		

Table 8.— *Measurements of the water level in wells*— Continued

Date	Water level	Date	Water level	Date	Water level
		MERRICK COUNTY—Continued			
		15-5-12ad			
Sept. 30, 1949	22.62	Oct. 5, 1950	22.53		
		15-5-13dd			
Aug. 2, 1950	3.39	Oct. 5, 1950	3.89	Nov. 30, 1950	4.18
28	3.57	Nov. 1	4.38		
		15-5-15bc			
Sept. 30, 1949	27.05	Oct. 17, 1950	27.56		
		15-5-16cc			
May 16, 1950	13.04	Aug. 1, 1950	12.33	Nov. 1, 1950	12.98
26	13.12	28	12.54	30	13.12
June 26	13.20	Oct. 5	12.79		
		15-5-18cd			
June 26, 1950	14.32	Aug. 29, 1950	13.34	Nov. 1, 1950	13.79
July 31	13.40	Oct. 5	13.59	30	13.98
		15-5-20bb			
Mar. 7, 1947	10.13	May 4, 1950	10.00	Aug. 28, 1950	8.77
Mar. 18, 1948	7.75	26	8.95	Oct. 5	9.09
Apr. 12, 1949	8.31	June 26	9.00	Nov. 1	9.22
Mar. 13, 1950	9.72	Aug. 1	8.46	30	9.20
		15-5-21cc			
Aug. 1, 1950	8.23	Nov. 30, 1950	8.90	Mar. 30, 1951	8.65
29	8.21	Jan. 4, 1951	9.01	Apr. 26	8.03
Oct. 5	8.69	30	9.04	May 28	7.76
Nov. 1	8.86	Feb. 21	9.00		
		15-5-22aa			
Aug. 1, 1950	6.02	Oct. 5, 1950	7.25	Nov. 30, 1950	7.39
28	6.80	Nov. 1	7.62		
		15-5-25aa			
Aug. 2, 1950	5.10	Oct. 5, 1950	5.50	Nov. 30, 1950	5.64
28	5.06	Nov. 1	5.69		
		15-5-27dd			
Apr. 9, 1946	3.46	Oct. 10, 1946	4.09	July 8, 1947	1.92
May 7	3.35	Nov. 6	3.84	Sept. 4	4.05
June 4	3.06	Dec. 10	3.03	Jan. 13, 1948	4.37
July 9	3.41	Jan. 3, 1947	3.32	Mar. 18	4.16
Aug. 6	4.14	Mar. 7	3.46	May 8	3.87
Sept. 4	4.49	May 7	2.64	July 13	3.35

Table 8.—*Measurements of the water level in wells*—Continued

MERRICK COUNTY—Continued

15-5-27dd—Continued

Date	Water level	Date	Water level	Date	Water level
Sept. 2, 1948	3.42	Jan. 11, 1950	4.20	Nov. 30, 1950	4.41
Nov. 2	4.37	Mar. 10	4.03	Jan. 9, 1951	4.59
Jan. 5, 1949	4.19	May 4	3.98	Mar. 15	4.34
Mar. 8	3.20	June 29	4.02	May 7	3.50
Apr. 12	2.09	Aug. 1	3.40	Aug. 21	3.09
July 12	2.63	28	3.50		
Sept. 2	3.27	Oct. 5,	3.92		
Nov. 7	3.68	Nov. 1	4.24		

15-5-30cc

July 31, 1950	4.24	Oct. 5, 1950	4.92	Nov. 30, 1950	5.53
Aug. 29	4.45	Nov. 1	5.12		

15-5-32aa

May 16, 1950	8.92	Aug. 1, 1950	8.36	Nov. 1, 1950	9.14
26	8.84	29	8.32	30	9.27
June 23	8.88	Oct. 5	8.97		

15-5-34cc

Mar. 7, 1947	4.92	Apr. 12, 1949	3.88	Oct. 17, 1950	5.77
Mar. 18, 1948	5.82	Mar. 13, 1950	5.68	May 7, 1951	4.79

15-6-9ab

Apr. 13, 1950	39.92	Oct. 12, 1950	40.58		

15-6-12dd

Oct. 27, 1949	9.42	Oct. 16, 1950	8.84		

15-6-14bb

July 31, 1950	5.66	Oct. 4, 1950	6.93	Nov. 27, 1950	7.42
Sept. 5	6.35	30	7.26		

15-6-14cc

July 31, 1950	2.73	Oct. 4, 1950	4.98	Nov. 27, 1950	5.54
Sept. 5	4.80	30	5.41		

15-6-17aa

Aug. 8, 1950	20.53	Nov. 27, 1950	20.18	Mar. 30, 1951	20.58
Sept. 5	20.38	Jan. 4, 1951	20.18	Apr. 26	20.01
Oct. 4	20.33	30	20.13	May 28	19.98
30	20.18	Feb. 21	20.08		

15-6-17dd

Aug. 8, 1950	18.31	Oct. 4, 1950	17.99	Nov. 27, 1950	17.92
Sept. 5	18.06	30	17.86		

Table 8.— *Measurements of the water level in wells*— Continued

MERRICK COUNTY— Continued

15-6-18cb

Date	Water level	Date	Water level	Date	Water level
July 19, 1950	38.30	Oct. 17, 1950	41.70		

15-6-21cc

Date	Water level	Date	Water level	Date	Water level
Aug. 8, 1950	12.84	Oct. 4, 1950	13.69	Nov. 27, 1950	13.74
Sept. 5	13.26	30	13.64		

15-6-26bc

Date	Water level	Date	Water level	Date	Water level
Mar. 7, 1947	8.40	May 26, 1950	8.22	Oct. 4, 1950	8.34
Mar. 18, 1948	8.50	June 26	8.41	30	8.62
Apr. 12, 1949	6.39	July 31	7.06	Nov. 27	8.79
Mar. 13, 1950	8.47	Sept. 5	7.93	Aug. 20, 1951	9.56
May 4	8.60				

15-6-27cd

Date	Water level	Date	Water level	Date	Water level
Sept. 30, 1949	5.65	Aug. 3, 1950	5.00	Oct. 16, 1950	5.67
June 26, 1950	6.83				

15-6-27dd

Date	Water level	Date	Water level	Date	Water level
July 31, 1950	5.67	Nov. 27, 1950	6.43	Oct. 23, 1951	5.59
Sept. 5	5.90	July 26, 1951	5.03	Nov. 23	5.78
Oct. 4	6.00	Aug. 24	5.09	Dec. 26	5.99
30	6.25	Sept. 25	5.33	Jan. 24, 1952	5.89

15-6-30bb

Date	Water level	Date	Water level	Date	Water level
Sept. 30, 1949	15.72	Oct. 17, 1950	14.85		

15-6-31cc

Date	Water level	Date	Water level	Date	Water level
Aug. 8, 1950	5.64	Oct. 3, 1950	6.10	Nov. 27, 1950	6.45
Sept. 5	5.90	30	6.25		

15-6-32aa

Date	Water level	Date	Water level	Date	Water level
Aug. 8, 1950	4.61	Oct. 4, 1950	5.16	Nov. 27, 1950	5.58
Sept. 5	4.91	30	5.41		

15-6-32bc

Date	Water level	Date	Water level	Date	Water level
Mar. 7, 1947	5.22	Apr. 12, 1949	2.94	Oct. 12, 1950	4.81
Mar. 18, 1948	4.92	Mar. 13, 1950	5.15	May 1, 1951	4.56

15-6-35cc

Date	Water level	Date	Water level	Date	Water level
July 31, 1950	8.70	Oct. 4, 1950	8.97	Nov. 27, 1950	9.31
Sept. 5	8.78	30	9.09		

15-6-36bb

Date	Water level	Date	Water level	Date	Water level
May 15, 1950	7.97	Oct. 16, 1950	7.93		

Table 8. — *Measurements of the water level in wells* — Continued

Date	Water level	Date	Water level	Date	Water level
		MERRICK COUNTY—Continued			
		15-7-14bb			
Aug. 8, 1950	4.08	Oct. 3, 1950	5.34	Nov. 27, 1950	5.84
Sept. 5	4.85	30	5.59		
		15-7-14cc			
Aug. 8, 1950	2.09	Nov. 27, 1950	3.69	Mar. 30, 1951	1.44
Sept. 5	3.68	Jan. 4, 1951	3.51	Apr. 26	1.41
Oct. 3	3.85	30	3.55	May 28	2.32
30	4.05	Feb. 21	3.53		
		15-7-19bb			
Aug. 4, 1950	5.22	Oct. 3, 1950	8.69	Nov. 29, 1950	9.63
Sept. 5	8.13	31	9.10		
		15-7-23cc			
Sept. 30, 1949	18.85	Oct. 17, 1950	15.42		
		15-7-25dd			
Aug. 8, 1950	3.67	Oct. 3, 1950	5.68	Nov. 27, 1950	5.87
Sept. 5	5.35	30	5.91		
		15-7-26cc			
Aug. 8, 1950	15.15	Oct. 3, 1950	14.84	Nov. 27, 1950	15.13
Sept. 5	15.04	30	15.02		
		15-7-29aa			
Aug. 9, 1950	3.86	Nov. 27, 1950	4.95	Mar. 30, 1951	3.69
Sept. 5	4.98	Jan. 4, 1951	4.84	Apr. 26	3.59
Oct. 3	5.12	30	4.92	May 28	3.98
31	5.15	Feb. 21	4.67		
		15-7-31bc			
Oct. 27, 1949	20.50	Oct. 16, 1950	18.92		
		15-7-32dd			
Aug. 9, 1950	45.68	Oct. 31, 1950	45.44	Nov. 29, 1950	45.45
Oct. 3	45.62				
		15-8-17dd			
Aug. 4, 1950	2.19	Jan. 30, 1951	3.58	Aug. 24, 1951	3.36
29	3.08	Feb. 21	2.87	Sept. 25	3.26
Oct. 2	2.84	Mar. 30	1.98	Oct. 23	3.02
31	3.30	Apr. 26	2.15	Nov. 23	2.87
Nov. 27	2.94	May 28	2.56	Dec. 26	2.56
Jan. 4, 1951	2.84	July 26	3.51	Jan. 25, 1952	2.67

Table 8.—*Measurements of the water level in wells*— Continued

MERRICK COUNTY—Continued

15-8-18dd

Date	Water level	Date	Water level	Date	Water level
Sept. 14, 1950	13.26	Oct. 31, 1950	13.22	Nov. 29, 1950	13.18
Oct. 2	13.31				

15-8-22ad

Aug. 4, 1950	7.34	Oct. 3, 1950	8.83	Nov. 29, 1950	9.48
29	8.01	31	9.27		

15-8-22cc

Aug. 4, 1950	3.55	Oct. 3, 1950	5.75	Nov. 29, 1949	6.06
29	4.53	30	6.07		

15-8-22dd

Aug. 4, 1950	7.54	Oct. 2, 1950	9.19	Nov. 27, 1950	9.79
29	8.25	31	9.55		

15-8-25aa

Aug. 4, 1950	4.27	Oct. 3, 1950	5.94	Nov. 27, 1950	6.52
Sept. 5	5.63	31	6.48		

15-8-27dd

Aug. 4, 1950	1.37	Oct. 2, 1950	2.74	Nov. 29, 1950	3.05
29	2.72	31	3.48		

15-8-28bb

Aug. 4, 1950	4.97	Oct. 2, 1950	5.91	Nov. 27, 1950	6.47
29	5.84	31	6.38		

15-8-33bc

May 20, 1948	12.60	Apr. 28, 1950	11.29	Jan. 29, 1951	11.27
Oct. 1	13.69	May 26	11.05	Feb. 21	11.15
May 2, 1949	10.92	June 27	12.12	Mar. 26	10.73
June 1	10.77	July 27	10.61	Apr. 26	10.58
July 1	10.69	28	10.62	May 28	10.50
Aug. 8	16.54	Aug. 28	10.87	July 26	11.10
Sept. 21	11.93	29	10.92	Aug. 24	10.91
Nov. 3	11.78	Oct. 2	11.51	Sept. 25	10.93
Dec. 2	11.49	25	11.23	Oct. 23	10.88
Jan. 10, 1950	11.49	31	11.18	Nov. 23	10.79
Feb. 6	10.38	Nov. 28	11.11	Dec. 26	11.06
27	11.29	Dec. 27	11.03	Jan. 25, 1952	10.80
Mar. 28	11.11				

15-8-34bb

May 19, 1948	2.80	July 1, 1949	4.75	Dec. 2, 1949	6.96
Oct. 1	8.90	Aug. 8	7.34	Jan. 10, 1950	7.40
May 2, 1949	4.25	Sept. 21	6.43	Feb. 6	6.56
June 1	4.02	Nov. 4	6.96	Feb. 27	4.87

Table 8.—*Measurements of the water level in wells*— Continued

MERRICK COUNTY— Continued

15-8-34bb— Continued

Date	Water level	Date	Water level	Date	Water level
Mar. 28, 1950	5.99	June 27, 1950	7.04	Oct. 3, 1950	6.50
Apr. 28	6.49	July 28	5.52	31	6.75
May 28	6.09	Aug. 29	5.58	Nov. 29	6.85

15-8-35cc1

Aug. 4, 1950	3.36	Oct. 2, 1950	5.15	Nov. 29, 1950	5.98
29	4.37	31	5.61	Jan. 4, 1951	6.31

15-8-35cc2

Aug. 4, 1950	3.37	Nov. 29, 1950	6.83	Mar. 30, 1951	8.17
29	4.22	Jan. 4, 1951	7.48	Apr. 26	8.24
Oct. 2	5.66	30	7.77	May 28	8.24
31	6.32	Feb. 21	7.97		

15-8-36aa

Aug. 4, 1950	9.34	Oct. 3, 1950	10.57	Nov. 29, 1950	11.86
Sept. 5	10.32	31	10.82		

16-3-1aa

Aug. 5, 1950	13.12	Oct. 10, 1950	13.18	Dec. 1, 1950	13.42
23	13.00	Nov. 3	13.23		

16-3-5aa

Aug. 3, 1950	3.80	Oct. 9, 1950	4.33	Nov. 30, 1950	4.75
25	4.33	Nov. 2	4.49		

16-3-7dd

Sept. 4, 1947	4.94	Nov. 7, 1949	4.01	Jan. 31, 1951	5.29
Nov. 11	4.97	Jan. 11, 1950	4.07	Feb. 21	5.25
Jan. 13, 1948	4.40	Mar. 10	4.59	Mar. 26	3.99
Mar. 18	3.67	May 4	4.15	Apr. 26	3.08
May 8	2.94	26	3.68	May 28	3.34
July 13	3.75	June 23	4.23	July 26	3.57
Sept. 2	4.20	Aug. 3	4.33	Aug. 24	3.90
Nov. 2	4.89	23	4.39	Sept. 25	4.14
Jan. 4, 1949	3.86	Oct. 9	4.66	Oct. 23	3.79
Mar. 8	3.49	Nov. 2	4.93	Nov. 23	4.02
Apr. 15	.79	30	4.98	Dec. 27	4.00
July 12	3.50	Jan. 5, 1951	5.19	Jan. 24, 1952	3.72
Sept. 2	4.85				

16-3-9dd

Aug. 3, 1950	4.87	Nov. 2, 1950	3.97	Jan. 31, 1951	5.68
25	4.23	30	5.17	Feb. 21	5.79
Oct. 9	3.70	Jan. 5, 1951	5.51	May 28	4.08

Table 8.—*Measurements of the water level in wells*—Continued

MERRICK COUNTY—Continued

16-3-12aa

Date	Water level	Date	Water level	Date	Water level
Aug. 5, 1950	14.40	Oct. 10, 1950	14.48	Nov. 30, 1950	14.62
23	14.24	Nov. 2	14.54		

16-3-20bb

Aug. 3, 1950	4.61	Oct. 9, 1950	5.10	Nov. 30, 1950	5.52
25	4.60	Nov. 2	5.38		

16-3-23dd

Mar. 7, 1947	6.84	Apr. 12, 1949	4.30	Oct. 9, 1950	7.69
Mar. 18, 1948	6.45	Mar. 10, 1950	6.62	May 7, 1951	6.07

16-3-24aa

Aug. 5, 1950	5.45	Nov. 30, 1950	6.24	Oct. 23, 1951	6.05
23	5.70	July 26, 1951	5.75	Nov. 23	6.00
Oct. 9	6.00	Aug. 24	6.08	Dec. 27	5.64
Nov. 2	6.23	Sept. 25	6.12	Jan. 24, 1952	5.52

16-3-26ac

Jan. 11, 1950	4.80	Aug. 23, 1950	4.97	Jan. 9, 1951	4.59
Mar. 10	4.35	Oct. 9	5.00	Mar. 15	4.40
May 4	4.64	Nov. 2	5.22	May 7	4.42
June 29	5.26	30	4.69	Aug. 21	5.75

16-3-27cc

Oct. 17, 1945	6.52	Mar. 6, 1947	6.40	July 12, 1948	5.54
Dec. 14	7.11	May 7	5.67	Sept. 2	7.48
Jan. 4, 1946	6.54	July 8	4.39	Nov. 7	7.15
Feb. 12	6.40	Sept. 4	7.50	Jan. 11, 1950	6.91
Mar. 12	6.35	Nov. 11	7.35	Mar. 10	6.02
Apr. 9	6.32	Jan. 13, 1948	6.66	May 4	6.46
May 7	6.29	Mar. 18	5.35	June 29	7.00
June 4	6.67	May 8	5.85	Aug. 25	6.43
July 9	6.22	July 12	5.97	Oct. 9	7.06
Aug. 6	7.44	Sept. 2	6.85	Nov. 2	7.24
Sept. 4	7.99	Nov. 2	7.45	30	6.59
Oct. 10	7.44	Jan. 5, 1949	6.19	Jan. 9, 1951	6.53
Nov. 6	6.91	Mar. 7	4.05	Mar. 15	6.24
Dec. 10	6.24	Apr. 19	4.43	May 7	5.72
Jan. 3, 1947	6.44				

16-3-28cc

June 1, 1950	7.29	Aug. 25, 1950	7.47	Nov. 2, 1950	8.47
23	7.76	Oct. 9	8.40	30	8.14
Aug. 3	7.54				

16-3-29cb

June 23, 1950	8.08	Aug. 25, 1950	5.67	Nov. 2, 1950	6.94
Aug. 3	5.93	Oct. 9	6.92	30	6.76

Table 8.—*Measurements of the water level in wells*—Continued

Date	Water level	Date	Water level	Date	Water level
MERRICK COUNTY—Continued					
16-3-32cb					
Mar. 7, 1947	6.07	Apr. 12, 1949	3.68	Oct. 9, 1950	7.10
Mar. 18, 1948	5.87	Mar. 10, 1950	6.38	May 7, 1951	5.42
16-4-32dd					
Aug. 2, 1950	3.32	Oct. 6, 1950	3.99	Nov. 30, 1950	4.20
25	3.54	Nov. 1	4.31		
NANCE COUNTY					
15-5-5ad					
June 15, 1950	10.27	Oct. 5, 1950	11.95		
15-5-6ab					
Sept. 29, 1949	8.95	Oct. 17, 1950	8.60		
15-6-2bb					
Sept. 22, 1949	4.28	July 28, 1950	1.78	Feb. 21, 1951	2.75
Nov. 4	4.08	Aug. 28	2.25	Apr. 26	1.08
30	4.05	Sept. 5	3.01	May 28	1.65
Jan. 5, 1950	4.26	Oct. 4	1.96	July 26	2.50
Feb. 6	4.14	25	2.99	Aug. 24	2.14
Mar. 3	2.48	30	3.08	Sept. 25	2.29
28	1.07	Nov. 27	2.83	Oct. 23	2.09
Apr. 28	2.35	28	2.80	Nov. 23	2.09
May 24	2.18	Dec. 27	2.91	Dec. 26	2.04
June 23	3.21	Jan. 29, 1951	3.39	Jan. 24, 1952	1.94
27	3.35				
15-6-2cc					
July 31, 1950	7.71	Oct. 4, 1950	7.38	Nov. 27, 1950	7.51
Sept. 5	7.43	30	7.33		
15-6-4cc					
Aug. 8, 1950	27.01	Oct. 4, 1950	26.81	Nov. 27, 1950	26.57
Sept. 5	26.88	30	26.63		
15-6-6cc					
Sept. 29, 1940	7.12	Oct. 17, 1950	7.23		
15-6-7cc					
Aug. 8, 1950	12.24	Oct. 3, 1950	12.27	Nov. 27, 1950	12.23
Sept. 5	12.27	30	12.25		

Table 8.—*Measurements of the water level in wells*—Continued

Date	Water level	Date	Water level	Date	Water level
		NANCE COUNTY—Continued			
		15-7-6bb			
Sept. 30, 1948	66.00	Feb. 9, 1950	65.47	Oct. 30, 1950	65.42
Apr. 26, 1949	64.33	Mar. 3	65.44	Nov. 28	65.36
June 1	65.72	28	63.88	Jan. 4, 1951	65.30
July 1	65.78	Apr. 28	65.59	30	65.36
Aug. 8	65.61	May 24	65.53	Feb. 21	65.33
Sept. 21	65.54	June 27	65.73	Mar. 30	65.32
Nov. 7	65.51	July 24	65.49	Apr. 26	65.34
Dec. 2	65.49	Aug. 29	65.52	May 28	65.35
Jan. 10, 1950	65.50	Oct. 2	65.48		
		15-7-8dd			
Aug. 4, 1950	6.51	Jan. 4, 1951	8.32	Oct. 23, 1951	8.47
Sept. 5	7.42	July 26	7.70	Nov. 23	8.72
Oct. 3	7.89	Aug. 24	7.95	Dec. 26	9.02
30	8.12	Sept. 25	8.24	Jan. 25, 1952	9.09
Nov. 27	8.46				
		15-7-11bd			
June 13, 1950	4.80	Oct. 17, 1950	5.70		
		15-7-11da			
Sept. 23, 1949	7.45	Oct. 17, 1950	6.53		
		15-7-16cc			
Aug. 4, 1950	2.41	Sept. 5, 1950	4.10	Oct. 30, 1950	4.82
9	1.50	Oct. 3	4.16	Nov. 27	4.96
		15-8-13cd			
Apr. 13, 1950	23.80	Oct. 17, 1950	22.74		
		15-8-16cb			
Aug. 4, 1950	3.59	Oct. 2, 1950	4.76	Nov. 27, 1950	4.78
29	4.37	30	4.79		
		16-4-6bc			
Aug. 2, 1950	6.91	Oct. 5, 1950	7.63	Nov. 28, 1950	7.61
25	7.41	Nov. 1	7.80		
		16-4-9dd			
Sept. 20, 1949	13.60	Oct. 6, 1950	14.14		
		16-4-10aa			
Aug. 3, 1950	5.39	Oct. 6, 1950	5.63	Nov. 30, 1950	5.81
25	5.52	Nov. 2	5.87		

Table 8.—*Measurements of the water level in wells*— Continued

Date	Water level	Date	Water level	Date	Water level
NANCE COUNTY—Continued					
16-4-15aa					
Aug. 3, 1950	3.73	Nov. 30, 1950	4.85	Oct. 23, 1951	3.75
25	4.14	July 26, 1951	3.08	Nov. 23	3.99
Oct. 6	4.45	Aug. 24	3.30	Dec. 26	4.17
Nov. 2	4.78	Sept. 25	3.70	Jan. 24, 1952	3.94
16-4-15bb					
Mar. 7, 1947	9.79	Apr. 12, 1949	8.57	May 8, 1951	9.98
Mar. 18, 1948	9.43	Oct. 6, 1950	9.97		
16-4-22aa					
Aug. 3, 1950	3.47	Oct. 6, 1950	3.99	Nov. 30, 1950	4.10
25	3.76	Nov. 1	4.12		
16-4-27aa					
Aug. 3, 1950	2.97	Oct. 6, 1950	3.85	Nov. 30, 1950	4.02
25	3.27	Nov. 1	4.02		
16-4-27dc					
Mar. 7, 1947	9.39	Apr. 12, 1949	7.18	May 8, 1951	8.27
Mar. 18, 1948	8.58	Oct. 6, 1950	9.31		
16-4-28bb					
Aug. 2, 1950	4.80	Nov. 30, 1950	5.77	Mar. 30, 1951	5.08
25	5.34	Jan. 4, 1951	5.86	Apr. 30	4.20
Oct. 6	5.63	30	5.88	May 28	4.21
Nov. 1	5.69	Feb. 21	5.85		
16-4-28dd					
Apr. 17, 1950	5.76	Oct. 6, 1950	6.03	Jan. 30, 1951	6.38
16-4-31bc					
Aug. 13, 1947	5.38	Apr. 2, 1949	3.08	June 23, 1950	6.05
Jan. 13, 1948	6.76	July 12	4.46	Aug. 2	5.04
Mar. 18	5.28	Sept. 2	5.24	28	5.45
May 8	6.15	Nov. 7	5.49	Oct. 5	6.15
July 13	5.72	Jan. 9, 1950	5.95	Nov. 1	6.26
Sept. 2	5.87	Mar. 14	5.65	30	6.41
Nov. 2	6.29	May 4	5.85	Aug. 20, 1951	5.42
Jan. 4, 1949	5.41	26	5.68		
16-4-36bb					
Mar. 7, 1947	11.64	Apr. 12, 1949	10.59	Oct. 6, 1950	12.92
Mar. 18, 1948	11.30	Mar. 13, 1950	12.72	May 8, 1951	12.31
16-5-2da					
Oct. 5, 1950	7.00				

Table 8.—*Measurements of the water level in wells*—Continued

Date	Water level	Date	Water level	Date	Water level
NANCE COUNTY—Continued					
16-5-9cb					
Aug. 1, 1950	2.75	Oct. 5, 1950	2.88	Nov. 28, 1950	2.92
28	2.92	Nov. 1	3.40		
16-5-11bc					
Aug. 2, 1950	4.90	Oct. 5, 1950	5.80	Nov. 28, 1950	6.16
28	5.54	Nov. 1	6.21		
16-5-16cc					
Aug. 1, 1950	1.34	Oct. 5, 1950	2.29	Nov. 30, 1950	3.19
25	2.23	Nov. 1	3.27		
16-5-20bc					
Sept. 21, 1949	7.05	Mar. 3, 1950	7.98	July 25, 1950	3.61
Nov. 4	7.64	29	7.58	Aug. 25	5.84
Dec. 2	8.82	Apr. 28	7.80	Oct. 5	6.41
Jan. 9, 1950	7.98	May 24	7.33	Nov. 1	6.92
Feb. 8	8.22	June 23	7.64	28	7.22
16-5-21cc					
Aug. 1, 1950	6.09	Jan. 30, 1951	8.22	Sept. 25, 1951	7.41
28	6.70	Feb. 21	8.26	Oct. 23	7.76
Oct. 5	7.07	Mar. 30	7.97	Nov. 23	7.94
Nov. 1	7.36	Apr. 26	7.52	Dec. 26	8.18
30	7.81	May 28	7.54	Jan. 24, 1952	8.12
Jan. 4, 1951	8.11	Aug. 24	7.20		
16-5-23aa					
Nov. 4, 1949	5.62	Apr. 12, 1950	5.54	Aug. 25, 1950	4.95
Dec. 2	5.84	28	5.70	Oct. 5	5.52
Jan. 9, 1950	6.06	May 24	5.28	Nov. 1	5.88
Feb. 8	6.29	June 23	5.28	30	6.04
Mar. 3	5.93	July 25	3.72	Aug. 20, 1951	5.08
29	5.65				
16-5-23bb					
Aug. 1, 1950	8.45	Oct. 5, 1950	9.53	Nov. 30, 1950	9.98
25	8.94	Nov. 1	9.74		
16-5-24aa					
Aug. 2, 1950	5.06	Oct. 6, 1950	6.59	Nov. 30, 1950	7.28
25	5.90	Nov. 1	7.05		
16-5-24dd					
Aug. 2, 1950	3.86	Oct. 5, 1950	4.95	Nov. 30, 1950	4.64
28	4.68	Nov. 1	4.85		

Table 8.—*Measurements of the water level in wells*— Continued

Date	Water level	Date	Water level	Date	Water level
		NANCE COUNTY—Continued			
		16-5-28cc			
Aug. 1, 1950	3.20	Oct. 5, 1950	5.26	Nov. 30, 1950	5.91
28	4.13	Nov. 1	5.64		
		16-5-30cc			
July 31, 1950	1.32	Oct. 5, 1950	3.21	Nov. 30, 1950	4.00
Aug. 29	2.92	Nov. 1	4.05		
		16-5-35bb			
June 7, 1950	4.55	Aug. 28, 1950	4.23	Nov. 1, 1950	4.46
Aug. 1	3.37	Oct. 5	4.09	30	4.27
		16-6-14ac			
Oct. 10, 1947	27.35	Jan. 10, 1950	26.58	Nov. 1, 1950	25.76
Apr. 23, 1948	26.47	Feb. 9	26.78	29	25.72
Sept. 29	26.60	Mar. 3	26.56	Jan. 4, 1951	26.05
Apr. 26, 1949	25.68	29	26.63	30	26.26
June 1	25.64	May 23	26.67	Feb. 21	26.52
July 1	25.24	June 22	26.85	Mar. 30	26.27
Aug. 8	25.99	July 25	25.96	Apr. 26	25.92
Sept. 21	26.02	Aug. 22	25.68	May 28	25.97
Nov. 7	25.93	Oct. 2	25.66	Nov. 5	26.11
Dec. 5	26.14				
		16-6-22ab			
Nov. 7, 1949	30.29	May 23, 1950	30.76	Jan. 4, 1951	30.87
Dec. 5	30.32	June 26	30.81	30	30.86
Jan. 10, 1950	30.45	Aug. 18	31.05	Feb. 21	30.84
Feb. 9	30.49	29	33.11	Mar. 30	30.60
Mar. 3	30.43	Oct. 2	30.72	Apr. 26	30.46
30	30.23	30	30.59	May 28	30.27
Apr. 28	30.89	Nov. 28	30.71	Nov. 5	28.89
		16-6-23cc			
July 31, 1950	3.26	Oct. 4, 1950	4.30	Nov. 27, 1950	4.90
Sept. 5	4.08	30	4.72		
		16-6-24aa			
June 5, 1950	1.13	Aug. 29, 1950	1.48	Nov. 1, 1950	2.12
26	2.24	Oct. 4	1.54	30	1.88
July 31	.53				
		16-6-26dd			
Apr. 21, 1950	6.25	Oct. 17, 1950	5.74		
		16-6-32aa			
Aug. 8, 1950	3.94	Oct. 4, 1950	4.53	Nov. 27, 1950	5.34
Sept. 5	4.71	30	5.13		

Table 8.—*Measurements of the water level in wells*—Continued

NANCE COUNTY—Continued

16-6-33cc

Date	Water level	Date	Water level	Date	Water level
Aug. 8, 1950	1.46	Oct. 4, 1950	2.27	Nov. 27, 1950	3.77
Sept. 5	3.03	30	3.68		

16-6-35bb

July 31, 1950	4.94	Oct. 4, 1950	5.89	Nov. 27, 1950	6.77
Sept. 5	6.28	30	6.69		

16-7-34cb

Sept. 30, 1948	29.02	Mar. 3, 1950	27.30	Nov. 28, 1950	26.71
Apr. 26, 1949	27.32	30	27.28	Jan. 4, 1951	26.79
June 1	27.12	Apr. 28	29.08	30	26.76
July 1	27.09	May 24	27.90	Feb. 21	26.76
Sept. 21	28.93	June 23	27.63	Mar. 30	26.75
Nov. 7	27.85	July 24	27.25	Apr. 26	26.81
Dec. 5	27.55	Aug. 29	26.74	May 28	26.80
Jan. 10, 1950	26.58	Oct. 2	26.80	Nov. 5	25.29
Feb. 9	27.32	30	26.60		

16-7-36aa

Sept. 30, 1948	22.52	Feb. 9, 1950	21.96	Nov. 28, 1950	21.67
Apr. 26, 1949	21.26	Mar. 3	21.88	Jan. 4, 1951	21.74
June 1	21.09	Apr. 28	21.59	30	21.73
July 1	20.98	May 24	21.51	Feb. 21	21.72
Aug. 8	21.42	June 26	21.62	Mar. 30	21.36
Sept. 21	21.68	July 24	21.27	Apr. 26	21.21
Nov. 7	21.83	Aug. 29	21.30	May 28	21.19
Dec. 5	21.87	Oct. 2	21.63	Nov. 5	19.99
Jan. 10, 1950	21.92	30	21.43		

17-4-14cd

Sept. 28, 1948	2.03	Jan. 10, 1950	2.67	Aug. 22, 1950	1.93
Apr. 26, 1949	1.54	Feb. 8	2.14	Oct. 11	1.98
June 6	1.22	Mar. 3	2.44	Jan. 2, 1951	2.39
July 6	.80	28	1.75	Feb. 20	2.41
Aug. 8	1.94	Apr. 28	1.39	May 4	2.00
Sept. 21	1.43	May 23	2.23	Aug. 20	1.26
Nov. 7	2.22	June 22	1.99	Nov. 5	2.23
Dec. 5	2.34	July 25	1.47	Dec. 27	2.85

17-4-21bd

Apr. 26, 1949	14.52	Feb. 8, 1950	24.20	Oct. 11, 1950	23.60
June 6	16.26	Mar. 3	24.51	Jan. 2, 1951	25.29
Aug. 8	19.01	28	19.10	Feb. 20	26.04
Sept. 21	16.77	May 23	20.30	May 4	23.57
Nov. 7	21.40	June 22	20.54	Aug. 20	23.40
Dec. 5	22.58	July 25	17.31	Nov. 5	25.24
Jan. 10, 1950	23.63	Aug. 22	20.93	Dec. 27	26.23

17-4-22dd

May 23, 1950	9.55	July 25, 1950	9.58	Oct. 11, 1950	10.25
June 22	9.97	Aug. 22	10.36	Jan. 2, 1951	10.65

Table 8.—*Measurements of the water level in wells*—Continued

NANCE COUNTY—Continued

17-4-22dd—Continued

Date	Water level	Date	Water level	Date	Water level
Feb. 20, 1951	11.01	May 4, 1951	10.25	Nov. 5, 1951	9.62

17-4-24db

Apr. 21, 1948	3.30	Mar. 28, 1950	6.04	Oct. 11, 1950	5.71
Sept. 28	6.22	Apr. 28	6.17	Nov. 28	6.18
Nov. 7, 1949	6.35	May 24	6.04	Jan. 2, 1951	6.23
Dec. 5	6.46	June 23	5.66	Feb. 23	6.54
Jan. 9, 1950	6.38	July 25	4.55	May 4	6.16
Feb. 8	6.37	Aug. 25	4.93		

17-4-25dc

May 19, 1948	11.27	Mar. 3, 1950	10.65	Oct. 25, 1950	11.88
Sept. 28	12.08	28	10.44	Nov. 2	11.90
Apr. 26, 1949	9.28	Apr. 24	10.78	28	11.69
June 6	10.32	May 24	10.74	Dec. 27	11.57
July 6	10.22	June 23	11.19	Jan. 31, 1951	11.47
Aug. 8	11.39	27	11.34	Feb. 21	11.11
Sept. 21	11.39	July 26	10.54	Mar. 26	10.58
Nov. 4	11.66	28	10.56	Apr. 26	10.53
Dec. 2	11.65	Aug. 25	11.34	May 28	10.65
Jan. 9, 1950	11.31	28	11.36	Aug. 20	11.21
Feb. 8	11.04	Oct. 6	11.77		

17-4-31aa

May 18, 1950	7.45	Aug. 22, 1950	7.65	Feb. 20, 1951	8.19
23	7.46	Oct. 11	8.09	May 4	6.97
June 22	7.55	Jan. 2, 1951	8.18	Nov. 5	7.90
July 25	6.90				

17-4-32dd

Sept. 28, 1948	6.42	Feb. 8, 1950	6.90	Nov. 1, 1950	6.17
Apr. 26, 1949	4.82	Mar. 3	5.49	28	6.10
June 6	4.11	29	5.02	Jan. 5, 1951	6.07
July 6	5.19	Apr. 28	5.46	30	6.25
Aug. 8	6.20	May 24	5.40	Feb. 21	6.00
Sept. 21	5.66	June 23	5.96	Mar. 30	4.94
Nov. 4	5.93	July 26	3.46	Apr. 30	4.48
Dec. 2	6.01	Aug. 25	5.45	May 28	5.31
Jan. 10, 1950	5.93	Oct. 6	5.81		

17-4-34cb

Sept. 19, 1949	6.48	Oct. 6, 1950	7.03		

17-4-36aa

May 18, 1948	4.11	Dec. 2, 1950	4.85	May 24, 1950	3.84
Sept. 28	5.15	Jan. 10	4.89	June 23	4.39
Apr. 26, 1949	2.93	Feb. 8	4.77	July 26	3.12
June 6	2.73	Mar. 3	4.24	Aug. 25	4.66
July 6	2.57	29	3.48	Oct. 6	5.11
Aug. 8	4.47	Apr. 12	3.60	Nov. 2	5.21
Sept. 21	4.35	24	4.06	28	5.17
Nov. 4	4.63				

Table 8.—*Measurements of the water level in wells*— Continued

NANCE COUNTY—Continued

17-5-35dd

Date	Water level	Date	Water level	Date	Water level
May 19, 1948	6.00	Jan. 10, 1950	5.79	Aug. 22, 1950	5.08
Sept. 28	6.72	Feb. 7	5.49	Oct. 11	5.71
Apr. 26, 1949	4.38	Mar. 3	3.96	Jan. 2, 1951	5.37
June 1	4.87	28	3.79	Feb. 20	5.56
July 6	3.58	Apr. 24	4.75	May 4	4.09
Aug. 8	5.91	May 23	4.68	Aug. 20	5.19
Sept. 21	4.65	June 22	5.14	Nov. 5	5.47
Nov. 7	5.42	July 25	3.52	Dec. 27	5.56
Dec. 5	5.59				

PLATTE COUNTY

16-1-5cc

Mar. 7, 1947	5.59	Apr. 12, 1949	4.36	Oct. 10, 1950	6.64
Mar. 18, 1948	5.20	Mar. 10, 1950	5.38	May 8, 1951	5.42

16-2-1cb

Mar. 5, 1947	5.19	Sept. 2, 1948	5.63	Mar. 10, 1950	4.22
May 7	4.14	Nov. 2	6.02	May 4	3.99
July 8	3.16	Jan. 4, 1949	5.05	Oct. 11	5.91
Sept. 4	5.99	Mar. 8	3.86	Nov. 3	5.95
Nov. 11	6.19	Apr. 15	1.86	Dec. 1	5.51
Jan. 13, 1948	5.74	July 12	3.67	Jan. 9, 1951	5.40
Mar. 23	4.14	Sept. 2	5.50	Mar. 15	4.86
May 8	4.07	Nov. 7	5.05	May 8	3.73
July 13	4.40	Jan. 11, 1950	5.20		

16-2-7aa

Aug. 5, 1950	16.87	Nov. 3, 1950	13.72	Dec. 1, 1950	16.80
Oct. 11	16.69				

16-2-7cc

Aug. 5, 1950	7.49	Oct. 9, 1950	8.13	Nov. 2, 1950	8.29
23	7.55				

16-2-9cc

Feb. 12, 1946	3.84	July 8, 1947	2.87	Sept. 2, 1949	3.62
Mar. 12	3.34	Sept. 4	4.53	Nov. 7	3.43
Apr. 9	3.50	Nov. 11	3.91	Jan. 11, 1950	3.83
May 7	3.22	Jan. 13, 1948	3.65	Mar. 10	2.45
June 4	3.81	Mar. 24	1.95	May 4	2.57
July 9	3.71	May 8	2.00	June 29	3.53
Aug. 6	4.44	July 13	3.18	Aug. 23	3.48
Sept. 4	4.80	Sept. 2	3.87	Oct. 10	3.72
Oct. 10	3.66	Nov. 2	3.85	Nov. 3	3.73
Nov. 5	3.55	Jan. 5, 1949	2.55	Dec. 1	3.58
Dec. 10	1.55	Mar. 8	.95	Jan. 9, 1951	3.65
Jan. 3, 1947	3.59	Apr. 15	.39	Mar. 15	2.96
Mar. 6	3.33	July 12	2.85	May 8	2.75
May 7	2.77				

Table 8.—*Measurements of the water level in wells*—Continued

PLATTE COUNTY—Continued

16-2-12ab

Date	Water level	Date	Water level	Date	Water level
Oct. 17, 1945	9.58	Mar. 6, 1947	8.64	Nov. 7, 1948	9.27
Jan. 4, 1946	9.36	May 7	7.53	Jan. 11, 1950	9.23
Feb. 12	9.14	July 8	6.53	Mar. 10	8.24
Mar. 12	8.92	Sept. 4	10.20	May 4	8.17
Apr. 9	8.80	Nov. 11	10.20	June 29	9.09
May 7	8.84	Jan. 13, 1948	9.61	Aug. 23	9.58
June 4	9.19	Mar. 24	7.83	Oct. 10	9.93
July 9	8.96	May 8	8.32	Nov. 3	9.97
Aug. 6	10.25	July 13	8.59	Dec. 1	9.52
Sept. 4	10.67	Sept. 2	9.80	Jan. 9, 1951	9.24
Oct. 10	10.39	Nov. 2	10.12	Mar. 15	8.70
Nov. 5	9.70	Apr. 15	6.24	May 8	7.60
Dec. 10	8.33	July 12	7.60	Jan. 23, 1952	8.02
Jan. 3, 1947	8.72	Sept. 2	9.95		

17-1-2cc

Jan. 19, 1945	[a]10.80	Nov. 29, 1946	[a]9.80	Nov. 7, 1949	10.43
June 28	[a]9.70	Dec. 10	9.89	Dec. 2	10.51
July 23	[a]9.00	Jan. 2, 1947	10.19	Jan. 9, 1950	10.54
Aug. 17	[a]9.70	Mar. 6	10.29	Feb. 8	10.59
Oct. 12	[a]10.50	May 7	10.05	Mar. 3	10.34
Nov. 15	[a]10.60	July 7	9.00	29	9.76
Dec. 21	[a]10.70	Sept. 4	10.64	Apr. 24	10.31
Jan. 11, 1946	[a]10.60	Nov. 11	10.74	May 26	10.16
Feb. 25	[a]8.30	Jan. 13, 1948	10.67	June 23	10.10
Mar. 15	[a]10.10	Mar. 22	10.01	July 26	10.24
Apr. 19	[a]10.60	May 8	10.36	Aug. 23	10.44
May 29	[a]10.70	July 13	10.50	Oct. 11	10.72
June 21	[a]10.10	Sept. 2	10.30	Jan. 3, 1951	10.56
July 12	[a]8.20	Nov. 2	10.68	Feb. 23	10.56
Aug. 22	[a]11.10	Apr. 25, 1949	9.70	May 5	9.88
Oct. 11	10.61	July 12	8.93	Aug. 21	10.04
28	[a]10.40	Sept. 2	10.65	Nov. 1	10.31
Nov. 5	10.39	Nov. 4	10.45		

17-1-5ad

Jan. 19, 1945	[a]3.60	Dec. 10, 1946	1.50	Nov. 4, 1949	2.24
May 17	[a]2.50	Jan. 2, 1947	2.07	7	2.20
June 28	[a]2.00	Mar. 6	2.00	Dec. 2	2.31
July 23	[a]1.40	May 7	1.70	Jan. 9, 1950	2.34
Aug. 13	[a]2.20	July 7	1.23	Feb. 7	2.29
Oct. 12	[a]2.90	Sept. 4	2.86	Mar. 3	.01
Nov. 15	[a]3.00	Nov. 11	2.74	29	1.64
Dec. 18	[a]3.10	Jan. 13, 1948	2.39	Apr. 24	2.00
Jan. 11, 1946	[a]3.00	Mar. 18	1.50	May 24	1.79
Feb. 25	[a]2.70	May 8	2.04	June 23	2.00
Mar. 11	[a]2.80	July 13	2.54	July 26	1.67
Apr. 11	[a]2.80	Sept. 2	1.55	Aug. 23	1.86
June 24	[a]2.40	Nov. 2	2.82	Oct. 11	2.22
Aug. 22	[a]3.70	Jan. 4, 1949	1.69	Jan. 3, 1951	3.02
Oct. 3	[a]3.30	Mar. 7	.94	Feb. 23	2.94
11	[a]1.64	Apr. 25	1.35	May 5	2.12
Nov. 5	[a]2.10	July 12	1.63	Aug. 21	1.60
Dec. 5	[a]1.50	Sept. 2	2.58	Nov. 1	2.27

[a]Measurements made by Loup River Public Power District.

Table 8. — *Measurements of the water level in wells* — Continued

PLATTE COUNTY — Continued

17-1-6cb

Date	Water level	Date	Water level	Date	Water level
May 18, 1950	2.64	Aug. 23, 1950	2.54	May 5, 1951	2.01
24	2.74	Oct. 11	3.20	Aug. 21	2.41
June 23	2.81	Jan. 3, 1951	3.52	Nov. 1	2.53
July 26	3.07	Feb. 23	3.52		

17-1-10cb

Date	Water level	Date	Water level	Date	Water level
May 18, 1950	7.74	Aug. 23, 1950	8.10	May 5, 1951	7.26
26	7.80	Oct. 11	8.48	Aug. 21	7.64
June 23	7.84	Jan. 3, 1951	8.23	Nov. 1	7.74
July 26	7.95	Feb. 23	8.34		

17-1-14cc

Date	Water level	Date	Water level	Date	Water level
Jan. 18, 1945	[a]10.20	Jan. 2, 1947	9.53	Nov. 7, 1949	10.72
June 28	[a]9.70	Mar. 6	9.72	Dec. 2	10.79
July 23	[a]9.20	May 7	9.65	Jan. 9, 1950	10.68
Aug. 13	[a]9.70	July 7	9.06	Feb. 8	10.71
Oct. 12	[a]10.20	Sept. 4	10.77	Mar. 3	10.57
Nov. 15	[a]10.20	Nov. 11	11.00	29	9.31
Dec. 21	[a]10.40	Jan. 13, 1948	10.97	Apr. 24	10.37
Jan. 11, 1946	[a]10.30	Mar. 22	9.50	May 26	10.22
Mar. 11	[a]10.00	May 8	10.60	June 23	10.47
Apr. 11	[a]10.00	July 13	10.86	July 26	10.50
May 17	[a]10.00	Sept. 2	10.92	Aug. 23	10.66
June 24	[a]9.30	Nov. 2	10.88	Oct. 11	10.85
July 6	[a]9.70	Jan. 4, 1949	10.67	Jan. 3, 1951	10.75
Oct. 3	[a]10.30	Mar. 8	9.45	Feb. 23	10.76
11	10.00	Apr. 25	9.77	May 5	10.01
Nov. 5	10.10	July 12	10.39	Aug. 21	10.45
Dec. 5	9.50	Sept. 2	11.00	Nov. 1	10.43
10	9.42	Nov. 4	10.71		

17-1-27ad

Date	Water level	Date	Water level	Date	Water level
Sept. 27, 1949	5.52	June 27, 1950	5.41	Mar. 26, 1951	4.11
Nov. 7	5.73	July 26	4.60	Apr. 26	4.07
Dec. 2	5.77	Aug. 23	5.38	May 28	4.60
Jan. 9, 1950	5.22	28	5.39	July 26	4.88
Feb. 8	5.12	Oct. 10	5.66	Aug. 24	4.50
Mar. 3	4.46	25	5.80	Sept. 25	5.12
29	3.31	Nov. 3	5.80	Oct. 23	5.11
Apr. 11	4.79	28	5.52	Nov. 23	5.04
24	5.09	Dec. 27	5.21	Dec. 27	4.83
May 26	4.83	Jan. 29, 1951	5.28	Jan. 24, 1952	4.43
June 23	4.26	Feb. 21	4.91		

17-1-30aa

Date	Water level	Date	Water level	Date	Water level
Mar. 7, 1947	11.60	Apr. 12, 1949	11.37	Oct. 10, 1950	12.32
Mar. 18, 1948	10.94	Mar. 10, 1950	11.72	May 8	11.71

17-1-32aa

Date	Water level	Date	Water level	Date	Water level
Aug. 5, 1950	8.68	Oct. 10, 1950	9.11	Dec. 1, 1950	9.27
23	8.70	Nov. 3	9.20		

[a] Measurements made by Loup River Public Power District.

Table 8.—*Measurements of the water level in wells*—Continued

PLATTE COUNTY—Continued

17-1-34dc

Date	Water level	Date	Water level	Date	Water level
Jan. 4, 1946	8.54	May 7, 1947	7.59	Sept. 2, 1948	8.79
Feb. 12	8.40	July 7	6.29	Nov. 7	8.68
Mar. 12	8.25	Sept. 4	9.05	Jan. 11, 1950	8.82
Apr. 9	8.27	Nov. 11	9.25	Mar. 10	8.14
May 7	8.39	Jan. 13, 1948	8.90	May 4	8.08
June 4	8.59	Mar. 24	7.89	June 29	8.49
July 9	8.11	May 8	8.28	Aug. 23	9.02
Aug. 6	9.23	July 13	8.56	Oct. 10	9.32
Sept. 4	9.40	Sept. 2	8.95	Nov. 3	9.47
Oct. 10	9.16	Nov. 2	9.29	Dec. 1	9.17
Nov. 5	8.78	Jan. 5, 1949	8.72	Jan. 9, 1951	9.00
Dec. 10	8.14	Mar. 7	7.82	Mar. 15	8.58
Jan. 3, 1947	8.36	July 12	7.58	May 8	8.18
Mar. 6	8.14				

17-2-2bb

Apr. 24, 1950	3.56	July 26, 1950	2.95	Jan. 3, 1951	4.99
May 24	2.71	Aug. 23	2.79	Aug. 21	3.15
June 23	2.64	Oct. 11	3.71	Nov. 1	2.58

17-2-2cd

Jan. 4, 1946	6.49	Mar. 22, 1948	5.08	Jan. 9, 1950	6.55
Feb. 11	6.47	May 8	6.02	Mar. 29	5.90
May 7	6.13	July 12	7.61	Apr. 24	6.11
Nov. 5	6.08	Sept. 2	7.82	May 24	5.54
Dec. 10	5.53	Nov. 2	8.27	June 23	5.28
Jan. 2, 1947	5.79	Jan. 4, 1949	8.01	July 26	5.38
Mar. 6	6.11	Mar. 7	6.73	Aug. 23	5.18
May 7	5.81	Apr. 18	4.87	Oct. 11	6.07
July 8	4.59	July 12	4.62	Jan. 3, 1951	6.64
Sept. 4	6.83	Sept. 2	6.84	Feb. 23	6.71
Oct. 22	6.92	Nov. 4	6.81	May 5	4.81
Nov. 11	6.73	7	6.36	Nov. 1	7.71
Jan. 13, 1948	6.82	Dec. 2	6.51		

17-2-4bc

Jan. 15, 1945	[a]10.00	Oct. 21, 1946	[a]9.90	Sept. 2, 1949	11.26
Apr. 24	[a]9.10	Nov. 5	9.95	Nov. 4	11.03
May 11	[a]9.34	Dec. 10	9.21	7	11.01
17	[a]9.00	Jan. 2, 1947	9.61	Dec. 2	11.06
31	[a]7.93	Mar. 6	9.62	Jan. 9, 1950	10.41
June 4	[a]7.76	May 7	9.26	Feb. 7	10.22
11	[a]7.24	July 8	7.70	Mar. 3	9.82
25	[a]8.00	Sept. 4	11.22	29	8.33
July 23	[a]8.30	Nov. 11	11.08	Apr. 24	10.08
Oct. 12	[a]10.60	Jan. 13, 1948	10.42	May 24	9.77
Nov. 12	[a]10.50	Mar. 22	8.78	June 23	9.91
Dec. 12	[a]10.30	May 8	10.49	July 26	9.64
Jan. 9, 1946	[a]10.20	July 12	10.83	Aug. 23	10.43
Mar. 21	[a]9.80	Sept. 2	11.12	Oct. 11	11.20
May 8	[a]10.10	Nov. 2	11.61	Jan. 3, 1951	10.57
June 14	[a]10.20	Jan. 4, 1949	10.98	Feb. 23	10.48
July 8	[a]9.10	Mar. 8	8.19	May 5	9.55
Aug. 8	[a]10.80	Apr. 25	9.06	Aug. 21	10.21
Oct. 11	10.32	July 12	9.32	Nov. 1	10.50

[a]Measurements made by Loup River Public Power District.

Table 8.—*Measurements of the water level in wells*—Continued

PLATTE COUNTY—Continued

17-2-6bd

Date	Water level	Date	Water level	Date	Water level
May 18, 1948	13.70	Dec. 2, 1949	13.98	July 26, 1950	12.92
Sept. 28	14.32	Jan. 9, 1950	13.97	Aug. 23	13.86
Apr. 27, 1949	13.07	Feb. 7	13.85	Oct. 11	14.28
June 6	12.53	Mar. 3	13.39	Jan. 3, 1951	14.02
July 6	12.93	29	13.36	Feb. 23	13.94
Aug. 8	14.53	Apr. 24	13.78	May 5	13.37
Sept. 21	13.94	May 24	13.56	Aug. 21	13.42
Nov. 7	13.87	June 23	13.69	Nov. 1	13.85

17-2-8dc

May 26, 1950	5.79	Aug. 23, 1950	6.07	Nov. 3, 1950	7.06
June 23	6.28	Oct. 10	6.62	Dec. 1	6.76
July 26	4.96				

17-2-17bb

May 18, 1948	3.40	Mar. 3, 1950	3.63	July 26, 1950	2.79
Sept. 28	3.62	29	3.59	Aug. 23	2.94
Nov. 7, 1949	3.18	Apr. 24	3.56	Oct. 10	3.38
Dec. 2	3.37	May 26	3.19	Nov. 3	3.53
Jan. 9, 1950	3.56	June 23	2.99	Dec. 1	3.66
Feb. 8	3.63				

17-2-18ab

Apr. 11, 1950	3.43	Oct. 10, 1950	4.72		

17-2-19ac

Sept. 27, 1949	12.32	Oct. 10, 1950	13.40		

17-2-19cc

Aug. 5, 1950	14.66	Oct. 10, 1950	14.76	Dec. 1, 1950	15.00
23	14.45	Nov. 3	14.90		

17-2-23bd

Sept. 27, 1949	14.60	Nov. 3, 1950	14.69		

17-2-24cb

Jan. 29, 1947	10.85	Sept. 21, 1949	11.41	Apr. 24, 1950	11.54
Mar. 4	10.70	Nov. 7	11.90	May 26	11.45
Mar. 24, 1948	9.65-	Dec. 2	12.04	June 23	11.59
Sept. 28	11.87	Jan. 9, 1950	11.78	July 26	10.99
Apr. 27, 1949	10.70	Feb. 8	11.89	Aug. 23	11.16
June 6	8.56	Mar. 3	11.31	Oct. 10	11.94
July 6	11.04	29	11.29	Nov. 3	12.12
Aug. 8	11.53	Apr. 11	11.41	Dec. 1	12.08

17-2-25bc

Mar. 7, 1947	32.32	Apr. 12, 1949	32.06	Oct. 10, 1950	32.54
Mar. 18, 1948	31.15	Mar. 10, 1950	32.20	May 8, 1951	32.74

Table 8.— *Measurements of the water level in wells*— Continued

PLATTE COUNTY—Continued

17-2-32bb

Date	Water level	Date	Water level	Date	Water level
Aug. 5, 1950	9.89	Oct. 10, 1950	10.05	Dec. 1, 1950	10.25
23	9.78	Nov. 3	10.24		

17-2-32dd

Aug. 5, 1950	12.27	Oct. 10, 1950	12.38	Dec. 1, 1950	12.46
23	12.19	Nov. 3	12.45		

17-2-34bb

Oct. 11, 1950	18.28	Aug. 14, 1951	18.44	Nov. 23, 1951	19.40
Nov. 3	18.31	24	18.48	Dec. 27	19.21
Dec. 1	18.12	Sept. 25	18.70	Jan. 24, 1952	19.42
July 26, 1951	19.60	Oct. 23	19.33		

17-3-2da

May 19, 1948	8.45	Dec. 2, 1949	8.79	July 26, 1950	7.46
Sept. 28	9.95	Jan. 9, 1950	8.85	Aug. 23	8.31
Apr. 7, 1949	6.61	Feb. 7	9.03	Oct. 11	8.91
June 6	5.51	Mar. 3	8.08	Jan. 3, 1951	8.39
July 6	6.39	29	7.91	Feb. 23	8.15
Aug. 9	8.96	Apr. 24	8.09	May 5	6.09
Sept. 21	8.48	May 24	7.76	Aug. 21	6.16
Nov. 7	8.66	June 23	8.17	Nov. 1	7.39

17-3-5da

May 18, 1950	12.48	Aug. 23, 1950	12.65	May 5, 1951	12.54
24	12.49	Oct. 11	13.00	Aug. 21	12.13
June 23	12.51	Jan. 3, 1951	12.98	Nov. 1	13.19
July 26	12.23	Feb. 23	12.96		

17-3-8cb

May 18, 1948	2.70	Dec. 2, 1949	1.75	July 26, 1950	1.15
Sept. 28	3.20	Jan. 9, 1950	2.44	Aug. 23	1.84
Apr. 26, 1949	1.04	Feb. 7	2.41	Oct. 11	1.97
June 6	.81	Mar. 6	1.56	Jan. 3, 1951	2.26
July 6	.40	29	.23	Feb. 23	2.40
Aug. 9	2.98	Apr. 24	1.79	May 5	1.40
Sept. 21	1.48	May 24	1.78	Aug. 21	1.12
Nov. 7	1.27	June 23	2.54	Nov. 1	1.47

17-3-22ad

Nov. 7, 1949	8.29	Apr. 24, 1950	9.19	Nov. 28, 1950	9.79
Dec. 2	8.53	May 26	9.26	Jan. 5, 1951	10.04
Jan. 9, 1950	8.68	June 23	9.25	31	10.14
Feb. 8	8.78	July 26	9.23	Feb. 21	10.15
Mar. 3	8.70	Aug. 23	9.34	Mar. 26	9.97
29	9.11	Oct. 10	9.54	Apr. 26	10.26
Apr. 11	9.15	Nov. 3	9.60	May 28	10.14

Table 8.—*Measurements of the water level in wells*— Continued

PLATTE COUNTY—Continued

17-3-23ad

Date	Water level	Date	Water level	Date	Water level
Sept. 28, 1948	14.80	Apr. 11, 1950	15.20	July 26, 1951	15.27
Apr. 27, 1949	14.43	24	14.34	Aug. 23	15.32
June 6	14.00	May 26	15.18	Oct. 10	15.55
July 6	13.55	June 23	15.21	Nov. 3	15.62
Aug. 9	13.71	July 26	15.27	28	15.81
Sept. 21	14.11	Aug. 23	15.32	July 26	15.34
Nov. 7	14.42	Oct. 10	15.55	Aug. 24	15.39
Dec. 2	14.69	Nov. 3	15.62	Sept. 25	15.51
Jan. 9, 1950	14.84	28	15.81	Oct. 23	15.70
Feb. 8	15.13	Apr. 24, 1951	14.34	Nov. 23	15.87
Mar. 3	15.12	May 26	15.18	Dec. 27	16.00
29	15.19	June 23	15.21	Jan. 24, 1952	16.01

17-3-29cc

Aug. 5, 1950	2.61	Oct. 6, 1950	3.21	Nov. 28, 1950	3.58
25	3.01	Nov. 2	3.44		

17-3-32cc

Aug. 5, 1950	10.35	Oct. 6, 1950	11.29	Dec. 1, 1950	11.75
25	10.85	Nov. 2	11.56		

Table 9.— *Records of wells in the Prairie Creek unit, Nebr.*

[Well no.: See description of well-numbering system in text. Owner or tenant: LRPPD, Loup River Public Power District; USGS, United States Geological Survey. Type of well: B, bored; Dn, driven; Dr, drilled; Du, dug; J, jetted. Type of casing: B, brick; Bs, boiler steel; C, concrete; GI, galvanized iron; I, iron; S, steel. Type of pump: Am, air motor; C, horizontal centrifugal; Cy, cylinder; N, none; T, turbine; Vc, vertical centrifugal. Type of power: E, electric motor; G, gas engine, directly connected or belted; H, hand operated; N, none; T, tractor; W, windmill. Use of water: D, domestic; I, irrigation; N, none; S, stock]

Well no.	Owner or tenant	Date of completion	Type of well	Depth of well below measuring point (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point: Description	Measuring point: Height above or below (-) land surface (feet)	Measuring point: Altitude (feet)	Depth to water level below measuring point, October 1950 (feet)
HOWARD COUNTY													
15- 9-16dd	USGS	1950	J	28.0		GI	N	N	N	Top of pipe	2.5	1,790.06	17.08
17cc	USGS	1950	J	25.0		GI	N	N	N	do	2.0	1,775.08	5.34
17dd	USGS	1950	J	21.0		GI	N	N	N	do	2.5	1,772.51	5.82
23bb	USGS	1950	J	21.0		GI	N	N	N	do	2.0	1,763.63	6.73
24aa	USGS	1950	J	15.0		GI	N	N	N	do	2.0	1,739.32	8.67
24bb	USGS	1950	J	21.0		GI	N	N	N	do	2.0	1,752.44	5.86
MERRICK COUNTY													
11- 8- 3dd	USGS	1946	Dn	9.4	1¼	I	N	N	N	Top of pipe	1.0	1,796.73	3.14
8bb	.....	.....	Dr	41.6	24	Bs	T	T	I	Top of steel beam	.0	1,821.18	10.15
16cb	.....	1941	Dr	43.7	24	GI	T	T	I	Hole in turbine base	1.2	1,819.39	6.78
12- 7- 4dc	.....	1946	Dr	46.4	18	GI	T	T	I	do	1.5	1,756.09	9.90
7aa	USGS	1945	Dn	12.7	1¼	GI	N	N	N	Top of pipe	1.0	1,763.16	7.53
17bc	.....	1945	Dr	.....	18	GI	T	G	I	Hole in turbine base	.6	1,768.40	8.27
12- 8- 7dc	.....	.....	Dr	.....	22	.....	T	T	I	do	1.0	1,818.61	10.61
10cc	.....	1934	Dr	39.6	18	GI	T	T	I	Top of steel beam	.0	1,792.42	7.65
12cc	.....	1946	Dr	32.4	18	GI	T	T	I	Hole in turbine base	.8	1,774.70	5.67
20cc	.....	.....	Dr	79.2	24	.....	T	E	I	Top edge turbine base	1.0	1,824.99	19.41

Table 9.— *Records of wells in the Prairie Creek unit, Nebr.*— Continued

Well no.	Owner or tenant	Date of completion	Type of well	Depth of well below measuring point (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point: Description	Measuring point: Height above or below (-) land surface (feet)	Measuring point: Altitude (feet)	Depth to water level below measuring point, October 1950 (feet)
										MERRICK COUNTY— Continued			
12- 8- 28dc	USGS	1945	Dn	12.3	1¼	GI	N	N	N	Top of pipe	1.0	1,800.83	2.70
13- 6- 2bc	USGS	1945	Dn	12.8	1¼	GI	N	N	N	do	1.0	1,688.87	6.70
4bb			Dr	38.9	18	GI	T	T	I	Hole in turbine base	.9	1,704.08	10.91
7bb	USGS	1945	Dn	12.6	1¼	GI	N	N	N	Top of pipe	1.0	1,714.73	7.09
15cb				46.0	18	GI	T	T	I	Hole in turbine base	.0	1,702.74	7.46
19cb	USGS	1945	Dn	12.5	1¼	GI	N	N	N	Top of pipe	1.0	1,719.88	5.94
28bb	USGS	1946	Dn	12.0	1¼	I	N	N	N	do	1.0	1,712.92	7.75
13- 7- 4bc	USGS	1945	Dn	12.8	1¼	GI	N	N	N	do	1.0	1,748.18	6.27
7cd				46.7	18	GI	T	T	I	Hole in turbine base	1.0	1,765.86	8.40
10cc		1943	Dr	68.8	24	GI	T	T	I	do	1.6	1,745.02	10.94
16cc		1948	Dr	95.0	18	GI	T	T	I	do	.0	1,755.58	11.90
22dc			Dr	42.6	18	GI	T	T	I	Top of casing	1.0	1,738.45	6.69
29cb	USGS	1946	Dn	11.0	1¼	I	N	N	N	Top of pipe	1.8	1,751.29	4.47
30cc		1946	Dr		18	GI	T	T	I	Top of casing	1.8	1,776.62	17.77
36cb			Dr	58.6	24	GI	T	T	I	Hole in turbine base	1.0	1,738.34	10.88
13- 8- 1cb		1943	Dr	28.0	24	GI	T	E	I	Hole in turbine base	.5	1,765.05	6.18
9cd		1948	Dr	48.0	18	GI	T	T	I	do	1.0	1,788.56	9.98
10cd			Dr		18	GI	T	T	I	do	1.0	1,779.63	7.17
14cc	O. Sheer	1940	Du	48.0	24	GI	T	G	I	Edge of casing	.0	1,779.84	8.31
19bb			Dr	34.0	18	Bs	T	T	I	Hole in turbine base	.0	1,806.9	5.95
20cb		1945	Dr	46.0	18	GI	T	T	I	do	1.0	1,807.65	15.64
27dc			Dr	58.2	18	GI	T	T	I	do	.2	1,794.31	12.53
32dd		1944	Du, Dr		72-24	C, GI	Vc	T	I	Top of casing	.0	1,803.84	8.78
14- 4-18bb	USGS	1946	Dn	12.2	1½	I	N	N	N	Top of pipe	2.3	1,628.03	6.89
14- 5- 3dd	USGS	1950	J	14.0	¾	GI	N	N	N	do	3.5	1,635.83	7.69

4bb	R. W. Beck	1946	Dr	26.0	18	GI	T	T	I	Edge of casing	.5	1,643.87	6.06
4cb	Mrs. A. Sampson	1949	Dr	35.0	24	GI	T	T	I	do	.5	1,650.33	11.15
6aa	.....	1944	Dr	32.0	24	GI	T	T	I	Hole in turbine base	1.4	1,652.07	9.89
7bb	USGS	1950	J	10.0	¾	GI	N	N	N	Top of pipe	1.5	1,655.93	5.56
7cc	.....	1941	Dr	.....	24	GI	T	T	I	Hole in turbine base	1.0	1,660.4	7.22
8cc	.....	.....	Dr	.....	24	GI	T	T	I	Hole in cover	.0	1,656.56	6.21
9bc	.....	.....	Dr	26.0	24	GI	T	T	I	Hole in turbine base	.8	1,647.73	5.64
9cc2	.....	1943	Dr	30.0	18	GI	T	T	I	Edge of casing	.6	1,650.52	6.83
15da	.....	1939	Dr	.....	18	GI	T	T	I	Hole in turbine base	.4	1,643.77	7.59
17dd	USGS	1950	J	17.5	¾	GI	N	N	N	Top of pipe	2.0	1,659.62	11.52
19bb	USGS	1950	J	14.0	¾	GI	N	N	N	do	1.0	1,666.88	7.46
28cb	.....	.....	Dr	39.6	24	GI	T	T	I	Top of steel beam	.6	1,660.33	6.55
31bc	.....	.....	Dr	32.4	24	GI	T	T	I	Top of casing	.3	1,672.55	4.82
14- 6- 2cc	USGS	1950	J	14.0	¾	GI	N	N	N	Top of pipe	1.0	1,670.65	3.80
3bc	.....	.....	Dr	42.0	18	GI	T	T	I	Hole in turbine base	1.0	1,700.24	15.76
4bb	USGS	1950	J	13.0	¾	GI	N	N	N	Top of pipe	1.0	1,700.25	7.58
6cb	.....	1933	Dr	31.0	24	Bs	T	T	I	Hole in turbine base	.5	1,709.79	8.37
9bb	USGS	1950	J	18.5	¾	GI	N	N	N	Top of pipe	2.5	1,704.20	8.73
9cc	USGS	1950	J	21.5	¾	GI	N	N	N	do	3.5	1,704.60	Dry
15aa	USGS	1950	J	14.0	¾	GI	N	N	N	do	1.0	1,670.03	3.90
15bb	USGS	1945	Dn	13.1	1¼	GI	N	N	N	do	1.0	1,680.85	4.78
17bc	.....	1938	Dr	52.0	24	GI	T	T	I	Hole in turbine base	1.0	1,699.01	14.56
14- 6-18bb	USGS	1950	J	14.0	¾	GI	N	N	N	Top of pipe	2.0	1,711.77	7.26
24bc	.....	.....	Dr	.....	24	GI	C	E	I	Top of casing	-3.0	1,667.54	5.21
25dd	USGS	1950	J	14.0	¾	GI	N	N	N	Top of pipe	1.0	1,671.73	6.30
28cc	Charron	1944	Dr	40.0	48	C	Vc	T	I	Top of casing	.6	1,693.47	6.27
14- 7- 2bb	Ferres	1932	Dr	32.0	24	Bs	T	T	I	Edge of casing	.0	1,717.64	6.51
4cd	.....	1941	Dr	38.0	24	GI	T	T	I	Hole in turbine base	.5	1,734.5	7.51
5dd	USGS	1950	J	23.0	¾	GI	N	N	N	Top of pipe	2.5	1,740.3	9.25
7bb	USGS	1950	J	36.0	¾	GI	N	N	N	do	2.0	1,801.5	10.41
8dd	USGS	1950	J	14.0	¾	GI	N	N	N	do	1.0	1,731.14	2.67
11bb	USGS	.....	Dr	.....	18	GI	T	E	I	Hole in turbine base	1.0	1,721.66	9.99
11cc	USGS	1950	J	14.0	¾	GI	N	N	N	Top of pipe	4.0	1,729.31	10.59
13ab	.....	.....	Dr	30.4	18	Bs	T	T	I	Hole in turbine base	.5	1,717.10	9.21
21cb	Tsudy	1933	Dr	32.5	8	GI	C	G	I	Top of casing	1.0	1,738.77	7.90
26cc	USGS	1946	Dn	21.5	1¼	I	N	N	N	Top of pipe	1.0	1,727.02	12.28
14- 8- 3ab	Lemmerman	1948	Dr	41.0	18	GI	T	T	I	Hole in turbine base	2.0	1,778.09	11.76

Table 9.— *Records of wells in the Prairie Creek unit, Nebr.* — Continued

Well no.	Owner or tenant	Date of completion	Type of well	Depth of well below measuring point (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point: Description	Measuring point: Height above or below (-) land surface (feet)	Measuring point: Altitude (feet)	Depth to water level below measuring point, October 1950 (feet)
					MERRICK COUNTY— Continued								
14- 8- 4bb	A. Gee	1946	Dr	76.0	18	GI	T	T	I	Hole in turbine base.....	1.0	1,797.25	23.57
7aa	A. Meyer	1934	Dr	84.0	24	Bs	T	T	I	Edge of casing.....	.5	1,817.14	19.28
7cd	.....	1943	Dr	86.0	18	Bs	T	T	I	Hole in turbine base.....	1.0	1,838.80	31.36
9bb	USGS	1950	J	9.0	2	GI	N	N	N	Top of pipe.....	2.0	1,789.71	5.36
9cc	USGS	1950	J	20.5	2	GI	N	N	N	.....do.....	1.0	1,805.84	7.80
11bb	USGS	1950	J	21.0	2	GI	N	N	N	.....do.....	1.0	1,797.34	Dry
12dd	USGS	1950	J	21.0	2	GI	N	N	N	.....do.....	1.0	1,770.35	14.83
14bb	USGS	1950	J	26.0	2	GI	N	N	N	.....do.....	2.0	1,806.76	Dry
17ca	.....	1943	Dr	99.0	18	GI	T	T	I	Hole in turbine base.....	1.0	1,832.11	31.75
18dd	.....	1946	Dr	81.0	18	GI	T	G	I	.....do.....	.0	1,837.01	29.60
21bc	L. Joseph	1946	Dr	91.0	18	GI	T	T	I	.....do.....	2.0	1,833.44	35.43
25dd	.....	.....	Dr	.....	18	GI	T	T	I	.....do.....	.0	1,752.55	6.42
15- 3- 6aa	USGS	1950	J	14.0	2	GI	N	N	N	Top of pipe.....	1.5	1,557.88	5.74
15- 4- 2bd	.....	1937	Dr	20.2	24	GI	N	N	N	Edge of casing.....	.5	1,576.03	5.66
2cc	.....	1946	Dr	54.0	18	GI	T	T	I	Hole in turbine base.....	.5	1,601.64	27.98
3aa	USGS	1950	J	14.0	2	GI	N	N	N	Top of pipe.....	1.5	1,575.79	6.45
8bb	.....	1949	Dr	47.0	18	GI	T	T	I	Hole in turbine base.....	.0	1,623.94	26.89
8dd	USGS	1950	J	14.0	2	GI	N	N	N	Top of pipe.....	1.0	1,597.82	7.07
15- 4-10bb	.....	1941	Dr	52.0	18	GI	T	G	I	Hole in turbine base.....	1.0	1,611.85	29.10
12bc	.....	.....	Dr	58.0	18	GI	T	T	I	.....do.....	.0	1,571.14	6.47
15aa	USGS	1950	J	14.0	2	GI	N	N	N	Top of pipe.....	1.0	1,580.15	5.72
15dd	USGS	1945	Dn	15.0	1¼	GI	N	N	N	.....do.....	1.0	1,587.37	9.72
19ab	.....	1945	Dr	.....	24	GI	T	T	I	Hole in turbine base.....	.2	1,607.41	6.70

	21ab	.....	.....	Dr	24.3	36	C	Vc	E	I	Edge of steel rim.....	.8	1,594.28	7.10
	21cc	.....	.....	Dr	50.0	24	GI	T	T	I	Hole in turbine base.....	.0	1,599.78	6.69
	30cc	.....	.....	Dr	42.0	18	GI	T	T	I	.....do.....	.0	1,615.74	7.98
	31cc	USGS	1945	Dn	12.0	1¼	GI	N	N	N	Top of pipe.....	1.0	1,616.49	5.65
	33bc	.....	.....	Dr	19.8	12	GI	C	T	I	Top of casing.....	1.8	1,606.39	8.04
15- 5-	1da	USGS	1950	J	14.0	¾	GI	N	N	N	Top of pipe.....	1.5	1,604.37	4.38
	2cc	USGS	1950	J	11.5	¾	GI	N	N	N	.....do.....	1.0	1,621.76	4.47
	7bb	USGS	1950	J	21.0	¾	GI	N	N	N	.....do.....	1.5	1,680.63	19.63
	8aa	USGS	1950	J	14.0	¾	GI	N	N	N	.....do.....	1.0	1,644.61	9.66
	8dd	USGS	1946	Dn	19.4	1¼	I	N	N	N	.....do.....	1.0	1,650.63	13.21
	12ad	.....	1947	Dr	69.0	18	GI	T	T	I	Hole in turbine base.....	.0	1,627.91	22.53
	13dd	USGS	1950	J	10.5	¾	GI	N	N	N	Top of pipe.....	1.0	1,610.21	4.89
	15bc	.....	1948	Dr	72.0	18	GI	T	T	I	Hole in turbine base.....	1.0	1,650.36	28.56
	16cc	W. A. Morris	.....	Dr	35.0	24	GI	T	T	I	.....do.....	1.0	1,652.37	13.79
	18cd	.....	.....	Dr	52.0	18	GI	T	T	I	.....do.....	1.0	1,666.93	14.59
	20bb	.....	.....	Dr	.....	18	GI	T	T	I	Top of casing.....	.0	1,658.69	9.09
	21cc	USGS	1950	J	17.0	¾	GI	N	N	N	Top of pipe.....	1.5	1,639.03	10.19
	22aa	USGS	1950	J	14.0	¾	GI	N	N	N	.....do.....	1.0	1,625.47	8.25
	25aa	USGS	1950	J	14.0	¾	GI	N	N	N	.....do.....	1.0	1,613.39	6.50
	27dd	USGS	1946	Dn	12.0	1¼	I	N	N	N	.....do.....	1.0	1,626.52	4.92
	30cc	USGS	1950	J	10.0	¾	GI	N	N	N	.....do.....	1.5	1,652.36	6.42
	32aa	J. Kiolbasa	1946	Dr	33.0	24	GI	T	G	I	Edge of casing.....	.5	1,642.99	9.47
	34cc	.....	1946	Dr	.....	18	GI	T	G	I	Hole in turbine base.....	.8	1,636.15	6.57
15- 6-	9ab	.....	.....	Dr	50.0	2½	Bs	Cy	W	S	Top of casing.....	.0	1,720.60	40.58
	12dd	McLeney	1949	Dr	31.0	18	GI	C	T	I	.....do.....	.0	1,669.83	8.84
	14bb	USGS	1950	J	24.0	¾	GI	N	N	N	Top of pipe.....	2.0	1,685.58	8.93
	14cc	USGS	1950	J	18.0	¾	GI	N	N	N	.....do.....	2.0	1,682.07	6.98
	17aa	USGS	1950	J	28.0	¾	GI	N	N	N	.....do.....	2.5	1,709.67	28.83
	17dd	USGS	1950	J	25.0	¾	GI	N	N	N	.....do.....	1.5	1,707.39	19.49
	18cb	Dankleson	1948	B	71.5	4¾	GI	Am	E	D	Top of pump pit.....	.0	1,753.0	41.70
	21cc	USGS	1950	J	21.0	¾	GI	N	N	N	Top of pipe.....	1.5	1,701.40	15.19
	26bc	.....	.....	Dr	.....	18	GI	T	T	I	Hole in turbine base.....	.4	1,680.21	8.74
	27cd	.....	1945	Dr	.....	24	GI	T	T	I	.....do.....	.5	1,685.95	6.17
	27dd	USGS	1950	J	14.0	¾	GI	N	N	N	Top of pipe.....	1.0	1,682.85	7.00
	30bb	McLeney	1946	Dr	43.0	24	GI	T	T	I	Hole in turbine base.....	.5	1,713.86	15.35
	31cc	USGS	1950	J	14.0	¾	GI	N	N	N	Top of pipe.....	1.0	1,706.39	7.10
	32aa	USGS	1950	J	14.0	¾	GI	N	N	N	.....do.....	1.5	1,691.85	6.66

Table 9.— *Records of wells in the Prairie Creek unit, Nebr.*— Continued

Well no.	Owner or tenant	Date of completion	Type of well	Depth of well below measuring point (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point: Description	Measuring point: Height above or below (-) land surface (feet)	Measuring point: Altitude (feet)	Depth to water level below measuring point, October 1950 (feet)
					MERRICK COUNTY— Continued								
15- 6-32bc	.....	.....	Dr	47.7	18	GI	T	T	I	Hole in turbine base.....	0.8	1,699.25	5.61
35cc	USGS	1950	J	14.0	2	GI	N	N	N	Top of pipe.....	1.0	1,687.89	9.97
36bb	.....	.....	Dr	43.0	.....	.....	T	T	I	Hole in turbine base.....	.0	1,676.32	7.93
15- 7-14bb	USGS	1950	J	14.0	2	GI	N	N	N	Top of pipe.....	2.0	1,691.34	7.34
14cc	USGS	1950	J	16.0	2	GI	N	N	N	.....do.....	.5	1,703.9	4.35
19bb	USGS	1950	J	16.0	2	GI	N	N	N	.....do.....	2.0	1,716.90	10.69
23cc	.....	.....	B	24.5	4	GI	Cy	H	D	Top of casing.....	2.0	1,755.32	17.42
25dd	USGS	1950	J	14.0	2	GI	N	N	N	Top of pipe.....	1.0	1,701.57	6.68
26cc	USGS	1950	J	21.0	2	GI	N	N	N	.....do.....	3.5	1,731.88	18.34
28cc	USGS	1950	J	32.0	2	GI	N	N	N	.....do.....	3.0	1,780.4	Dry
29aa	USGS	1950	J	21.0	2	GI	N	N	N	.....do.....	2.0	1,724.47	7.12
31bc	.....	.....	B	39.0	48	GI	Cy	W	S	Top of casing.....	.0	1,762.1	18.92
32dd	.....	.....	Dr	70.0	4	I	Cy	W	S	.....do.....	3.0	1,780.9	48.62
15- 8-17dd	USGS	1950	J	14.0	2	GI	N	N	N	Top of pipe.....	1.0	1,712.89	3.84
18dd	USGS	1950	J	21.0	2	GI	N	N	N	.....do.....	3.0	1,735.57	16.31
22ad	USGS	1950	J	.....	2	GI	N	N	N	.....do.....	2.5	1,726.08	11.33
22cc	USGS	1950	J	14.0	2	GI	N	N	N	.....do.....	2.5	1,731.71	8.25
22dd	USGS	1950	J	16.0	2	GI	N	N	N	.....do.....	2.0	1,732.21	11.19
25aa	USGS	1950	J	19.5	2	GI	N	N	N	.....do.....	1.5	1,723.9	7.44
27dd	USGS	1950	J	21.0	2	GI	N	N	N	.....do.....	1.5	1,739.76	4.24
28bb	USGS	1950	J	17.0	2	GI	N	N	N	.....do.....	3.0	1,738.80	8.91

33bc	.....	1948	Dr	56.0	18	GI	T	T	I	Hole in turbine base.....	.0	1,780.94	11.51
34bb	T. Anderson	.....	Dn	38.0	1¼	GI	N	N	N	Top of pipe.....	5.0	1,753.59	11.50
35cc1	USGS	1950	J	14.0	¾	GI	N	N	N	.....do.....	1.0	1,773.41	6.15
35cc2	USGS	1950	J	23.0	¾	GI	N	N	N	.....do.....	2.2	1,774.68	7.86
36aa	USGS	1950	J	21.0	¾	GI	N	N	N	.....do.....	2.0	1,753.5	12.57
36dd	USGS	1950	J	28.0	¾	GI	N	N	N	.....do.....	3.0	1,780.8	Dry
16- 3- 1aa	USGS	1950	J	21.0	¾	GI	N	N	N	.....do.....	1.0	1,543.4	14.18
5aa	USGS	1950	J	14.0	¾	GI	N	N	N	.....do.....	1.0	1,565.78	5.33
7dd	USGS	1947	Dn	10.6	1¼	GI	N	N	N	.....do.....	1.0	1,573.65	5.66
9dd	USGS	1950	J	21.0	¾	GI	N	N	N	.....do.....	1.5	1,564.02	5.20
11aa	USGS	1950	J	19.0	¾	GI	N	N	N	.....do.....	4.0	1,558.4	Dry
12aa	USGS	1950	J	21.0	¾	GI	N	N	N	.....do.....	3.5	1,545.4	17.98
20bb	USGS	1950	J	14.0	¾	GI	N	N	N	.....do.....	1.5	1,576.52	6.60
23dd	Tomlah	1945	Dr	56.0	18	GI	T	G	I	Hole in turbine base.....	1.4	1,531.02	9.09
24aa	USGS	1950	J	14.0	¾	GI	N	N	N	Top of pipe.....	2.5	1,524.8	8.50
26ac	.....	1932	Dr	17.0	8	Bs	T	T	I	Edge of discharge pipe....	.0	1,531.22	5.00
27cc	P. Pearson	1934	Du	28.0	22	Bs	Vc	G	I	Edge of casing.....	1.5	1,545.93	8.56
28cc	.....	.....	Dr	36.0	18	GI	T	T	I	Hole in turbine base.....	.5	1,551.76	8.90
29cb	.....	1949	Dr	22.0	18	GI	T	E	I	Edge of casing.....	.5	1,557.06	7.42
32cb	.....	1944	Dr	43.2	24	GI	T	G	I	Hole in turbine base.....	1.2	1,558.85	8.30
16- 4-32dd	USGS	1950	J	14.0	¾	GI	N	N	N	Top of pipe.....	1.5	1,589.41	5.49

NANCE COUNTY

15- 5- 5ad	.....	.....	Dn	25.4	1¼	GI	N	N	N	Top edge of base.....	3.0	1,646.71	14.95
6ab	.....	.....	Dn	23.8	1¼	GI	Cy	H	D	.....do.....	1.5	1,650.91	10.10
15- 6- 2bb	USGS	1949	Dn	18.5	¾	GI	N	N	N	Top of pipe.....	1.0	1,663.46	2.96
2cc	USGS	1950	J	21.0	¾	GI	N	N	N	.....do.....	4.0	1,686.15	11.38
4cc	USGS	1950	J	37.0	¾	GI	N	N	N	.....do.....	2.0	1,711.68	28.81
6cc	.....	.....	Du	8.5	60	B	Cy	W	S	Top of platform.....	.0	1,680.9	7.23
7cc	USGS	1950	J	30.0	¾	GI	N	N	N	Top of pipe.....	3.0	1,706.4	15.27
15- 7- 6bb	.....	.....	Dr	81.0	3	GI	Cy	W	N	Hole on pump side.....	2.0	1,769.56	67.48
8dd	USGS	1950	J	14.0	¾	GI	N	N	N	Top of pipe.....	1.0	1,691.57	8.89
11bd	J. Santin	.....	Dr	10.8	6	GI	Cy	W	S	Edge of casing.....	.5	1,676.3	6.20
11da	.....	.....	Dr	12.6	4	GI	Cy	H	D	Hole in casing side.....	1.0	1,685.1	7.53
16cc	USGS	1950	J	14.0	¾	GI	N	N	N	Top of pipe.....	2.5	1,705.20	6.66
15- 8-13cd	.....	.....	Dr	100.0	4	GI	Cy	H	N	Edge of casing.....	1.0	1,722.44	23.74

Table 9.— *Records of wells in the Prairie Creek unit, Nebr.*— Continued

Well no.	Owner or tenant	Date of completion	Type of well	Depth of well below measuring point (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point: Description	Measuring point: Height above or below (-) land surface (feet)	Measuring point: Altitude (feet)	Depth to water level below measuring point, October 1950 (feet)
NANCE COUNTY— Continued													
15- 8-16cb	USGS	1950	J	14.0	3/4	GI	N	N	N	Top of pipe	1.5	1,711.79	6.26
16- 4- 2bb	USGS	1950	J	16.5	2	GI	N	N	N	do	2.5	1,581.28	Dry
6bc	USGS	1950	J	14.0	2	GI	N	N	N	do	1.0	1,586.03	8.63
9dd	E. Krzycki	1937	Dr	45.0	18 3/4	GI	T	T	I	Hole in turbine base	.0	1,602.77	14.14
10aa	USGS	1950	J	28.0	3/4	GI	N	N	N	Top of pipe	.5	1,586.93	6.13
15aa	USGS	1950	J	21.0	3/4	GI	N	N	N	do	1.0	1,588.63	5.45
15bb	.....	.....	Dr	27.8	18 3/4	GI	T	G	I	Hole in turbine base	.0	1,597.23	9.97
16bb	USGS	1950	J	21.0	3/4	GI	N	N	N	Top of pipe	1.0	1,618.07	Dry
22aa	USGS	1950	J	14.0	3/4	GI	N	N	N	do	1.0	1,588.92	4.99
27aa	USGS	1950	J	14.0	3/4	GI	N	N	N	do	4.0	1,575.84	7.85
27dc	.....	.....	Dr	.....	36	GI	T	T	I	Hole in turbine base	.5	1,581.51	9.81
28bb	USGS	1950	J	12.0	3/4	GI	N	N	N	Top of pipe	3.0	1,588.59	8.63
28dd	.....	.....	Dn	17.0	1 1/4	GI	N	N	N	do	-2.5	1,578.88	3.53
31bc	USGS	1947	Dn	15.0	1 1/4	I	N	N	N	do	1.0	1,603.01	7.15
36bb	.....	1946	Dr	.....	18	GI	T	G	I	Hole in turbine base	.0	1,573.85	12.92
16- 5- 2da	LRPPD	.....	Dr	16.0	1 1/2	Bs	N	N	N	Top of pipe	3.5	1,592.68	10.50
9cb	USGS	1950	J	7.0	2	GI	N	N	N	do	1.5	1,604.22	4.38
11bc	USGS	1950	J	14.0	2	GI	N	N	N	do	1.0	1,601.30	6.80
16cc	USGS	1950	J	14.0	2	GI	N	N	N	do	1.5	1,617.94	3.79
20bc	W. Prosaski	1937	Dr	18.0	12 4-6	S	C	G	I	Hole in turbine base	.0	1,624.26	6.41
21cc	USGS	1950	J	14.0	3/4	GI	N	N	N	Top of pipe	1.5	1,627.60	8.57
23aa	USGS	1949	Dn	11.4	1 1/4	GI	N	N	N	do	1.0	1,607.66	6.52

23bb	USGS	1950	J	14.0	2	GI	N	N	N	do	2.0	1,618.20	11.53
24aa	USGS	1950	J	19.5	2	GI	N	N	N	do	2.0	1,604.60	8.59
24dd	USGS	1950	J	16.0	2	GI	N	N	N	do	2.0	1,600.46	6.95
28cc	USGS	1950	J	14.0	2	GI	N	N	N	do	2.0	1,629.19	7.26
30cc	USGS	1950	J	14.0	2	GI	N	N	N	do	2.0	1,635.09	5.21
35bb	USGS	1950	J	15.4	2	GI	N	N	N	do	2.4	1,618.05	6.49
16- 6-14ac	C. Aldrich		Dr	51.0	10	Bs	C	G	I	Curb of well	.5	1,642.87	26.26
22ab	A. Cuba	1949	Dr	63.0	18	GI	T	E	I	Top of casing	.0	1,657.58	30.72
23cc	USGS	1950	J	14.0	2	GI	N	N	N	Top of pipe	3.0	1,632.19	7.30
24aa	J. Lesiak		Dn	8.0	1¼	GI	N	N	N	do	.5	1,617.32	2.04
26dd	J. Shotkoski	1943	Dr	15.0	6	GI	Cy	W	S	Top of casing	.1	1,641.08	5.84
16- 6-32aa	USGS	1950	J	14.0	2	GI	N	N	N	Top of pipe	2.0	1,644.55	6.53
33cc	USGS	1950	J	14.0	2	GI	N	N	N	do	1.5	1,667.84	3.77
35bb	USGS	1950	J	14.0	2	GI	N	N	N	do	2.0	1,648.72	7.89
16- 7-34cb	R. Brooks	1948	Dr	58.0	18	GI	T	E	I	Hole in turbine base	.5	1,710.51	27.30
36aa	Russell	1934	B	32.5	60-18	GI	C		I	Curb of well	.5	1,672.51	22.13
17- 4-14cd	LRPPD	1936	Dr	15.0	1½	I	N	N	N	Top of pipe	1.5	1,561.84	3.48
21bd	LRPPD	1934	Dr	34.0	1¼	I	N	N	N	do	4.2	1,650.66	27.80
22dd	LRPPD	1935	Dr	21.2	1¼	I	N	N	N	do	2.0	1,567.92	12.25
24db		1925	B	19.1	6	Bs	N	N	D	Top of casing	.6	1,547.52	5.71
25dc	LRPPD		Dn	18.5	1¼	Bs	N	N	N	Top of pipe	2.0	1,559.61	13.77
31aa	LRPPD		Dr	16.6	1¼	Bs	N	N	N	do	3.0	1,580.76	11.09
32dd	LRPPD		Dr	14.5	1¼	Bs	N	N	N	do	5.0	1,578.01	10.81
34cb	LRPPD	1934	Dr	17.0	1¼	Bs	N	N	N	do	2.9	1,569.60	9.93
36aa	LRPPD		Dr	11.0	1¼	Bs	N	N	N	do	2.0	1,556.90	7.11
17- 5-35dd	LRPPD		Dn	16.0	1¼	Bs	N	N	N	do	3.5	1,591.23	9.21

PLATTE COUNTY

16- 1- 5cc			Dr	32.6	24	GI	T	T	I	Top of casing	.5	1,475.34	7.14
16- 2- 1cb	LRPPD		Dr	16.0	1½	GI	N	N	N	Top of pipe	2.5	1,491.61	8.41
3bb	USGS	1950	J	14.0	¾	GI	N	N	N	do	1.0	1,526.75	Dry
4dd	USGS	1950	J	14.0	¾	GI	N	N	N	do	4.0	1,547.68	Dry
7aa	USGS	1950	J	26.0	¾	GI	N	N	N	do	2.0	1,540.25	18.69
7cc	USGS	1950	J	21.0	¾	GI	N	N	N	do	1.0	1,538.4	9.13
9cc	J. Nyffeler	1941	Dr	38.0	24	GI	T	T	I	Hole in turbine base	1.2	1,509.37	4.92
12ab	H. Ernst	1905	Dr	17.5	1¼	GI	N	N	N	Top of pipe	1.0	1,489.57	10.93
17- 1- 2cc	LRPPD	1935	Dr	21.6	1¼	Bs	N	N	N	do	.0	1,470.03	11.72
5ad	LRPPD	1935	Dr	15.9	1¼	Bs	N	N	N	do	3.7	1,475.14	5.92

Table 9.— *Records of wells in the Prairie Creek unit, Nebr.*— Continued

Well no.	Owner or tenant	Date of completion	Type of well	Depth of well below measuring point (feet)	Diameter of well (inches)	Type of casing	Type of pump	Type of power	Use of water	Measuring point: Description	Measuring point: Height above or below (-) land surface (feet)	Measuring point: Altitude (feet)	Depth to water level below measuring point, October 1950 (feet)
						PLATTE COUNTY—Continued							
17- 1- 6cb	LRPPD	1935	Dn	15.4	1¼	Bs	N	N	N	Top of pipe	3.0	1,484.85	6.20
10cb	LRPPD	1935	Dn	21.0	1¼	Bs	N	N	N	do	3.0	1,470.00	11.48
14cc	LRPPD	1935	Dr	20.2	1½	Bs	N	N	N	do	2.3	1,463.45	13.15
27ad	LRPPD	1935	Dn	13.5	1¼	I	N	N	N	do	3.0	1,453.40	8.66
30aa	.....	.....	Dr	38.0	18	GI	T	G	I	do	.5	1,476.61	12.82
32aa	USGS	1950	J	14.0	¾	GI	N	N	N	do	1.5	1,469.71	10.61
34dc	J. Ernst	.....	Dr	65.2	.....	.....	T	E	I	Hole in pump head	.3	1,459.29	9.62
17- 2- 2bb	LRPPD	1935	Dn	16.9	1¼	I	N	N	N	Top of pipe	4.0	1,495.65	7.71
2cc	E. Schacher	.....	Dr	43.9	3	I	N	N	N	Top of check valve	-4.0	1,489.67	2.07
4bc	LRPPD	1935	Dn	20.8	1¼	Bs	N	N	N	Top of pipe	3.0	1,510.44	14.20
6bd	LRPPD	1936	Dn	23.0	1¼	I	N	N	N	do	2.4	1,522.39	16.68
8dc	LRPPD	1936	Dn	12.0	1¼	I	N	N	N	do	2.5	1,504.77	9.12
17bb	.....	.....	Dn	9.6	2	I	N	N	N	do	2.0	1,507.15	5.38
18ab	.....	.....	Dn	11.0	2	I	N	N	N	do	3.0	1,511.13	7.72
19ac	.....	.....	.....	42.0	18	Bs	T	T	I	Edge of discharge pipe	2.5	1,520.55	15.90
19cc	USGS	1950	J	21.0	¾	GI	N	N	N	Top of pipe	1.0	1,530.12	15.76
21cc	USGS	1950	J	17.0	¾	GI	N	N	N	do	1.5	1,519.87	Dry
22cb	USGS	1950	J	14.0	¾	GI	N	N	N	do	1.0	1,501.86	Dry
23bd	LRPPD	.....	Dr	20.8	1	I	N	N	N	do	3.5	1,496.23	18.19
24cb	LRPPD	.....	Dn	19.0	1¼	GI	N	N	N	do	3.0	1,489.40	14.94
25bc	LRPPD	.....	Dn	40.0	1¼	GI	N	N	N	do	1.6	1,511.65	34.14
31bb	USGS	1950	J	21.0	¾	GI	N	N	N	do	3.0	1,543.53	Dry

32bb	USGS	1950	J	21.0	3/4	GI	N	N	N	.....do.....	2.0	1,532.25	12.05
32dd	USGS	1950	J	21.0	3/4	GI	N	N	N	.....do.....	2.0	1,531.93	14.38
34bb	USGS	1950	J	27.0	3/4	GI	N	N	N	.....do.....	2.5	1,522.09	20.78
17- 3- 2da	LRPPD	1936	Dn	18.0	1 1/4	I	N	N	N	.....do.....	2.5	1,527.76	11.41
5da	LRPPD	1935	Dn	.....	1 1/4	I	N	N	N	.....do.....	3.0	1,561.98	16.00
8cb	LRPPD	1936	Dn	14.5	1 1/4	I	N	N	N	.....do.....	2.0	1,556.43	3.97
22ad	LRPPD	1949	Dn	16.5	1 1/4	GI	N	N	N	.....do.....	2.0	1,536.10	11.54
23ad	.....	.....	Dr	48.2	24	GI	Vc	T	I	Top of casing.....	.6	1,532.91	16.15
27bb	USGS	1950	J	14.0	3/4	GI	N	N	N	Top of pipe.....	.5	1,547.18	Dry
29cc	USGS	1950	J	14.0	3/4	GI	N	N	N	.....do.....	1.0	1,562.06	4.21
32cc	USGS	1950	J	21.0	3/4	GI	N	N	N	.....do.....	1.5	1,576.19	12.79

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